



Industria y Comercio

SUPERINTENDENCIA

Delegatura de propiedad Industrial

División de Nuevas Creaciones

PCT

SOLICITUD

PATENTE DE INVENCION

05-91264

21. EXPEDIENTE No.

54. TÍTULO METODO PARA REDUCIR LA FORMACION DE ACRILAMIDA EN ALIMENTOS
PROCESADOS TERMICAMENTE

51. CLASIFICACIÓN INTERNACIONAL

71. SOLICITANTE FRITO LAY NORTH AMERICA INC. F/k/a RECOT INC.

DOMICILIO TEXAS, ESTADOS UNIDOS DE AMERICA

74. APODERADO JAIME EDUARDO DELGADO VILLEGAS

22. BOGOTÁ, D. C.,

1 2

Kodificacion : 45091164 Definicion : Follows 300
Fecha (MM): 2005-09-09 15:50:33
Transmiso : 011 PCF-PATENT 379 FREE HCL 411 PRESENCE
Dependencia: 2000 DIVISION DE MARCAS USACIONES

ENTRADA EN FASE NACIONAL

2020-F08 (02-04-01)

10

ANEXOS

☒

Comprobante de pago de la tasa de presentación de la solicitud.

☐

Documento que acredite la existencia y representación legal cuando el solicitante sea persona jurídica.

☒

Poderees, si fuere el caso.

☒

Documento de cesión del inventor al solicitante o a su causante.

☐

Declaraciones

☒

Copia de la solicitud internacional (Resumen, descripción, reivindicaciones, dibujos)

☒

Traducción de la solicitud internacional al castellano. (Resumen, descripción, reivindicaciones, dibujos)

☒

Copia del examen preliminar internacional efectuado por la Autoridad Internacional de Examen Preliminar (IPEA).

☒

Traducción del examen preliminar internacional efectuado por la IPEA.

☐

De ser el caso, copia del contrato de acceso.

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De ser el caso, certificado de depósito del material biológico

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Arte final 12X12 cm.

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De ser el caso, información de otras solicitudes de patente o títulos obtenidos en el extranjero por el mismo titular o su causante, relacionadas total o parcialmente con la invención de esta solicitud.

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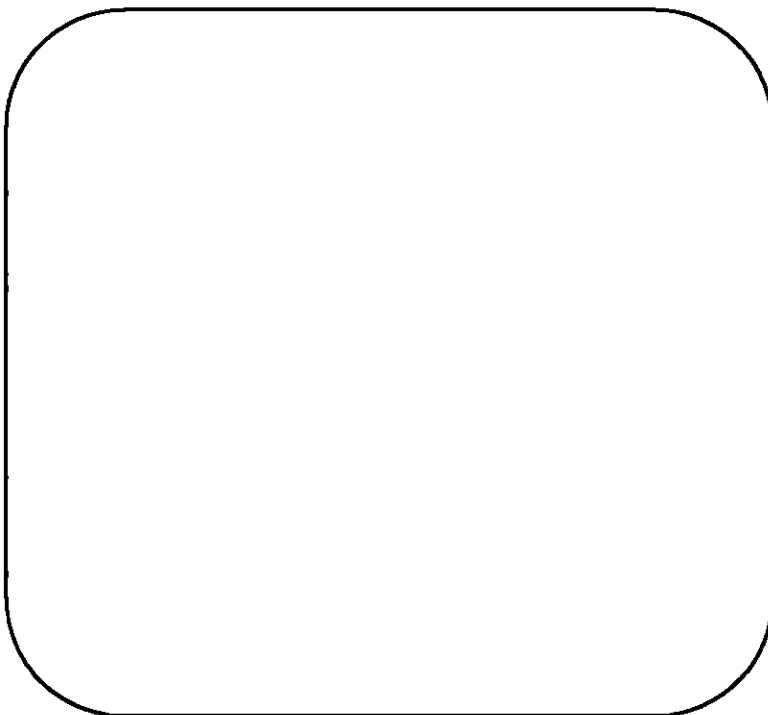
De ser el caso, modificaciones efectuadas a la solicitud internacional, Nuevas Reivindicaciones

☒

Otros: Informe de Búsqueda de Antecedentes Internacional

11

FIGURA CARACTERISTICA



12

Solicito la concesión de la patente,

NOMBRE: JAIME EDUARDO DELGADO VILLEGAS

FIRMA:

C.C. 19.270.955 Bogotá T.P. 49.308 C.S.J.

Instrucciones para el diligenciamiento del presente formulario, ver reverso de esta página

INVENTORES

**Vincent Allen Elder
2903 Panorama Drive
Carrollton, Dallas County, Texas 75007
Ciudadano Americano**

**John Gregory Fulcher
9930 Ontario Lane
Dallas, Dallas County, Texas 75220
Ciudadano Americano**

**Henry Kin-Hang Leung
3704 Ellington Drive
Plano, Collin County, Texas 75093
Ciudadano Americano**

**Michael Grant Topor
2312 Evergreen
Carrollton, Dallas County, Texas 75006
Ciudadano Americano**

PCT/US2004/003448, Documentos adjuntos al Petitorio:

1. **Carta de Recordatorio de asignación documento de cesión de los inventores, de la Oficina de Patentes y Marcas de los Estados Unidos del 18 de Septiembre de 2003 (4 folios).**
2. **Traducción de la solicitud PCT/US2004/003448 presentada el 6 de febrero de 2004 con descripción, reivindicaciones, figuras o dibujos y resumen (38 folios).**
3. **Solicitud PCT/US2004/003448 en inglés, tal como fue presentada el 6 de febrero de 2004 con descripción, reivindicaciones, figuras o dibujos y resumen, con carta transmisión a la Oficina de los Estados Unidos del 6 de febrero de 2004. (36 folios).**
4. **Formulario PCT/IB/304, notificación del recibo del documento de prioridad No. US 10/372.154 del 21 de febrero de 2003, con fecha de envío del PCT del 13 de mayo de 2004. (1 folio).**
5. **Formulario PCT/IB/301, notificación del recibo de copia registrada de la solicitud PCT con lista de países designados con fecha de envío PCT del 13 de mayo de 2004 (3 folios).**
6. **Formulario PCT/ISA/220 y 210, notificación envío del Reporte de la Búsqueda Internacional y Opinión Escrita del 24 de agosto de 2004, (9 folios) junto con documentos del arte anterior:**
 - a) **Patente US 5.514.387 del 7 de Mayo de 1996. (15 folios).**
 - b) **Publicación de la solicitud de Patente US 2002/0015759 A1 del 7 de Febrero 7 de 2002. (44 folios).**
 - c) **Patente US 6.210.720 B1 del 3 de Abril de 2001. (8 folios).**
 - d) **Patente GB No. 335.214 del 19 de Septiembre de 1930. (2 folios).**
7. **Formulario PCT/IB/311, notificación y copia de la Publicación Internacional en la Gaceta Oficial del PCT No. WO 2004/075.657 A2 del 10 de Septiembre de 2004. (24 folios).**
8. **Formulario PCT/IB/308 Primera notificación informando comunicación de la Oficina del PCT sobre la solicitud internacional a los países designados, lo cual no aplica de 30 meses tiempo llmite bajo el Artículo 22(1), de fecha 23 de Septiembre de 2004. (1 folio).**
9. **Formulario PCT/IB/346 Copia del recibo de la presentación de las modificaciones a las reivindicaciones de acuerdo al Artículo 19 del PCT del 5 de Noviembre de 2004 (1 folio)**
10. **Formulario PCT/IPEA/401, Solicitud de Examen Preliminar, junto con carta de recibo por parte de la Oficina de los Estados Unidos (6 folios), con fecha 18 de noviembre de 2004, Respuesta a la Opinión Escrita junto con modificación de las reivindicaciones (26 folios), Corrección al Poder y Cesión de los derechos de los**

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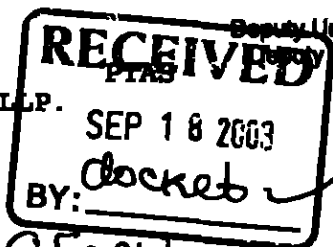
Inventores (3 folios) en inglés, y Traducción Oficial al español de los anteriores documentos (27 folios).

- 11. Formulario PCT/IPEA/402, Notificación del Recibo de la Solicitud de Examen Preliminar por la Autoridad Competente encargada de dicho Examen, con fecha del 14 de Diciembre de 2004 (1 folio).*
- 12. Formulario PCT/IB/311, notificación y copia de la Solicitud Internacional tal como fue publicada por segunda vez en la Gaceta Oficial del PCT No. WO 2004/075.657 A3 del 17 de Febrero de 2005. (9 folios).*
- 13. Formulario PCT/IB/306 Notificación de Registro de un Cambio de nombre y domicilio del Inventor Topor, Michael, Grant, del 21 de Febrero de 2005.*
- 14. Formulario PCT/IB/332 Información concerniente a las oficinas elegidas y su notificación, del 10 de Marzo de 2005.*
- 15. Formulario PCT/IPEA/416, Notificación de Envío de Reporte del Examen Preliminar Internacional de Patentabilidad (7 folios) con fecha 17 de Marzo de 2005.*
- 16. Formulario PCT/IB/308 Segunda y notificación suplementaria informando al solicitante la comunicación de la Oficina del PCT sobre la solicitud internacional a los países designados, aplicando los 30 meses como tiempo límite bajo el Artículo 22(1), del 23 de junio de 2005. (1 folio).*
- 17. Tarjeta Archivo Temático y Tarjeta Propietarios.*



SEPTEMBER 15, 2003

CARSTENS, YEE & CAHOON, LLP.
COLIN P. CAHOON
PO BOX 802334
DALLAS, TX 75380



Deputy Under Secretary of Commerce For Intellectual Property and
Deputy Director of the United States Patent and Trademark Office
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BRIEF: ASSIGNMENT OF ASSIGNOR'S INTEREST (SEE DOCUMENT FOR DETAILS).

ASSIGNOR:
ELDER, VINCENT ALLEN

DOC DATE: 02/18/2003

ASSIGNOR:
FULCHER, JOHN GREGORY

DOC DATE: 02/18/2003

ASSIGNEE:
RECOT, INC.
5000 HOPYARD ROAD
PLEASANTON, CALIFORNIA 94588

SERIAL NUMBER: 10372154
PATENT NUMBER:

FILING DATE: 02/21/2003
ISSUE DATE:

STEVEN POST, EXAMINER
ASSIGNMENT DIVISION
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PTO-1595
(Rev. 03/01)

OMB No. 0851-0027 (exp. 5/31/2002)

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To the Honorable Commissioner of Patents and Trademarks: Please record the attached original documents or copy thereof.

1. Name of conveying party(ies):

Vincent Allen Elder
John Gregory Fulcher

4-15-03

2. Name and address of receiving party(ies)

Name: RECOT, Inc.

Internal Address: _____

Street Address: 5000 Hopyard Road

City: Picasanton State: CA Zip: 94588

Additional name(s) of conveying party(ies) attached? ☐ Yes ☒ No

3. Nature of conveyance:

- ☒ Assignment ☐ Merger
☐ Security Agreement ☐ Change of Name
☐ Other _____

Execution Date: February 18, 2003

Additional name(s) & address(es) attached? ☐ Yes ☒ No

4. Application number(s) or patent number(s):

If this document is being filed together with a new application, the execution date of the application is: _____

A. Patent Application No.(s)

10/372,154

B. Patent No.(s)

Additional numbers attached? ☐ Yes ☒ No

5. Name and address of party to whom correspondence concerning document should be mailed:

Name: CAHOON, Colin P.

Internal Address: Carstens, Yee & Cahoon, L.L.P.

Street Address: P.O. Box 802334

City: Dallas State: TX Zip: 75380

6. Total number of applications and patents involved: ☒ 1

7. Total fee (37 CFR 3.41).....\$ 40.00

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Signature

April 11, 2003
Date

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ASSIGNMENT

WHEREAS, we, Vincent Allen Elder, a citizen of the United States, residing at 2903 Panorama Drive, Carrollton, Texas 75007, and John Gregory Fulcher, a citizen of the United States, residing at 9930 Ontario Lane, Dallas, Texas 75220, are the inventors of the invention Method for Reducing Acrylamide Formation in Thermally Processed Foods, for which we have executed an application for Letters Patent of the United States with attorney reference number CFLAY.00179; and

WHEREAS, RECOT, INC., incorporated in the state of Delaware, with a place of business at 5000 Hopyard Road, Suite 460, Pleasanton, California 94588 is desirous of obtaining the entire right, title and interest in, to and under the said invention and the said application;

NOW, THEREFORE, in consideration of the sum of One Dollar (\$1.00) to us in hand paid, and other good and valuable consideration, the receipt of which is hereby acknowledged, we the said Vincent Allen Elder and John Gregory Fulcher, have sold, assigned, transferred, and set over, and by these presents do hereby sell, assign, transfer, and set over, unto the said RECOT, INC., its successors, legal representatives, and assigns, the entire right, title, and interest in, to, and under the said invention, and the said application and all divisions, renewals, and continuations thereof, and all Letters Patent of the United States which may be granted thereon and all reissues and extensions thereof, and all applications for Letters Patent which may hereafter be filed for said invention in any country or countries foreign to the United States, and all Letters Patent which may be granted for said invention in any country or countries foreign to the United States and all extensions, renewals, and reissues thereof and all rights of priority in any such country or countries based upon the filing of the said application for Letters Patent of the United States which are created by any law, treaty, or international convention; and we hereby authorize and request the Commissioner of Patents of the United States, and any Official of any country or countries foreign to the United States, whose duty it is to issue patents on applications as aforesaid, to issue all Letters Patent for said invention to the said RECOT, INC., its successors, legal representatives, and assigns, in accordance with the terms of this instrument.

AND WE HEREBY covenant that we have full right to convey the entire interest herein assigned, and that we have not executed, and will not execute, any agreement in conflict herewith.

AND WE HEREBY further covenant and agree that we will communicate to said RECOT, INC., its successors, legal representatives, and assigns, any facts known to us respecting said invention, and testify in any legal proceeding, sign all lawful papers, execute all divisional, continuing, and reissue applications, make all rightful oaths, and generally do everything possible to aid the said RECOT, INC., its successors, legal representatives, and assigns, to obtain and enforce proper patent protection for said invention in all countries.

IN TESTIMONY WHEREOF, we hereunto set our hand and seal the day and year set opposite our signatures.

Date: February 18, 2003 Vincent A. Elder L.S.
Vincent Allen Elder

Date: February 18 2003 John G. Fulcher L.S.
John Gregory Fulcher



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1. Name of conveying party(ies): Vincent Allen Elder John Gregory Fulcher			2. Name and address of receiving party(ies) Name: <u>RECOT, Inc.</u> Internal Address: _____ _____ Street Address: <u>5000 Hopyard Road</u> _____ City: <u>Pleasanton</u> State: <u>CA</u> Zip: <u>94588</u> Additional name(s) & address(es) attached? ☐ Yes ☒ No		
3. Nature of conveyance: ☒ Assignment ☐ Merger ☐ Security Agreement ☐ Change of Name ☐ Other _____					
Execution Date: <u>February 18, 2003</u>					
4. Application number(s) or patent number(s): If this document is being filed together with a new application, the execution date of the application is: _____ A. Patent Application No.(s) <u>10/372,154</u> B. Patent No.(s) _____ Additional numbers attached? ☐ Yes ☒ No					
5. Name and address of party to whom correspondence concerning document should be mailed: Name: <u>CAHOON, Colin P.</u> Internal Address: <u>Carstons, Yee & Cahoon, L.L.P.</u> _____ Street Address: <u>P.O. Box 802334</u> _____ City: <u>Dallas</u> State: <u>TX</u> Zip: <u>75380</u>			6. Total number of applications and patents involved: <u>1</u> 7. Total fee (37 CFR 3.41).....\$ <u>40.00</u> ☒ Enclosed ☒ Authorized to be charged to deposit account 8. Deposit account number: <u>50-0392</u> (Attach duplicate copy of this page if paying by deposit account)		
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Traducción Oficial código: PCT-ARTIC179 de un documento escrito en inglés,
sellada por el suscrito Traductor Oficial, septiembre 8 de dos mil cinco, Bogotá,
D.C., República de Colombia.

**MÉTODO PARA REDUCIR LA FORMACIÓN DE ACRILAMIDA EN
ALIMENTOS PROCESADOS TÉRMICAMENTE**

ANTECEDENTES DEL INVENTO

Referencia cruzada con aplicaciones relacionadas

Esta aplicación es una continuación parcial de invención conjunta pendiente de
Aplicación de Patente de los Estados Unidos 10/247.504, archivada el 19 de
septiembre de 2002.

Área técnica

El presente invento se relaciona con un método para reducir la cantidad de
acrilamida en alimentos procesados térmicamente. Este invento permite la
producción de alimentos que tengan niveles significativamente reducidos de
acrilamida. El método se basa en la adición de un catión bivalente o trivalente,

Silvio A. PUERTAS P.
TRADUCTOR E INTERPRETE OFICIAL INGLÉS
Colección No. 07/13 30/09/94 Alcantarilla

como los que se encuentran en las sales de calcio, magnesio, cobre, hierro, zinc o aluminio, en la formulación de la masa de un alimento.

Descripción de la técnica relacionada

La acrilamida química se ha usado durante mucho tiempo en su forma de polímero en aplicaciones industriales para el tratamiento del agua, la recuperación de petróleo mejorado, hacer papel, agentes de floculación, espesantes, procesamiento de oro y textiles que no se arrugan. La acrilamida se precipita en forma de sólido cristalino blanco, inodoro y altamente soluble en agua (2155 g/L a 30°C). Los sinónimos de la acrilamida son 2-propenamida, etilencarboxamida, amida de ácido acrílico, amida de vinilo y amida de ácido propenóico. La acrilamida tiene una masa molecular de 71.08, un punto de fusión de 84.5°C y un punto de ebullición de 125°C a 25 mmHg.

Recientemente, una gran variedad de alimentos ha resultado positiva al buscar la presencia de monómero de acrilamida. La acrilamida se ha encontrado básicamente en productos alimenticios de carbohidratos que han sido calentados o procesados a altas temperaturas. Entre los ejemplos de alimentos que han resultado positivos al buscar acrilamida se encuentran el café, los cereales, las galletas, las papas fritas, las galletas de sal, las papas a la francesa, los panes y panecillos y las carnes apanadas fritas. En general, se han encontrado contenidos relativamente bajos de acrilamida

en alimentos ricos en proteínas calentados, mientras que se han encontrado niveles relativamente altos de acrilamida en alimentos ricos en carbohidratos, en comparación con niveles no detectables en alimentos hervidos o no calentados. Los niveles reportados de acrilamida que se han encontrado en diversos alimentos procesados de manera similar incluyen un rango de 330-2300 ($\mu\text{g/kg}$) en las papas fritas, un rango de 300-1100 ($\mu\text{g/kg}$) en las papas a la francesa, un rango 120-180 ($\mu\text{g/kg}$) en las hojuelas de maíz, y niveles que van desde lo no detectable hasta 1400 ($\mu\text{g/kg}$) en diversos cereales para el desayuno.

Actualmente se cree que la acrilamida se forma a partir de la presencia de aminoácidos y azúcares reductores. Por ejemplo, se cree que una reacción entre la asparagina libre, un aminoácido que se encuentra comúnmente en los vegetales crudos, y los azúcares reductores libres, explica la mayoría de la acrilamida que se encuentra en los productos alimenticios fritos. La asparagina brinda aproximadamente el 40% de los aminoácidos libres totales encontrados en las papas crudas, aproximadamente el 18% de los aminoácidos libres totales encontrados en el centeno rico en proteínas y aproximadamente el 14% de los aminoácidos libres totales encontrados en el trigo.

Es posible que se forme acrilamida a partir de aminoácidos diferentes de la asparagina, pero todavía no se ha confirmado con certeza. Por ejemplo, se ha

reportado cierta formación de acrilamida al probar como precursores la glutamina, la metionina, la cisteína y el ácido aspártico. Sin embargo, estos hallazgos son difíciles de confirmar debido a las posibles impurezas de asparagina presentes en los aminoácidos almacenados. No obstante, se ha identificado la asparagina como el aminoácido precursor más responsable de la formación de acrilamida.

Como la acrilamida en los alimentos es un fenómeno descubierto recientemente, no se ha confirmado el mecanismo exacto de su formación. Sin embargo, ahora se cree que la ruta más probable para la formación de acrilamida incluye una reacción de Maillard. La reacción de Maillard ha sido identificada desde hace mucho tiempo en la química de los alimentos como una de las reacciones químicas más importantes en el procesamiento de alimentos y puede afectar el sabor, el color y el valor nutritivo de los alimentos. La reacción de Maillard necesita calor, humedad, azúcares reductores y aminoácidos.

La reacción de Maillard incluye una serie de reacciones complejas con numerosos productos intermedios, aunque por lo general se puede describir como una reacción de tres pasos. El primer paso de la reacción de Maillard incluye la combinación de un grupo amino libre (proveniente de aminoácidos libres y/o proteínas) con un azúcar reductor (como la glucosa) para formar productos de reagrupación de Amadori o Heyns. El segundo paso incluye la degradación de los productos de

reagrupación de Amadori o Heyns a través de diferentes rutas alternativas que incluyen desoxiosonas, fisión o degradación de Strecker. Una serie compleja de reacciones que incluyen la deshidratación, eliminación, ciclización, fisión y fragmentación producen una mezcla de productos saborizantes intermedios y compuestos saborizantes. El tercer paso de la reacción de Maillard se caracteriza por la formación de polímeros y co-polímeros nitrogenados de color marrón. La Figura 1 ilustra una simplificación de las presuntas rutas de la formación de la acrilamida a partir de asparagina y glucosa, usando la reacción de Maillard como la ruta probable para la formación de acrilamida.

No se ha determinado que la acrilamida sea nociva para los humanos, aunque su presencia en los productos alimenticios es indeseable, especialmente a niveles elevados. Como se señaló anteriormente, en los productos alimenticios que han sido calentados o procesados térmicamente, se encuentran concentraciones relativamente altas de acrilamida. La reducción de acrilamida en esos productos alimenticios podría lograrse reduciendo o eliminando los compuestos precursores que forman la acrilamida, inhibiendo la formación de acrilamida durante el procesamiento de los alimentos, desdoblado o haciendo reaccionar el monómero de acrilamida una vez se haya formado en los alimentos, o extrayendo la acrilamida del producto antes de su consumo. Cada producto alimenticio, obviamente, presenta retos únicos para llevar a cabo algunas de las opciones anteriores. Por ejemplo, es posible que los

alimentos que se cortan y se cocinan en pedazos uniformes no se mezclen con facilidad con diversos aditivos sin destruir físicamente las estructuras celulares que le dan a los productos alimenticios sus características únicas al ser cocinados. Otros requisitos de procesamiento para los productos alimenticios específicos pueden, igualmente, hacer que las estrategias de reducción de acrilamida sean incompatibles o extremadamente difíciles.

A manera de ejemplo de productos alimenticios calentados que presentan retos únicos para la reducción de los niveles de acrilamida en los productos fabricados son los pasabocas que se pueden fabricar a partir de una masa. El término “pasabocas fabricado” quiere decir un alimento de refrigerio para el que se usa como ingrediente inicial un ingrediente diferente al material inicial feculento original e inalterado. Los pasabocas fabricados incluyen, por ejemplo, las papas fritas fabricadas para las que se usa un producto de papa deshidratada como materia inicial y las hojuelas de maíz para las que se usa harina de maíz como material inicial. Aquí se observa que el producto de papa deshidratada puede ser harina de papa, hojuelas de papa, gránulos de papa o cualquier otra forma en que exista la papa deshidratada. Cuando se use alguno de estos términos para esta aplicación, se entiende que se incluyen todas estas variaciones. La papa frita fabricada comienza, por ejemplo, con hojuelas de papa, que se mezclan con agua y otros ingredientes menores para formar una masa. Luego se aplana la masa y se corta antes de proceder con el paso de cocción.

El paso de cocción puede incluir freír u hornear. Luego las papas se someten a un paso de sazonado y un paso de empacado. La mezcla de la masa de papa *generalmente hace fácil la adición de otros ingredientes*. Por el contrario, la adición de dichos ingredientes a un producto crudo, como a las tajadas de papa, exige encontrar un mecanismo que permita la penetración de los ingredientes en la estructura celular del producto. Sin embargo, la adición de cualquier ingrediente en el paso de mezclado debe hacerse teniendo en cuenta que los ingredientes pueden afectar de manera desfavorable las características laminares de la masa al igual que las características de la papa frita final, como el sabor, la textura y el color.

Sería deseable desarrollar uno o más métodos para reducir el nivel de acrilamida en el producto final de los alimentos procesados térmicamente. En condiciones ideales, dicho proceso reduciría o eliminaría sustancialmente la acrilamida en el producto final sin afectar de manera adversa la calidad y las características del producto final. Además, el método sería fácil de implementar y, mejor aún, no aumentaría o aumentaría muy poco el costo del proceso general.

RESUMEN DEL INVENTO

En el proceso de invención, se añade un catión bivalente o trivalente o una combinación de dichos cationes a los alimentos fabricados antes de la cocción para

reducir la formación de acrilamida. El catión bivalente o trivalente se puede añadir durante el proceso de molienda, mezclado seco, mezclado húmedo u otro mezclado adicional, de modo que el catión se encuentre presente en todo el producto alimenticio. En las configuraciones preferidas, el catión añadido puede escogerse del grupo de las sales de calcio, magnesio y aluminio, y menos favorablemente, de las sales de hierro, zinc y cobre. El catión se añade a la masa en cantidad suficiente como para reducir la formación de acrilamida en el producto terminado hasta un nivel deseable.

La adición de cationes bivalentes o trivalentes reduce de manera efectiva la cantidad de acrilamida presente en el producto final del alimento calentado o procesado térmicamente al tiempo que se afecta al mínimo la calidad y características del producto final. Además, dicho método de reducción de acrilamida normalmente es fácil de implementar y añade poco o ningún costo al proceso general.

BREVE DESCRIPCIÓN DE LOS DIBUJOS

Los rasgos novedosos que se creen característicos del invento se formulan más adelante en las afirmaciones anexas. Sin embargo, el invento mismo, así como un modo preferido de usarlo, los objetivos ulteriores y las ventajas del mismo, se

entenderán mejor remitiéndose a la siguiente descripción detallada de las configuraciones ilustrativas, leída junto con los dibujos acompañantes, donde la:

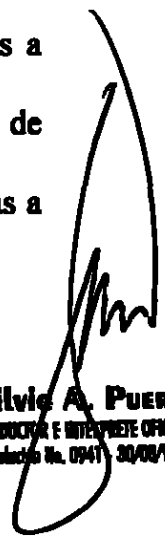
Figura 1 es un diagrama de supuestas rutas químicas para la formación de acrilamida en alimentos; y

Figura 2 es un diagrama de un método para fabricar pasabocas de papa fabricados a partir de hojuelas, gránulos o harina de papa según una configuración del invento presente.

DESCRIPCIÓN DETALLADA

La formación de acrilamida en los alimentos procesados térmicamente requiere una fuente de carbono y una fuente de nitrógeno. Se ha formulado la hipótesis de que el carbono es suministrado por una fuente de carbohidratos y el nitrógeno es suministrado por una fuente proteínica o de aminoácidos. Muchos ingredientes alimenticios derivados vegetales como el arroz, el trigo, el maíz, la cebada, la soya, la papa y la avena contienen asparagina y son principalmente componentes de carbohidratos que tienen aminoácidos en menor cantidad. Normalmente, dichos ingredientes alimenticios tienen un contenido de aminoácidos pequeño, que contiene otros aminoácidos aparte de la asparagina.

Por “procesado térmicamente” se entiende alimento o ingredientes alimenticios en los que los componentes del alimento, como mezcla de ingredientes alimenticios, se calienta a temperaturas de al menos 80°C. Preferiblemente el procesamiento térmico de los alimentos o los ingredientes alimenticios sucede a temperaturas entre 100°C y 205°C aproximadamente. El ingrediente alimenticio puede procesarse por separado a temperatura elevada antes de la formación del producto alimenticio final. Un ejemplo de un ingrediente alimenticio procesado térmicamente son las hojuelas de papa, que se hacen con papas crudas en un proceso que expone las papas a temperaturas de hasta 170°C (Los términos “hojuelas de papa”, “gránulos de papa” y “harina de papa” se usan indistintamente aquí, y sirven para denotar cualquier producto deshidratado a base de papa). Algunos ejemplos de otros ingredientes procesados térmicamente son la avena, el arroz semi-cocido y seco, los productos de soya cocinados, la masa de maíz, los granos de café tostados y los granos de cacao tostados. Alternativamente, los ingredientes alimenticios crudos se pueden usar en la preparación del producto alimenticio final, en donde la producción del producto alimenticio final incluye un paso de calentamiento térmico. Un ejemplo de procesamiento de materia prima en donde el producto alimenticio final es el resultado de un paso de calentamiento térmico es la fabricación de papas fritas a partir de tajadas de papa cruda en el paso de fritura a una temperatura de aproximadamente 100°C hasta 205°C aproximadamente, o la producción de papas a la francesa fritas a temperaturas similares.


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Sin embargo, según el presente invento, se ha encontrado que una formación significativa de acrilamida sucede cuando el aminoácido asparagina se calienta en presencia de un azúcar reductor. El calentamiento de otros aminoácidos como la lisina y la alanina en presencia de un azúcar reductor como la glucosa no conlleva a formación de acrilamida. Sin embargo, la adición de otros aminoácidos a la mezcla de asparagina y azúcar puede aumentar o disminuir la cantidad de acrilamida formada.

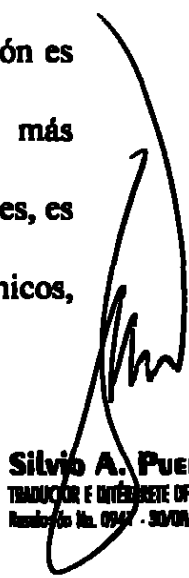
Habiendo establecido la formación rápida de acrilamida cuando la asparagina se calienta en presencia de un azúcar reductor, se puede lograr una reducción de la acrilamida en los alimentos procesados térmicamente mediante la desactivación de la asparagina. Por "desactivación" se entiende la remoción de la asparagina del alimento o hacer que la asparagina se vuelva no reactiva a lo largo de la ruta de formación de acrilamida mediante la conversión o fijación a otro químico que interfiera con la formación de acrilamida a partir de la asparagina.

En el presente invento, esto se logra mediante la adición de un catión bivalente o trivalente a una fórmula para alimento en pasabocas antes de la cocción o procesamiento térmico de ese pasabocas. Los químicos entienden que los cationes no existen de manera aislada, sino que se encuentran en presencia de un anión que

tiene la misma valencia. Aunque se hace referencia aquí a la sal que contiene el catión bivalente o trivalente, es el catión presente en la sal la que se cree que suministra una reducción en la formación de acrilamida al reducir la solubilidad de las asparagina en el agua. Estos cationes también se llaman aquí como catión con valencia mínima de dos.

Es interesante mencionar que los cationes de una sola valencia no son efectivos en el uso con el presente invento. Al escoger un compuesto apropiado que contenga el catión de valencia mínima dos en combinación con un anión, los factores relevantes son la solubilidad del agua, seguridad del alimento y mínima alteración de las características del alimento particular. Se pueden usar combinaciones de varias sales, incluso cuando se tratan aquí como sales individuales.

Los químicos se refieren a la valencia de un átomo como una medida de su capacidad para combinarse con otros elementos. En particular, un átomo bivalente tiene la capacidad de formar dos enlaces iónicos con otros átomos, mientras que un átomo trivalente puede formar tres enlaces iónicos con otros átomos. Un catión es un ión cargado positivamente, es decir, un átomo que ha perdido uno o más electrones, dándole una carga positiva. Un catión bivalente o trivalente, entonces, es un ión cargado positivamente que está disponible para dos o tres enlaces iónicos, respectivamente.



Silvio A. PUERTAS P.
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Se pueden usar sistemas de modelo simple para probar los efectos de los cationes bivalentes o trivalentes en la formación de acrilamida. Al calentar asparagina y glucosa en proporciones molares de 1:1, se puede generar acrilamida. Las comparaciones cuantitativas del contenido de acrilamida con y sin adición de la sal miden la capacidad de la sal de fomentar o inhibir la formación de acrilamida. Se usaron dos métodos de preparación y calentamiento de muestra. Un método implicaba la mezcla de los componentes secos, añadiendo una cantidad igual de agua, y el calentamiento en un frasco vial tapado herméticamente. Los reactivos se concentraron durante el calentamiento a medida que escapaba la mayoría del agua, duplicando las condiciones de cocción. Se pueden formar jarabes espesos o alquitranes dificultando la recuperación de la acrilamida. Estas pruebas se muestran en los Ejemplos 1 y 2 siguientes.

Un segundo método que usaba vasos de presión permitía experimentos más controlados. Las soluciones de los componentes de prueba se combinaban y se calentaban bajo presión. Los componentes de prueba se pueden añadir a las concentraciones que se encuentran en los alimentos y los búferes pueden duplicar el pH de los alimentos comunes. En estas pruebas no escapa agua, lo que simplifica la recuperación de la acrilamida, como se muestra en el Ejemplo 3 siguiente.

Ejemplo 1

Se cubrió un frasco vial de vidrio de 20 mL (mililitros) que contenía monohidrato de L-asparagina (0.15 g, 1 mmol), glucosa (0.2 g, 1 mmol) y agua (0.4 mL) con una lámina de aluminio y se calentó en horno de cromatografía de gases (GC) programado para calentarse de 40° a 220°C a 20°/min. El residuo se extrajo con agua y se analizó para ver la acrilamida usando espectroscopia de masa y cromatografía de gas (GC-MS). El análisis encontró aproximadamente 10.000 ppb (partes por mil millones) de acrilamida.

Se calentaron y analizaron dos frascos vial adicionales que contenían monohidrato de L-asparagina (0.13 g, 1 mmol), glucosa (0.2 g, 1 mmol), cloruro de calcio anhidro (0.1 g, 1 mmol) y agua (0.4 mL). El análisis encontró 7 y 30 ppb de acrilamida, una reducción mayor al 99%.

Dados los resultados sorprendentes de que las sales de calcio reducen fuertemente la formación de acrilamida, una revisión adicional de sales identificó los cationes bivalentes o trivalentes (magnesio, aluminio) que producían un efecto similar. Se observa que los experimentos similares con cationes monovalentes, por ejemplo 0.1/0.2 g de bicarbonato de sodio y carbonato de amonio (como carbamato de

amonio y bicarbonato de amonio) aumentaban la formación de acrilamida, como se observa en la Tabla 1 siguiente.

Sal	Sal micro mol	Micromol de acrilamida después del calentamiento, ppb
Ninguna (control)	0	9857
Bicarbonato de sodio	1200	13419
Carbonato de amonio	1250	22027
Carbonato de amonio	2500	47897

Tabla 1

Ejemplo 2

En un segundo experimento, se realizó una prueba similar a la descrita anteriormente, pero en vez de usar cloruro de calcio anhidro, se utilizaron dos diluciones diferentes de cloruro de calcio y cloruro de magnesio. Los frascos vial que contenían monohidrato de L-asparagina (0.15 g, 1 mmol) y glucosa (0.2 g, 1 mmol) se mezclaron con alguno de los siguientes:

0.5 mL de agua (control)

0.5 mL de solución de cloruro de calcio al 10% (0.5 mmol)

0.05 mL de solución de cloruro de calcio al 10% (0.05 mmol) más 0.45 mL de agua

0.5 mL de solución de cloruro de magnesio al 10% (0.5 mmol), o

00.5 mL de solución de cloruro de magnesio al 10% (0.05 mmol) más 0.45 mL de agua

Las muestras duplicadas se calentaron y analizaron como se describió en el Ejemplo

1. Los resultados se promediaron y se resumieron en la Tabla 2 siguiente:

Ident. de la sal	Amt añadida micromoles	Acrilamida formada micromoles	Reducción de acrilamida
Ninguna (control)	0	408	0
Cloruro de calcio	450	293	27%
Cloruro de calcio	45	864	Ninguna
Cloruro de magnesio	495	191	53%
Cloruro de magnesio	50	2225	Ninguna

Tabla 2

Ejemplo 3

Como se mencionó anteriormente, esta prueba no implicaba pérdida de agua del contenedor, sino que se realizó bajo presión. Los frascos vial que contenían 2 mL

de solución almacenada de búfer (15 mM de asparagina, 15 mM de glucosa, 500 mM de fosfato o acetato) y 0.1 mL de solución de sal (1000 mM) se calentaron en una bomba Parr ubicada en un horno GC programado para calentarse de 40 a 150°C a 20°/min y se mantuvo a 150°C por 2 minutos. La bomba se retiró del horno y se refrigeró por 10 minutos. Se extrajeron los contenidos con agua y se analizaron para ver la acrilamida después del método GC-MS. Para cada combinación de pH y búfer, se realizó un control sin adición de sal, así como con las tres sales diferentes. Los resultados de las pruebas duplicadas se promediaron y se resumieron en la Tabla 3 siguiente:

Sal	pH	Búfer	Mcg de acrilamida con adición de sal	Mcg de acrilamida de control	Reducción de acrilamida
Cloruro de calcio	5.5	Acetato	337	550	19%
Cloruro de calcio	7.0	Acetato	990	1205	18%
Cloruro de calcio	5.5	Fosfato	154	300	49%
Cloruro de calcio	7.0	Fosfato	762	855	11%
Cloruro de magnesio	5.5	Acetato	380	550	16%
Cloruro de magnesio	7.0	Acetato	830	1205	31%

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Cloruro de magnesio	5.5	Fosfato	198	300	34%
Cloruro de magnesio	7.0	Fosfato	773	855	10%
Sulfato de aluminio potasio	5.5	Acetato	205	550	31%
Sulfato de aluminio potasio	7.0	Acetato	453	1205	62%
Sulfato de aluminio potasio	5.5	Fosfato	64	300	79%
Sulfato de aluminio potasio	7.0	Fosfato	787	855	8%

Tabla 3

A lo largo de las tres sales usadas, las mayores reducciones ocurrieron en acetato de pH 7 y fosfato de pH 5.5. Solo se observaron reducciones pequeñas en acetato de pH 5.5 y fosfato de pH 7.

Ejemplo 4

Siguiendo los resultados de los sistemas modelo, se realizó una prueba de laboratorio a pequeña escala en la que se añadía cloruro de calcio a las hojuelas de papa antes del calentamiento. Se añadieron 3 ml de una solución de cloruro de

calcio al 0.4%, 2% o 10% a 3 g de hojuelas de papa. El control fue 3 g de hojuelas de papa mezcladas con 3 ml de agua desionizada. Las hojuelas se mezclaron para formar una pasta relativamente uniforme y luego se calentaron en un frasco vial sellado a 120°C por 40 minutos. Se midió luego la acrilamida después del calentamiento mediante GC-MS. Antes del calentamiento, las hojuelas de papa de control contenían 46 ppb de acrilamida. Los resultados de prueba se reflejan en la Tabla 4 siguiente.

Ident. de la mezcla	Acrilamida, ppb	Reducción de acrilamida
Control (agua)	2604	Ninguna
Solución de CaCl ₂ al 0.4%	1877	28%
Solución de CaCl ₂ al 2%	338	76%
Solución de CaCl ₂ al 10%	86	97%

Tabla 4

Dados los resultados anteriores, se realizaron pruebas en las que se añadía una sal de calcio a la fórmula para un alimento de pasabocas fabricado, en este caso, papas fabricadas horneadas. El proceso para la fabricación de las papas fabricadas consistió en los pasos mostrados en la Figura 3. El paso de preparación de la masa 31 combina las hojuelas de papa con agua, el par catión / anión (que en este caso es el cloruro de calcio) y otros ingredientes menores, que se mezclan completamente

para formar una masa. (Nuevamente, el término “hojuelas de papa” se entiende aquí que abarca la hojuela de papa seca, los gránulos o las preparaciones en polvo, sin importar el tamaño de partícula). En el paso de laminado / corte 32, la masa se hace pasar por una laminadora que aplana la masa y luego se corta en pedazos individuales. En el paso de cocción 33, las piezas se cocinan hasta que tengan un color y contenido de agua específico. Los pasabocas resultantes se sazonan luego en el paso de sazonado 34 y se empacan en el paso de empaque 35.

Una primera configuración del invento se demuestra usando el proceso de pasabocas de papa fabricado horneado descrito anteriormente. Para ilustrar esta configuración, se hace una comparación ente un lote de control y un lote de prueba usando una formulación comercial de pasabocas de papa fabricado horneado y los procesos. Tanto los lotes de prueba como los de control se hicieron siguiendo las formulaciones enumeradas en la Tabla 5. La única diferencia entre los lotes era que el lote de prueba contenía cloruro de calcio.

Ingrediente	Control	Prueba de CaCl ₂
Hojuelas de papa y almidón modificado	5496 g	5496 g
Azúcar	300 g	300 g
Accite	90 g	90 g


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Agentes leudantes	54 g	54 g
Emulsificante	60 g	60 g
Cloruro de calcio (disuelto en agua)	0 g	39 g
Mezcla seca total	6000 g	6039 g
Agua	3947 ml	3947 ml

Tabla 5

En todos los lotes, los ingredientes secos se mezclaron juntos primero y luego se añadió el aceite a cada mezcla seca y se revolvió. El cloruro de calcio se disolvió en el agua antes de añadirlo a la masa. El nivel de humedad de la masa antes del laminado era de 40% a 45% en peso. La masa se laminó para producir un espesor de entre 0.020 y 0.030 pulgadas, se cortó en piezas y se horneó.

Después de la cocción, se realizó prueba de humedad, aceite y color según la escala Hunter L-a-b. Se probaron las muestras para obtener los niveles de acrilamida del producto terminado. La Tabla 6 muestra los resultados de estos análisis.

	Control	Prueba de CaCl_2
H_2O , %	2.21	2.58
Aceite, %	1.99	2.08

Acrilamida, ppb		1030	160
Color	L	72.34	76.67
	A	1.99	-0.67
	B	20.31	24.21

Tabla 6

Como lo muestran estos resultados, la adición de cloruro de calcio a la masa en una razón por peso de cloruro de calcio versus hojuelas de papa de aproximadamente 1:125 disminuye significativamente el nivel de acrilamida presente en el producto terminado, disminuyendo los niveles de acrilamida final de 1030 ppb a 160 ppb. Además, los porcentajes de aceite y agua en el producto final no parecen haberse visto afectados por la adición de cloruro de calcio. Sin embargo, se observa que el CaCl_2 puede originar cambios en el gusto, textura y color del producto, dependiendo de la cantidad usada.

En nivel del catión bivalente o trivalente que se añade a un alimento para la reducción de la acrilamida puede expresarse de distintas maneras. Para que sea comercialmente aceptable, la cantidad de catión añadido debería ser suficiente para reducir el nivel final de producción de acrilamida en al menos veinte por ciento (20%). Mejor aún, el nivel de producción de acrilamida debería reducirse aproximadamente en una cantidad en el rango de treinta y cinco a noventa y cinco

por ciento (35-95%). Incluso mejor, el nivel de producción de acrilamida debería reducirse aproximadamente en una cantidad en el rango de cincuenta a noventa y cinco por ciento (50-95%). Para expresar esto de manera diferente, la cantidad de catión bivalente o trivalente a añadir puede expresarse como un cociente entre las moles de catión sobre los moles de asparagina libre presente en el producto alimenticio. La razón de moles de catión bivalente o trivalente en moles de asparagina libre debería ser al menos uno a cinco (1:5). Mejor aún, la razón es al menos uno a tres (1:3), e incluso mejor, uno a dos (1:2). En la configuración preferida presenta, la razón de moles de cationes sobre moles de asparagina está entre aproximadamente 1:2 y 1:1. En el caso del magnesio, que tiene mejor efecto en el sabor del producto que el calcio, la razón molar del catión sobre asparagina puede ser tan alto como dos a uno (2:1).

Se realizaron pruebas adicionales usando el mismo procedimiento descrito anteriormente, pero con lotes diferentes de hojuelas de papa que contenían diferentes niveles de azúcares reductores y cantidades variables de cloruro de calcio añadido. En la Tabla 7 siguiente, el lote 1 de hojuelas de papa, que fue la prueba mostrada anteriormente, tenía 0.81% de azúcares reductores, el lote 2 tenía 1.0% y el lote 3 tenía 1.8% de azúcares reductores.

CaCl ₂ añadido	Lote de hojuelas	Humedad de terminado en % de peso	Color de terminado en valor L	Acrilamida de terminado en ppb
0 g	1	2.21	72.34	1030
39 g	1	2.58	76.67	160
0 g	2	1.80	73.35	464
0 g	2	1.61	72.12	1060
17.5 g	2	1.82	74.63	350
39 g	2	2.05	76.95	80
39 g	2	1.98	75.86	192
0 g	3	1.99	71.37	1020
0 g	3	1.71	72.68	599
0 g	3	1.69	71.26	1640
0 g	3	1.63	74.44	1880
39 g	3	1.89	76.59	148
39 g	3	1.82	75.14	275

Tabla 7

Como se observa en esta tabla, la adición de CaCl₂ reduce constantemente el nivel de acrilamida del producto final, incluso cuando la razón en peso de CaCl₂ añadido a las hojuelas de papa es menor a 1:250.

Se puede usar cualquier cantidad de sales que formen cationes bivalentes o trivalentes (o dicho de otra manera, produzcan un catión con valencia mínima de dos) con el invento revelado aquí, siempre y cuando se hagan ajustes debido a los efectos colaterales de este ingrediente adicional. El efecto de disminuir el nivel de acrilamida parece derivarse del catión bivalente o trivalente, más que del anión que se conjuga con éste. Las limitaciones en el par catión / anión diferentes a la valencia, están relacionados con su aceptabilidad en alimentos, como la seguridad, solubilidad y su efecto sobre el sabor, olor, apariencia y textura. Los cationes sugeridos incluyen el calcio, el magnesio, el aluminio, el hierro, el cobre y el zinc. Las sales convenientes de estos cationes incluyen el cloruro de calcio, citrato de calcio, lactato de calcio, malato de calcio, gluconato de calcio, fosfato de calcio, acetato de calcio, EDTA sódico de calcio, glicerofosfato de calcio, hidróxido de calcio, lactobionato de calcio, óxido de calcio, propionato de calcio, carbonato de calcio, estearoil-lactato de calcio, cloruro de magnesio, citrato de magnesio, lactato de magnesio, malato de magnesio, gluconato de magnesio, fosfato de magnesio, hidróxido de magnesio, carbonato de magnesio, sulfato de magnesio, cloruro de aluminio hexahidratado, cloruro de aluminio, hidróxido de aluminio, alumbre de amonio, alumbre de potasio, alumbre de sodio, sulfato de aluminio, cloruro férrico, gluconato ferroso, citrato amonio férrico, pirofosfato férrico, fumarato ferroso, lactato ferroso, sulfato ferroso, cloruro cúprico, gluconato cúprico, sulfato cúprico,

gluconato de zinc, óxido de zinc y sulfato de zinc. La configuración preferida en la actualidad para este invento usa cloruro de calcio, aunque se cree que los requisitos se cumplen mejor con una combinación de sales de uno o más de los cationes apropiados. Diversas sales, como las sales de calcio, y en particular el cloruro de calcio, son relativamente económicas y se usan comúnmente como alimentos. El cloruro de calcio puede usarse en una combinación con citrato de calcio, reduciendo así los efectos colaterales sobre el sabor ocasionados por el CaCl_2 . Además, cualquier variedad de sales de calcio se puede usar en combinación con una o más sales de magnesio. Una persona hábil en la técnica entenderá que la formulación específica de sales requeridas puede ajustarse dependiendo del producto alimenticio en cuestión y las características deseadas del producto final.

Debería entenderse que los cambios en las características del producto final, como los cambios de color, sabor y textura, pueden compensarse de diversas formas. Por ejemplo, las características de color en las papas fritas pueden ajustarse controlando la cantidad de azúcares en el producto inicial. Algunas características de sabor pueden modificarse añadiendo diversos agentes saborizantes al producto final. La textura física del producto puede ajustarse, por ejemplo, añadiendo agentes leudantes o distintos emulsificantes.

Mientras que el invento se ha mostrado y descrito particularmente con referencia a una o más configuraciones, las personas expertas en la técnica entienden que los distintos enfoques en la reducción de la acrilamida en los alimentos procesados térmicamente pueden hacerse sin salirse del espíritu y alcance de esta invención. Por ejemplo, mientras el proceso se ha mostrado aquí con respecto a productos de papa, el proceso también se puede usar en el procesamiento de productos alimenticios hechos a partir de maíz, cebada, trigo, centeno, arroz, avena, mijo y otros granos con base de almidón. Además de las papas fabricadas, el invento puede usarse en la fabricación de otros tipos de pasabocas, así como en cereales, galletas, galletas saladas, pretzels crocantes, panes y bizcochos, y apanado de carnes y otros alimentos que contengan asparagina y un azúcar reductor. En cada uno de estos alimentos, el catión puede añadirse durante la mezcla de la masa usada para hacer el producto, haciendo que el catión añadido esté disponible durante la cocción para brindar una reducción en el nivel de acrilamida. Además, la adición de un catión bivalente o trivalente puede combinarse con otras estrategias para la reducción de acrilamida para obtener un nivel de acrilamida aceptable de acrilamida sin afectar negativamente el sabor, color, olor u otra característica de un alimento particular.

AFIRMACIONES:

Nosotros afirmamos:

1. Un método para disminuir el nivel de acrilamida producida por el procesamiento térmico de un pasabocas de papa fabricado a partir de una masa que contiene un material a base de almidón con asparagina libre, en donde dicho método consta de los pasos de:

- a) añadir un catión con una valencia mínima de 2, a dicha masa; y
- b) procesamiento térmico de dicha masa para producir un pasabocas de papa;

En donde dicho catión se añade en cantidad suficiente como para reducir el nivel final de acrilamida en dicho pasabocas de papa a un nivel que es inferior al que se hubiera obtenido si no se hubiera añadido el catión en el paso a).

2. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente para reducir el nivel final de acrilamida en dicho pasabocas de papa en al menos 20%.

3. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente para reducir el nivel final de acrilamida en dicho pasabocas de papa en al menos 35%.

4. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente para reducir el nivel final de acrilamida en dicho pasabocas de papa en aproximadamente 50%.

5. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente para reducir el nivel final de acrilamida en dicho pasabocas de papa en un rango aproximado de 50 a 95%.

6. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente para reducir una razón molar de catión versus asparagina libre de al menos 1:5.

7. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente para reducir una razón molar de catión versus asparagina libre de al menos 1:3.

8. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente para reducir una razón molar de catión versus asparagina libre de al menos 1:2.

9. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente para reducir una razón molar de catión versus asparagina libre de al menos 1:1.

10. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora un ión de calcio a dicha masa, siendo dicho ión de calcio parte de una sal seleccionada del grupo de cloruro de calcio, lactato de calcio, citrato de calcio, malato de calcio, gluconato de calcio, fosfato de calcio, acetato de calcio, EDTA sódico de calcio, glicerofosfato de calcio, hidróxido de calcio, lactobionato de calcio, óxido de calcio, propionato de calcio, carbonato de calcio y estearoil-lactato de calcio.

11. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora un ión de magnesio a dicha masa, siendo dicho ión de magnesio parte de una sal seleccionada del grupo de cloruro de magnesio, citrato de magnesio, lactato de magnesio, malato de magnesio, gluconato de magnesio, fosfato de magnesio, hidróxido de magnesio, carbonato de magnesio y sulfato de magnesio.

12. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora un ión de aluminio a dicha masa, siendo dicho ión parte de una sal seleccionada del grupo de cloruro de aluminio hexahidratado, cloruro de aluminio, hidróxido de aluminio, alumbre de amonio, alumbre de potasio, alumbre de sodio y sulfato de aluminio.

13. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora una sal de hierro a dicha masa, siendo dicha sal seleccionada del grupo de cloruro

AD
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férrico, gluconato ferroso, citrato amonio férrico, pirofosfato férrico, fumarato ferroso, lactato ferroso y sulfato ferroso.

14. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora un ión de cobre a dicha masa, siendo dicho ión de cobre parte de una sal seleccionada del grupo de cloruro cúprico, gluconato cúprico y sulfato cúprico.

15. El método de la Afirmación 1, en donde dicho paso de procesamiento térmico b) implica freír dicha masa.

16. El método de la Afirmación 1, en donde dicho paso de procesamiento térmico b) implica hornear dicha masa.

17. El pasabocas de papa producido por el método de la Afirmación 1.

18. Un método de elaboración de pasabocas de papa fabricados, en donde dicho método comprende los pasos de:

a) preparar una mezcla que consta de hojuelas de papa, agua y un ingrediente que produce un catión que tiene una valencia mínima de dos, y dicho ingrediente se selecciona del grupo de sales que constan de sales de calcio, sales de magnesio, sales de aluminio, sales de hierro y sales de cobre;

- b) laminado y corte de dicha mezcla para formar piezas cortadas; y
- c) el procesamiento térmico de dichas piezas cortadas, en donde dicho ingrediente reduce la formación de acrilamida en dichos pasabocas de papa fabricados.

19. El método de la Afirmación 18, en donde dicho procesamiento térmico del paso c) implica horneado.

20. El método de la Afirmación 18, en donde dicho procesamiento térmico del paso c) implica fritura.

21. El método de la Afirmación 18, en donde la formación de acrilamida en dicho pasabocas de papa fabricado se reduce en al menos 50% más que el pasabocas de papa fabricado preparado sin dicho catión.

22. Un pasabocas de papa fabricado producido por el método de la Afirmación 18.

23. Un método para disminuir el nivel de acrilamida producida por el procesamiento térmico de un pasabocas fabricado a partir de una masa que consta de un material a base de maíz que tiene asparagina libre, en donde dicho método consta de los pasos de:

- a) adición de un catión, que tiene una valencia mínima de 2 a dicha masa; y

b) procesamiento térmico de dicha masa para producir un pasabocas;

En donde dicho catión se añade en cantidad suficiente como para reducir el nivel final de acrilamida en dicho pasabocas a un nivel que es menor que si el catión no se hubiera añadido en el paso a).

24. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente como para reducir dicho nivel final de acrilamida en dicho pasabocas en al menos 20%.

25. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente como para reducir dicho nivel final de acrilamida en dicho pasabocas en al menos 35%.

26. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente como para reducir dicho nivel final de acrilamida en dicho pasabocas en aproximadamente 50%.

27. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente como para reducir dicho nivel final de acrilamida en dicho pasabocas en un rango aproximado de 50 a 95%.

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28. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente como para producir una razón molar de catión libre de asparagina de al menos 1:5.

29. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente como para producir una razón molar de catión libre de asparagina de al menos 1:3.

30. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente como para producir una razón molar de catión libre de asparagina de aproximadamente 1:2.

31. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente como para producir una razón molar de catión libre de asparagina de aproximadamente 1:1.

32. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora un ión de calcio a dicha masa, siendo dicho ión de calcio parte de una sal seleccionada del grupo de cloruro de calcio, lactato de calcio, citrato de calcio, malato de calcio, gluconato de calcio, fosfato de calcio, acetato de calcio, EDTA sódico de calcio,

glicerofosfato de calcio, hidróxido de calcio, lactobionato de calcio, óxido de calcio, propionato de calcio, carbonato de calcio y estearoil-lactato de calcio.

33. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora un ión de magnesio a dicha masa, siendo dicho ión de magnesio parte de una sal seleccionada del grupo de cloruro de magnesio, citrato de magnesio, lactato de magnesio, malato de magnesio, gluconato de magnesio, fosfato de magnesio, hidróxido de magnesio, carbonato de magnesio y sulfato de magnesio.

34. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora un ión de aluminio a dicha masa, siendo dicho ión parte de una sal seleccionada del grupo de cloruro de aluminio hexahidratado, cloruro de aluminio, hidróxido de aluminio, alumbre de amonio, alumbre de potasio, alumbre de sodio y sulfato de aluminio.

35. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora una sal de hierro a dicha masa, siendo dicha sal seleccionada del grupo de cloruro férrico, gluconato ferroso, citrato amonio férrico, pirofosfato férrico, fumarato ferroso, lactato ferroso y sulfato ferroso.

36. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora un ión de cobre a dicha masa, siendo dicho ión de cobre parte de una sal seleccionada del grupo de cloruro cúprico, gluconato cúprico y sulfato cúprico.

37. El método de la Afirmación 23, en donde dicho paso de procesamiento térmico b) implica freír dicha masa.

38. El método de la Afirmación 23, en donde dicho paso de procesamiento térmico b) implica hornear dicha masa.

39. El pasabocas de papa producido por el método de la Afirmación 23.

40. El método de la Afirmación 23, en donde el pasabocas es un pasabocas de maíz.

41. El método de la Afirmación 23, en donde el pasabocas es un pasabocas de harina de maíz.

MÉTODO PARA REDUCCIÓN DE LA FORMACIÓN DE ACRILAMIDA EN ALIMENTOS PROCESADOS TÉRMICAMENTE

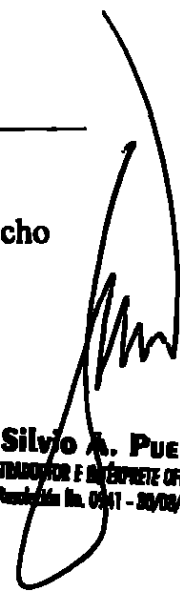
RESUMEN DEL DESCUBRIMIENTO

En alimentos procesados térmicamente fabricados, la adición de uno de un grupo selecto de cationes bivalentes o trivalentes a la receta del alimento inhibe la formación de acrilamida durante el procesamiento térmico. El catión puede provenir del grupo que incluye sales de calcio, magnesio, cobre, aluminio, cobre y hierro.

(Hay 1 anexo)

Traductor: SILVIO ALEJANDRO PUERTAS PINO

Resolución 0941 del 30 de agosto de 1996 del Ministerio de Justicia y del Derecho



Silvio A. Puertas P.
TRADUCTOR E INTERPRETE OFICIAL. INGLÉS
Resolución No. 0941 - 30/08/96 Ministerio de Justicia y del Derecho

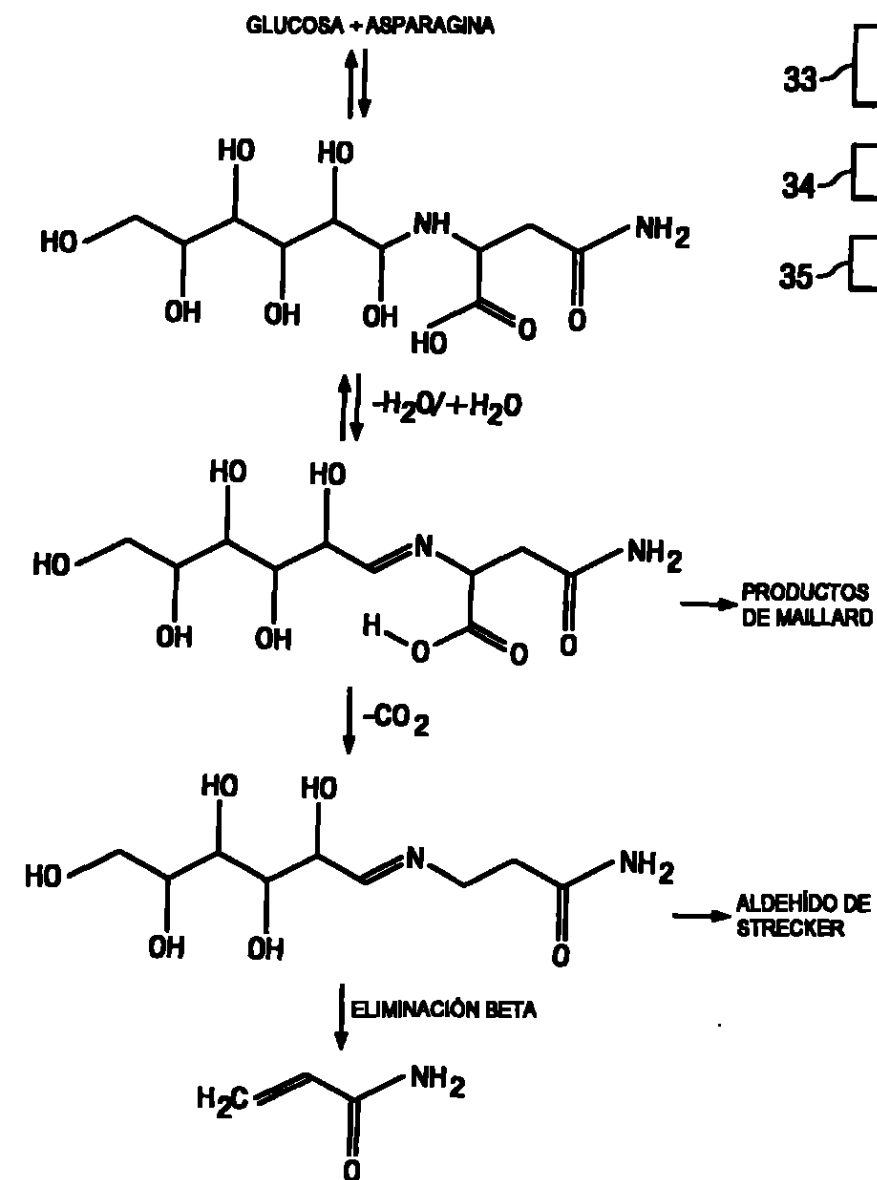


FIG. 1

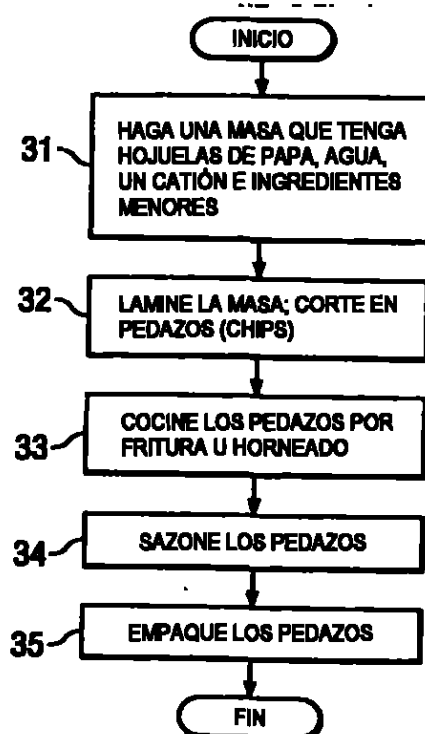


FIG. 2

**TRANSMITTAL LETTER TO THE
UNITED STATES RECEIVING OFFICE**

Date	
International Application No.	
Attorney Docket No.	CFLAY.00178P

I. Certification under 37 CFR 1.16 (if applicable)

EV 333419133 US	February 8, 2004
Express Mail mailing number	Date of Deposit

I hereby certify that the application/correspondence attached hereto is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to Mail Stop PCT, Commissioner for Patents, PO Box 1450, Alexandria, VA 22313-1450.

	Rhonda K. McGee
Signature of person mailing correspondence	Typed or printed name of person mailing correspondence

II. ☒ New International Application

TITLE	Method for Reducing Acrylamide Formation in Thermally Processed Foods	Earliest priority date (Day/Month/Year)	21 Feb 2003 (21.02.2003)
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SCREENING DISCLOSURE INFORMATION: In order to assist in screening the accompanying international application for purposes of determining whether a license for foreign transmittal should and could be granted and for other purposes, the following information is supplied. (Note: check as many boxes as apply):

A. ☐ The invention disclosed was not made in the United States.

B. ☐ There is no prior U.S. application relating to this invention.

C. ☒ The following prior U.S. application(s) contain subject matter which is related to the invention disclosed in the attached international application. (NOTE: priority to these applications may or may not be claimed on form PCT/RO/101 (Request) and this listing does not constitute a claim for priority.)

application no.	10/372,164	Filed on	21 Feb 2003 (21.02.2003)
application no.		Filed on	

D. ☐ The present international application contains additional subject matter not found in the prior U.S. application(s) identified in paragraph C. above. The additional subject matter is found on pages _____ and ☐ DOES NOT ALTER ☐ MIGHT BE CONSIDERED TO ALTER the general nature of the invention in a manner which would require the U.S. application to have been made available for inspection by the appropriate defense agencies under 35 U.S.C. 181 and 37 CFR 8.1. See 37 CFR 8.15.

III. ☐ A Response to an invitation from the ROAUS. The following document(s) is (are) enclosed:

A. ☐ A Request for An Extension of Time to File a Response

B. ☐ A Power of Attorney (General or Regular)

C. ☐ Replacement pages:

pages		of the request (PCT/RO/101)	pages		of the figures
pages		of the description	pages		of the abstract
pages		of the claims	pages		

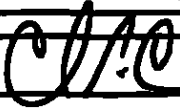
D. ☐ Submission of Priority Documents

Priority document		Priority document	
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E. ☐ Fees as specified on attached Fee Calculation sheet form PCT/RO/101 annex

IV. ☐ A Request for Rectification under PCT 91 ☐ A Petition ☐ A Sequence Listing Disclosure

V. ☐ Other (please specify):

The person signing this form is the:	☐ Applicant	Colin P. Cahoon, Registration No. 38,838
	☒ Attorney/Agent (Reg. No.)	 Typed name of signer
	☐ Common Representative	Signature

PCT

REQUEST

The undersigned requests that the present International application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No.
International Filing Date
Name of receiving Office and "PCT International Application"
Applicant's or agent's file reference (if desired) (12 characters maximum) CFLAY.00179P

Box No. I TITLE OF INVENTION Method for Reducing Acrylamide Formation In Thermally Processed Foods	
Box No. II APPLICANT ☐ This person is also inventor	
Name and address: (Family name followed by given names; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence (no State of residence is indicated below.) FRITO-LAY NORTH AMERICA, INC. t/k/a RECOT, INC. 7701 Legacy Drive Plano, TX 75288	Telephone No. Facsimile No. Teleprinter No. Applicant's registration No. with the Office
State (that is, country) of nationality: US	State (that is, country) of residence: US
This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box	
Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)	
Name and address: (Family name followed by given names; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence (no State of residence is indicated below.) ELDER, Vincent Allen 2903 Panorama Drive Carrollton, Texas 75007 US	This person is: ☐ applicant only ☒ applicant and inventor ☐ inventor only (if this check-box is marked, do not fill in below.) Applicant's registration No. with the Office
State (that is, country) of nationality: US	State (that is, country) of residence: US
This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box	
☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.	
Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE	
The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☐ agent ☐ common representative	
Name and address: (Family name followed by given names; for a legal entity, full official designation. The address must include postal code and name of country.) CAHOON, Colin P. Carstens, Yee & Cahoon, L.L.P. P.O. Box 802334 Dallas, TX 75380 US	Telephone No. 972-367-2001 Facsimile No. 972-367-2002 Teleprinter No. Agent's registration No. with the Office 38,838
☐ Address for correspondence: Mark this check-box when no agent or common representative has been appointed and the address above is used instead to indicate a special address to which correspondence should be sent.	

Continuation of Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S) <i>If none of the following sub-boxes is used, this sheet should not be included in the request.</i>	
Name and address: <i>(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this box is the applicant's State (that is, country) of residence (for State of residence is indicated below.)</i> FULCHER, John Gregory 9930 Ontario Lane Dallas, Texas 75220 US	This person is: ☐ applicant only ☒ applicant and inventor ☐ inventor only <i>(If this check-box is marked, do not fill in below.)</i> Applicant's registration No. with the Office
State (that is, country) of nationality: US	State (that is, country) of residence: US
This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box	
Name and address: <i>(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this box is the applicant's State (that is, country) of residence (for State of residence is indicated below.)</i> LEUNG, Henry Kin-Hang 3704 Ellington Drive Plano, Texas 75093 US	This person is: ☐ applicant only ☒ applicant and inventor ☐ inventor only <i>(If this check-box is marked, do not fill in below.)</i> Applicant's registration No. with the Office
State (that is, country) of nationality: US	State (that is, country) of residence: US
This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box	
Name and address: <i>(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this box is the applicant's State (that is, country) of residence (for State of residence is indicated below.)</i> TOPOR, Michael Grant 2312 Evergreen Carrollton, Texas 75006 US	This person is: ☐ applicant only ☒ applicant and inventor ☐ inventor only <i>(If this check-box is marked, do not fill in below.)</i> Applicant's registration No. with the Office
State (that is, country) of nationality: US	State (that is, country) of residence: US
This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box	
Name and address: <i>(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this box is the applicant's State (that is, country) of residence (for State of residence is indicated below.)</i> 	This person is: ☐ applicant only ☐ applicant and inventor ☐ inventor only <i>(If this check-box is marked, do not fill in below.)</i> Applicant's registration No. with the Office
State (that is, country) of nationality:	State (that is, country) of residence:
This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box	
☐ Further applicants and/or (further) inventors are indicated on another continuation sheet.	

Box No. V

DESIGNATIONS

The filing of this request constitutes under Rule 4.9(a), the designation of all Contracting States bound by the PCT on the international filing date, for the grant of every kind of protection available and, where applicable, for the grant of both regional and national patents.

However,

☐

DE Germany is not designated for any kind of national protection

☐

KR Republic of Korea is not designated for any kind of national protection

☐

KU Russian Federation is not designated for any kind of national protection

(The check-boxes above may be used to exclude (irrevocably) the designations concerned in order to avoid the ceasing of the effect, under the national law, of an earlier national application from which priority is claimed. See the Notes to Box No. V as to the consequences of such national law provisions in those and certain other States.)

Box No. VI

PRIORITY CLAIM

The priority of the following earlier application(s) is hereby claimed:

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is:		
		national application: country or Member of WTO	regional application: regional Office	international application: receiving Office
Item (1) 21.02.2003 (21 Feb. 2003)	10/372,154	US		
Item (2)				
Item (3)				

☐

Further priority claims are indicated in the Supplemental Box.

The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) (only if the earlier application was filed with the Office which for the purposes of this international application is the receiving Office) identified above as:

☐

all items

☒

Item (1)

☐

Item (2)

☐

Item (3)

☐

other, see Supplemental Box

* Where the earlier application is an ARIPO application, indicate at least one country party to the Paris Convention for the Protection of Industrial Property or one Member of the World Trade Organization for which that earlier application was filed (Rule 4.10(b)(ii)):

Box No. VII

INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) (If two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):

ISA / .ROUS.....

Request to use results of earlier search; reference to that search (If an earlier search has been carried out by or requested from the International Searching Authority):

Date (day/month/year)	Number	Country (or regional Office)
-----------------------	--------	------------------------------

Box No. VIII

DECLARATIONS

The following declarations are contained in Boxes Nos. VIII (i) to (v) (mark the applicable check-boxes below and indicate in the right column the number of each type of declaration):

		Number of declarations
☐	Box No. VIII (i) Declaration as to the identity of the inventor	:
☒	Box No. VIII (ii) Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent	: 1
☐	Box No. VIII (iii) Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application	:
☒	Box No. VIII (iv) Declaration of inventorship (only for the purposes of the designation of the United States of America)	: 1
☐	Box No. VIII (v) Declaration as to non-prejudicial disclosures or exceptions to lack of novelty	:

Box No. VIII (B) DECLARATION: ENTITLEMENT TO APPLY FOR AND BE GRANTED A PATENT
The declaration must conform to the standardized wording provided for in Section 212; see Notes to Boxes Nos. VIII, VIII (1) to (4) (in general) and the specific Notes to Box No. VIII (B). If this Box is not used, this sheet should not be included in the request.

Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent (Rules 4.17(I) and 51bis.1(a)(ii)), in a case where the declaration under Rule 4.17(iv) is not appropriate:

FRITO-LAY NORTH AMERICA, INC. is entitled to apply for and be granted a patent by the virtue of the following:

an assignment from

RECOT, Inc., to **FRITO-LAY NORTH AMERICA, INC.**, and recorded on February 2, 2004, at Reel/Frame 014282/0815,

and an assignment from

Vincent Allen Elder, John Gregory Fulcher, Henry Kin-Hang Leung, and Michael Grant Topor, to **RECOT, INC.**, and recorded on May 19, 2003, at Reel/Frame 014085/0346.

This declaration is made for the purposes of all designations, except for the designation of the United States of America.

☐ This declaration is continued on the following sheet, "Continuation of Box No. VIII (B)".

Box No. VIII (iv) DECLARATION: INVENTORSHIP (only for the purposes of the designation of the United States of America)
The declaration must conform to the following standardized wording provided for in Section 214; see Notes to Boxes Nos. VII, VIII (i) to (iv) (in general) and the specific Notes to Box No. VIII (iv). If this Box is not used, this sheet should not be included in the request.

**Declaration of Inventorship (Rules 4.17(iv) and 51bis.1(a)(iv))
for the purposes of the designation of the United States of America:**

I hereby declare that I believe I am the original, first and sole (if only one inventor is listed below) or joint (if more than one inventor is listed below) inventor of the subject matter which is claimed and for which a patent is sought.

This declaration is directed to the international application of which it forms a part (if filing declaration with application).

This declaration is directed to international application No. PCT/..... (if furnishing declaration pursuant to Rule 26ter).

I hereby declare that my residence, mailing address, and citizenship are as stated next to my name.

I hereby state that I have reviewed and understand the contents of the above-identified international application, including the claims of said application. I have identified in the request of said application, in compliance with PCT Rule 4.10, any claim to foreign priority, and I have identified below, under the heading "Prior Applications," by application number, country or Member of the World Trade Organization, day, month and year of filing, any application for a patent or inventor's certificate filed in a country other than the United States of America, including any PCT international application designating at least one country other than the United States of America, having a filing date before that of the application on which foreign priority is claimed.

Prior Applications: U.S. Serial No. 10372,154 filed on February 21, 2003

I hereby acknowledge the duty to disclose information that is known by me to be material to patentability as defined by 37 C.F.R. § 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the PCT international filing date of the continuation-in-part application.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like as made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name: ELDER, Vincent Allen

Residence: Carrollton, TX, US
(city and either US state, if applicable, or country)

Mailing Address: 2903 Panorama Drive, Carrollton, TX 75007, US

Citizenship: US

Inventor's Signature: Vincent A. Elder
(if not contained in the request, or if declaration is corrected or added under Rule 26ter after the filing of the international application. The signature must be that of the inventor, not that of the agent)

Date: February 6, 2004
(of signature which is not contained in the request, or of the declaration that is corrected or added under Rule 26ter after the filing of the international application)

Name: FULCHER, John Gregory

Residence: Dallas, TX, US
(city and either US state, if applicable, or country)

Mailing Address: 9930 Ontario Lane, Dallas, TX 75220, US

Citizenship: US

Inventor's Signature: John G. Fulcher
(if not contained in the request, or if declaration is corrected or added under Rule 26ter after the filing of the international application. The signature must be that of the inventor, not that of the agent)

Date: February 7, 2004
(of signature which is not contained in the request, or of the declaration that is corrected or added under Rule 26ter after the filing of the international application)

☒ This declaration is continued on the following sheet, "Continuation of Box No. VIII (iv)".

Continuation of Box No. VIII (i) to (v) DECLARATION

If the space is insufficient in any of Boxes Nos. VIII (i) to (v) to furnish all the information, including in the case where more than two inventors are to be named in Box No. VIII (iv), in such case, write "Continuation of Box No. VIII ..." (indicate the item number of the Box) and furnish the information in the same manner as required for the purposes of the Box in which the space was insufficient. If additional space is needed in respect of two or more declarations, a separate continuation box must be used for each such declaration. If this Box is not used, this sheet should not be included in the request.

Continuation of Box No. VIII(iv), DECLARATION: INVENTORSHIP

Name: LEUNG, Henry Kin-Hang

Residence: Plano, TX, US

Mailing Address: 3704 Ellington Drive, Plano, TX 75093, US

Citizenship: US

XX Inventor's Signature: Henry Leung Date: February 2, 2004

Name: TOPOR, Michael Grant

Residence: Carrollton, TX, US

Mailing Address: 2312 Evergreen, Carrollton, TX 75006, US

Citizenship: US

XX Inventor's Signature: Michael Topor Date: February 5, 2004

Box No. IX CHECK LIST: LANGUAGE OF FILING	
This international application contains: (a) in paper form, the following number of sheets: request (including declaration sheets) : 7 description (excluding sequence listing and/or tables related thereto) : 17 claims : 4 abstract : 1 drawings : 1 Sub-total number of sheets : 30 sequence listing : tables related thereto : <i>(for both, actual number of sheets if filed in paper form, whether or not also filed in computer readable form; see (c) below)</i> Total number of sheets : 30 (b) ☐ only in computer readable form (Section 801(a)(i)) (i) ☐ sequence listing (ii) ☐ tables related thereto (c) ☐ also in computer readable form (Section 801(a)(ii)) (i) ☐ sequence listing (ii) ☐ tables related thereto Type and number of carriers (diskette, CD-ROM, CD-R or other) on which are contained the: ☐ sequence listing: ☐ tables related thereto: <i>(additional copies to be indicated under items 9(ii) and/or 10(ii), in right column)</i>	This international application is accompanied by the following item(s) (mark the applicable check-boxes below and indicate in right column the number of each item): 1. ☒ fee calculation sheet : 1 2. ☒ original separate power of attorney : 1 3. ☐ original general power of attorney : 4. ☐ copy of general power of attorney; reference number, if any: : 5. ☐ statement explaining lack of signature : 6. ☐ priority document(s) identified in Box No. VI as item(s): : 7. ☐ translation of international application into (language): : 8. ☐ separate indications concerning deposited microorganism or other biological material : 9. ☐ sequence listing in computer readable form (indicate type and number of carriers) (i) ☐ copy submitted for the purposes of international search under Rule 134a only (and not as part of the international application) : (ii) ☐ (only where check-box (b)(i) or (c)(i) is marked in left column) additional copies including, where applicable, the copy for the purposes of international search under Rule 134a : (iii) ☐ together with relevant statement as to the identity of the copy or copies with the sequence listing mentioned in left column : 10. ☐ tables in computer readable form related to sequence listing (indicate type and number of carriers) (i) ☐ copy submitted for the purposes of international search under Section 802(b-quater) only (and not as part of the international application) : (ii) ☐ (only where check-box (b)(i) or (c)(i) is marked in left column) additional copies including, where applicable, the copy for the purposes of international search under Section 802(b-quater) : (iii) ☐ together with relevant statement as to the identity of the copy or copies with the tables mentioned in left column : 11. ☒ other (specify): Check in the Amount of \$1,655.00; and Postcard Receipt : Figure of the drawings which should accompany the abstract: Language of filing of the international application:
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FEE CALCULATION SHEET

Annex to the Request

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International Application No.

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CFLAY.00179P

Date stamp of the receiving Office

Applicant

FRITO-LAY NORTH AMERICA, INC.

CALCULATION OF PRESCRIBED FEES

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POWER OF ATTORNEY

(for an international application filed under the Patent Cooperation Treaty)

(PCT Rule 90.4)

The undersigned applicant(s) (Names should be indicated as they appear in the request):

FRITO-LAY NORTH AMERICA, INC.
 f/k/a RECOT, Inc.
 7701 Legacy Drive
 Plano, TX 75288
 US

hereby appoints (appoint) the following person as:



agent



common representative

Name and address

(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

Colin P. Cahoon, Esq.
 Carstana, Yee & Cahoon, L.L.P.
 P.O. Box 802334
 Dallas, TX 75380
 972-367-2001
 972-367-2002 Fax
 Registration No. 38,836

to represent the undersigned before



all the competent International Authorities



the International Searching Authority only



the International Preliminary Examining Authority only

in connection with the international application identified below:

Title of the invention: Method for Reducing Acrylamide Formation in Thermally Processed Foods

Applicant's or agent's file reference: CFLAY.00176P

International application number (if already available):

filed with the following Office RO/US

as receiving Office

and to make or receive payments on behalf of the undersigned.

Signature of the applicant(s) (where there are several applicants, each of them must sign; next to each signature, indicate the name of the person signing and the capacity in which the person signs, if such capacity is not obvious from reading the request or this power).



Thomas P. Schur, Assistant Secretary of
 Frito-Lay North America, Inc.
 f/k/a RECOT, Inc.

Date: February 2, 2004

**METHOD FOR REDUCING ACRYLAMIDE FORMATION
IN THERMALLY PROCESSED FOODS**

BACKGROUND OF THE INVENTION

Cross-Reference to Related Applications

This application is a continuation-in-part of co-pending U.S. Patent Application

5 10/247,504, filed September 19, 2002.

Technical Field

The present invention relates to a method for reducing the amount of acrylamide in thermally processed foods. This invention permits the production of foods having significantly reduced levels of acrylamide. The method relies on the addition of a divalent or
10 trivalent cation, such as are found in the salts of calcium, magnesium, copper, iron, zinc, or aluminum to the dough formulation of a food.

Description of Related Art

The chemical acrylamide has long been used in its polymer form in industrial applications for water treatment, enhanced oil recovery, papermaking, flocculants, thickeners,
15 ore processing and permanent press fabrics. Acrylamide participates as a white crystalline solid, is odorless, and is highly soluble in water (2155 g/L at 30°C). Synonyms for acrylamide include 2-propenamide, ethylene carboxamide, acrylic acid amide, vinyl amide, and propenoic acid amide. Acrylamide has a molecular mass of 71.08, a melting point of 84.5°C, and a boiling point of 125°C at 25 mmHg.

20 In very recent times, a wide variety of foods have tested positive for the presence of acrylamide monomer. Acrylamide has especially been found primarily in carbohydrate food products that have been heated or processed at high temperatures. Examples of foods that have tested positive for acrylamide include coffee, cereals, cookies, potato chips, crackers,

french-fried potatoes, breads and rolls, and fried breaded meats. In general, relatively low contents of acrylamide have been found in heated protein-rich foods, while relatively high contents of acrylamide have been found in carbohydrate-rich foods, compared to non-detectable levels in unheated and boiled foods. Reported levels of acrylamide found in various similarly processed foods include a range of 330 - 2,300 ($\mu\text{g/kg}$) in potato chips, a range of 300 - 1100 ($\mu\text{g/kg}$) in french fries, a range 120 - 180 ($\mu\text{g/kg}$) in corn chips, and levels ranging from not detectable up to 1400 ($\mu\text{g/kg}$) in various breakfast cereals.

It is presently believed that acrylamide is formed from the presence of amino acids and reducing sugars. For example, it is believed that a reaction between free asparagine, an amino acid commonly found in raw vegetables, and free reducing sugars accounts for the majority of acrylamide found in fried food products. Asparagine accounts for approximately 40% of the total free amino acids found in raw potatoes, approximately 18% of the total free amino acids found in high protein rye, and approximately 14% of the total free amino acids found in wheat.

The formation of acrylamide from amino acids other than asparagine is possible, but it has not yet been confirmed to any degree of certainty. For example, some acrylamide formation has been reported from testing glutamine, methionine, cysteine, and aspartic acid as precursors. These findings are difficult to confirm, however, due to potential asparagine impurities in stock amino acids. Nonetheless, asparagine has been identified as the amino acid precursor most responsible for the formation of acrylamide.

Since acrylamide in foods is a recently discovered phenomenon, its exact mechanism of formation has not been confirmed. However, it is now believed that the most likely route for acrylamide formation involves a Maillard reaction. The Maillard reaction has long been recognized in food chemistry as one of the most important chemical reactions in food processing and can affect flavor, color, and the nutritional value of the food. The Maillard

reaction requires heat, moisture, reducing sugars, and amino acids.

The Maillard reaction involves a series of complex reactions with numerous intermediates, but can be generally described as involving three steps. The first step of the Maillard reaction involves the combination of a free amino group (from free amino acids and/or proteins) with a reducing sugar (such as glucose) to form Amadori or Heyns rearrangement products. The second step involves degradation of the Amadori or Heyns rearrangement products via different alternative routes involving deoxyosones, fission, or Strecker degradation. A complex series of reactions - including dehydration, elimination, cyclization, fission, and fragmentation - results in a pool of flavor intermediates and flavor compounds. The third step of the Maillard reaction is characterized by the formation of brown nitrogenous polymers and co-polymers. Using the Maillard reaction as the likely route for the formation of acrylamide, Figure 1 illustrates a simplification of suspected pathways for the formation of acrylamide starting with asparagine and glucose.

Acrylamide has not been determined to be detrimental to humans, but its presence in food products, especially at elevated levels, is undesirable. As noted previously, relatively higher concentrations of acrylamide are found in food products that have been heated or thermally processed. The reduction of acrylamide in such food products could be accomplished by reducing or eliminating the precursor compounds that form acrylamide, inhibiting the formation of acrylamide during the processing of the food, breaking down or reacting the acrylamide monomer once formed in the food, or removing acrylamide from the product prior to consumption. Understandably, each food product presents unique challenges for accomplishing any of the above options. For example, foods that are sliced and cooked as coherent pieces may not be readily mixed with various additives without physically destroying the cell structures that give the food products their unique characteristics upon cooking. Other processing requirements for specific food products may likewise make

acrylamide reduction strategies incompatible or extremely difficult.

By way of an example of heated food products that represent unique challenges to reducing acrylamide levels in the final products, snacks can be fabricated from a dough. The term "fabricated snack" means a snack food that uses as its starting ingredient something other than the original and unaltered starchy starting material. For example, fabricated snacks include fabricated potato chips that use a dehydrated potato product as a starting material and corn chips that use a masa flour as its starting material. It is noted here that the dehydrated potato product can be potato flour, potato flakes, potato granules, or any other form in which dehydrated potatoes exist. When any of these terms are used in this application, it is understood that all of these variations are included. Fabricated potato chips start with, for example, potato flakes, which are mixed with water and other minor ingredients to form a dough. This dough is then sheeted and cut before proceeding to a cooking step. The cooking step may involve frying or baking. The chips then proceed to a seasoning step and a packaging step. The mixing of the potato dough generally lends itself to the easy addition of other ingredients. Conversely, the addition of such ingredients to a raw food product, such as potato slices, requires that a mechanism be found to allow for the penetration of ingredients into the cellular structure of the product. However, the addition of any ingredients in the mixing step must be done with the consideration that the ingredients may adversely affect the sheeting characteristics of the dough as well as the final chip characteristics, such as flavor, texture, and color.

It would be desirable to develop one or more methods of reducing the level of acrylamide in the end product of heated or thermally processed foods. Ideally, such a process should substantially reduce or eliminate the acrylamide in the end product without adversely affecting the quality and characteristics of the end product. Further, the method should be easy to implement and, preferably, add little or no cost to the overall process.

SUMMARY OF THE INVENTION

In the inventive process, a divalent or trivalent cation or combination of such cations is added to fabricated foods prior to cooking to reduce the formation of acrylamide. The divalent or trivalent cation can be added during milling, dry mix, wet mix, or other admix, so
5 that the cation is present throughout the food product. In preferred embodiments, the added cation can be chosen from the group of calcium, magnesium, and aluminum salts, and less favorably, iron, zinc, and copper salts. The cation is added to the dough in an amount sufficient to reduce the acrylamide formation in the finished product to a desired level.

The addition of divalent or trivalent cations effectively reduces the amount of
10 acrylamide found in the end product of the heated or thermally processed food while minimally affecting the quality and characteristics of the end product. Further, such a method of acrylamide reduction is generally easy to implement and adds little or no cost to the overall process.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will be best understood by reference to the following
5 detailed description of illustrative embodiments when read in conjunction with the accompanying drawings, wherein:

Figure 1 is a schematic of suspected chemical pathways for acrylamide formation in foods; and

Figure 2 is a schematic of a method for making fabricated potato chips from potato
10 flakes, granules, or flour according to an embodiment of the present invention.

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DETAILED DESCRIPTION

The formation of acrylamide in thermally processed foods requires a source of carbon and a source of nitrogen. It is hypothesized that carbon is provided by a carbohydrate source and nitrogen is provided by a protein source or amino acid source. Many plant-derived food ingredients such as rice, wheat, corn, barley, soy, potato and oats contain asparagine and are primarily carbohydrates having minor amino acid components. Typically, such food ingredients have a small amino acid pool, which contains other amino acids in addition to asparagine.

By "thermally processed" is meant food or food ingredients wherein components of the food, such as a mixture of food ingredients, are heated at temperatures of at least 80°C. Preferably the thermal processing of the food or food ingredients takes place at temperatures between about 100°C and 205°C. The food ingredient may be separately processed at elevated temperature prior to the formation of the final food product. An example of a thermally processed food ingredient is potato flakes, which is formed from raw potatoes in a process that exposes the potato to temperatures as high as 170°C. (The terms "potato flakes", "potato granules", and "potato flour" are used interchangeably herein, and are meant to denote any potato based, dehydrated product.) Examples of other thermally processed food ingredients include processed oats, par-boiled and dried rice, cooked soy products, corn masa, roasted coffee beans and roasted cacao beans. Alternatively, raw food ingredients can be used in the preparation of the final food product wherein the production of the final food product includes a thermal heating step. One example of raw material processing wherein the final food product results from a thermal heating step is the manufacture of potato chips from raw potato slices by the step of frying at a temperature of from about 100°C to about 205°C or the production of french fries fried at similar temperatures.

In accordance with the present invention, however, a significant formation of

acrylamide has been found to occur when the amino acid asparagine is heated in the presence of a reducing sugar. Heating other amino acids such as lysine and alanine in the presence of a reducing sugar such as glucose does not lead to the formation of acrylamide. Surprisingly, the addition of other amino acids to the asparagine sugar mixture can increase or decrease the amount of acrylamide formed.

Having established the rapid formation of acrylamide when asparagine is heated in the presence of a reducing sugar, a reduction of acrylamide in thermally processed foods can be achieved by inactivating the asparagine. By "inactivating" is meant removing asparagine from the food or rendering asparagine non-reactive along the acrylamide formation route by means of conversion or binding to another chemical that interferes with the formation of acrylamide from asparagine.

In the present invention, this is accomplished by the addition of a divalent or trivalent cation to a formula for a snack food prior to the cooking or thermal processing of that snack food. Chemists will understand that cations do not exist in isolation, but are found in the presence of an anion having the same valence. Although reference is made herein to the salt containing the divalent or trivalent cation, it is the cation present in the salt that is believed to provide a reduction in acrylamide formation by reducing the solubility of asparagine in water. These cations are also referred to herein as a cation with a valence of at least two.

Interestingly, cations of a single valence are not effective in use with the present invention. In choosing an appropriate compound containing the cation having a valence of at least two in combination with an anion, the relevant factors are water solubility, food safety, and least alteration to the characteristics of the particular food. Combinations of various salts can be used, even though they are discussed herein only as individuals salts.

Chemists speak of the valence of an atom as a measure of its ability to combine with other elements. Specifically, a divalent atom has the ability to form two ionic bonds with

other atoms, while a trivalent atom can form three ionic bonds with other atoms. A cation is a positively charged ion, that is, an atom that has lost one or more electrons, giving it a positive charge. A divalent or trivalent cation, then, is a positively charged ion that has availability for two or three ionic bonds, respectively.

5 Simple model systems can be used to test the effects of divalent or trivalent cations on acrylamide formation. Heating asparagine and glucose in 1:1 mole proportions can generate acrylamide. Quantitative comparisons of acrylamide content with and without an added salt measures the ability of the salt to promote or inhibit acrylamide formation. Two sample preparation and heating methods were used. One method involved mixing the dry
10 components, adding an equal amount of water, and heating in a loosely capped vial. Reagents concentrated during heating as most of the water escaped, duplicating cooking conditions. Thick syrups or tars can be produced, complicating recovery of acrylamide. These tests are shown in Examples 1 and 2 below.

A second method using pressure vessels allowed more controlled experiments.

15 Solutions of the test components were combined and heated under pressure. The test components can be added at the concentrations found in foods, and buffers can duplicate the pH of common foods. In these tests, no water escapes, simplifying recovery of acrylamide, as shown in Example 3 below.

Example 1

20 A 20 mL (milliliter) glass vial containing L-asparagine monohydrate (0.15 g, 1 mmole), glucose (0.2 g, 1 mmole) and water (0.4 mL) was covered with aluminum foil and heated in a gas chromatography (GC) oven programmed to heat from 40° to 220°C at 20°/minute, hold two minutes at 220°C, and cool from 220° to 40°C at 20°/min. The residue was extracted with water and analyzed for acrylamide using gas chromatography-mass
25 spectroscopy (GC-MS). Analysis found approximately 10,000 ppb (parts/billion) acrylamide.

Two additional vials containing L-asparagine monohydrate (0.13 g, 1 mmole), glucose (0.2 g, 1 mmole), anhydrous calcium chloride (0.1 g, 1 mmole) and water (0.4 mL) were heated and analyzed. Analysis found 7 and 30 ppb acrylamide, a greater than ninety-nine percent reduction.

Given the surprising result that calcium salts strongly reduced acrylamide formation, further screening of salts identified divalent and trivalent cations (magnesium, aluminum) as producing a similar effect. It is noted that similar experiments with monovalent cations, i.e. 0.1/0.2 g sodium bicarbonate and ammonium carbonate (as ammonium carbamate and ammonium bicarbonate) increased acrylamide formation, as seen in Table 1 below.

Salt	Micro Mole Salt	Micromole Acrylamide after heating, ppb
None (control)	0	9857
Sodium bicarbonate	1200	13419
Ammonium carbonate	1250	22027
Ammonium carbonate	2500	47897

Table 1

Example 2

In a second experiment, a similar test to that described above was performed, but instead of using anhydrous calcium chloride, two different dilutions of each of calcium chloride and magnesium chloride were used. Vials containing L-asparagine monohydrate (0.15 g, 1 mmole) and glucose (0.2 g, 1 mmole) were mixed with one of the following:

- 0.5 mL water (control),
- 0.5 mL 10% calcium chloride solution (0.5 mmole),
- 0.05 mL 10% calcium chloride solution (0.05 mmole) plus 0.45 mL water,
- 0.5 mL 10% magnesium chloride solution (0.5 mmole), or
- 0.05 mL 10% magnesium chloride solution (0.05 mmole) plus 0.45 mL water.

Duplicate samples were heated and analyzed as described in Example 1. Results were averaged and summarized in Table 2 below:

Salt ID	Amt added Micromoles	Acrylamide formed Micromoles	Acrylamide reduction
None (control)	0	408	0
Calcium chloride	450	293	27%
Calcium chloride	45	864	None
Magnesium chloride	495	191	53%
Magnesium chloride	50	2225	None

Table 2

5 Example 3

As mentioned above, this test did not involve the loss of water from the container, but was done under pressure. Vials containing 2 mL of buffered stock solution (15 mM asparagine, 15 mM glucose, 500 mM phosphate or acetate) and 0.1 mL salt solution (1000 mM) were heated in a Parr bomb placed in a GC oven programmed to heat from 40 to 150°C at 20°/min and hold at 150°C for 2 minutes. The bomb was removed from the oven and cooled for 10 minutes. The contents were extracted with water and analyzed for acrylamide following the GC-MS method. For each combination of pH and buffer, a control was run without an added salt, as well as with the three different salts. Results of duplicate tests were averaged and summarized in Table 3 below:

Salt	pH	Buffer	Mcg Acrylamide Salt added	Mcg Acrylamide Control	Acrylamide Reduction
Calcium chloride	5.5	Acetate	337	550	19%
Calcium chloride	7.0	Acetate	990	1205	18%
Calcium chloride	5.5	Phosphate	154	300	49%
Calcium chloride	7.0	Phosphate	762	855	11%
Magnesium chloride	5.5	Acetate	380	550	16%
Magnesium chloride	7.0	Acetate	830	1205	31%
Magnesium chloride	5.5	Phosphate	198	300	34%

Magnesium chloride	7.0	Phosphate	773	855	10%
Potassium aluminum sulfate	5.5	Acetate	205	550	31%
Potassium aluminum sulfate	7.0	Acetate	453	1205	62%
Potassium aluminum sulfate	5.5	Phosphate	64	300	79%
Potassium aluminum sulfate	7.0	Phosphate	787	855	8%

Table 3

Across the three salts used, the greatest reductions occurred in pH 7 acetate and pH 5.5 phosphate. Only small reductions were found in pH 5.5 acetate and pH 7 phosphate.

Example 4

5 Following the model systems results, a small-scale laboratory test was run in which calcium chloride was added to potato flakes before heating. Three ml of a 0.4%, 2%, or 10% calcium chloride solution was added to 3 g of potato flakes. The control was 3 g of potato flakes mixed with 3 ml of de-ionized water. The flakes were mixed to form a relatively uniform paste and then heated in a sealed glass vial at 120° C for 40 min. Acrylamide after heating was measured by GC-MS. Before heating, the control potato flakes contained 46 ppb of acrylamide. Test results are reflected in Table 4 below.

Mixture ID	Acrylamide, ppb	Acrylamide Reduction
Control (water)	2604	None
CaCl ₂ 0.4% solution	1877	28%
CaCl ₂ 2% solution	338	76%
CaCl ₂ 10% solution	86	97%

Table 4

15 Given the results from above, tests were conducted in which a calcium salt was added to the formula for a fabricated snack food, in this case baked fabricated potato chips. The process for making baked fabricated potato chips consists of the steps shown in Figure 3. The dough preparation step 31 combines potato flakes with water, the cation/anion pair (which in this case is calcium chloride) and other minor ingredients, which are thoroughly mixed to form a dough. (Again, the term “potato flakes” is intended herein to encompass all

dried potato flake, granule, or powder preparations, regardless of particle size.) In the sheeting/cutting step 32, the dough is run through a sheeter, which flattens the dough, and then is cut into individual pieces. In the cooking step 33, the formed pieces are cooked to a specified color and water content. The resultant chips are then seasoned in seasoning step 34 and packaged in packaging step 35.

A first embodiment of the invention is demonstrated using the baked, fabricated potato chip process described above. To illustrate this embodiment, a comparison is made between a control and a test batch using a commercial baked, fabricated potato chip dough formulation and processes. Both test and control batches were made according to the formulations listed in Table 5. The only difference between the batches was that the test batch contained calcium chloride.

Ingredient	Control	CaCl ₂ Test
Potato flakes and modified starch	5496 g	5496 g
Sugar	300 g	300 g
Oil	90 g	90 g
Leavening agents	54 g	54 g
Emulsifier	60 g	60 g
Calcium Chloride (dissolved in water)	0 g	39 g
Total Dry Mix	6000 g	6039 g
Water	3947 ml	3947 ml

Table 5

In all batches, the dry ingredients were first mixed together, then oil was added to each dry blend and mixed. The calcium chloride was dissolved in the water prior to adding to the dough. The moisture level of the dough prior to sheeting was 40% to 45% by weight. The dough was sheeted to produce a thickness of between 0.020 and 0.030 inches, cut into chip-sized pieces, and baked.

After cooking, testing was performed for moisture, oil, and color according to the Hunter L-a-b scale. Samples were tested to obtain acrylamide levels in the finished product. Table 6 below shows the results of these analyses.

		Control	CaCl ₂ Test
H ₂ O, %		2.21	2.58
Oil, %		1.99	2.08
Acrylamide, ppb		1030	160
Color	L	72.34	76.67
	A	1.99	-.67
	B	20.31	24.21

Table 6

As these results show, the addition of calcium chloride to the dough in a ratio by weight of calcium chloride to potato flakes of roughly 1:125 significantly lowers the level of acrylamide present in the finished product, lowering the final acrylamide levels from 1030 ppb to 160 ppb. Additionally, the percentages of oil and water in the final product do not appear to have been affected by the addition of calcium chloride. It is noted, however, that CaCl₂ can cause changes in the taste, texture, and color of the product, depending on the amount used.

The level of divalent or trivalent cation that is added to a food for the reduction of acrylamide can be expressed in a number of ways. In order to be commercially acceptable, the amount of cation added should be enough to reduce the final level of acrylamide production by at least twenty percent (20%). More preferably, the level of acrylamide production should be reduced by an amount in the range of thirty-five to ninety-five percent (35-95%). Even more preferably, the level of acrylamide production should be reduced by an amount in the range of fifty to ninety-five percent (50-95%). To express this in a different manner, the amount of divalent or trivalent cation to be added can be given as a ratio between the moles of cation to the moles of free asparagine present in the food product. The ratio of the moles of divalent or trivalent cation to moles of free asparagine should be at least one to five (1:5). More preferably, the ratio is at least one to three (1:3), and more preferably still, one to two (1:2). In the presently preferred embodiment, the ratio of moles of cations to

moles of asparagine is between about 1:2 and 1:1. In the case of magnesium, which has less effect on the product taste than calcium, the molar ratio of cation to asparagine can be as high as about two to one (2:1).

Additional tests were run, using the same procedure as described above, but with different lots of potato flakes containing different levels of reducing sugars and varying amounts of calcium chloride added. In Table 7 below, lot 1 of potato flakes, which was the test shown above, had 0.81% reducing sugars, lot 2 had 1.0 % and lot 3 had 1.8% reducing sugars.

Added CaCl ₂	Flake Lot	Finished moisture weight %	Finished Color L Value	Finished Acrylamide ppb
0 g	1	2.21	72.34	1030
39 g	1	2.58	76.67	160
0 g	2	1.80	73.35	464
0 g	2	1.61	72.12	1060
17.5 g	2	1.82	74.63	350
39 g	2	2.05	76.95	80
39 g	2	1.98	75.86	192
0 g	3	1.99	71.37	1020
0 g	3	1.71	72.68	599
0 g	3	1.69	71.26	1640
0 g	3	1.63	74.44	1880
39 g	3	1.89	76.59	148
39 g	3	1.82	75.14	275

Table 7

As seen in this table, the addition of CaCl₂ consistently reduces the level of acrylamide in the final product, even when the weight ratio of added CaCl₂ to potato flakes is lower than 1:250.

Any number of salts that form a divalent or trivalent cation (or said another way, produce a cation with a valence of at least two) can be used with the invention disclosed herein, as long as adjustments are made for the collateral effects of this additional ingredient. The effect of lowering the acrylamide level appears to derive from the divalent or trivalent cation, rather than from the anion that is paired with it. Limitations to the cation/anion pair,

other than valence, are related to their acceptability in foods, such as safety, solubility, and their effect on taste, odor, appearance, and texture. Suggested cations include calcium, magnesium, aluminum, iron, copper, and zinc. Suitable salts of these cations include calcium chloride, calcium citrate, calcium lactate, calcium malate, calcium gluconate, calcium phosphate, calcium acetate, calcium sodium EDTA, calcium glycerophosphate, calcium hydroxide, calcium lactobionate, calcium oxide, calcium propionate, calcium carbonate, calcium stearoyl lactate, magnesium chloride, magnesium citrate, magnesium lactate, magnesium malate, magnesium gluconate, magnesium phosphate, magnesium hydroxide, magnesium carbonate, magnesium sulfate, aluminum chloride hexahydrate, aluminum chloride, aluminum hydroxide, ammonium alum, potassium alum, sodium alum, aluminum sulfate, ferric chloride, ferrous gluconate, ferric ammonium citrate, ferric pyrophosphate, ferrous fumarate, ferrous lactate, ferrous sulfate, cupric chloride, cupric gluconate, cupric sulfate, zinc gluconate, zinc oxide, and zinc sulfate. The presently preferred embodiment of this invention uses calcium chloride, although it is believed that the requirements may be best met by a combination of salts of one or more of the appropriate cations. A number of the salts, such as calcium salts, and in particular calcium chloride, are relatively inexpensive and commonly used as food. Calcium chloride can be used in combination with calcium citrate, thereby reducing the collateral taste effects of CaCl_2 . Further, any number of calcium salts can be used in combination with one or more magnesium salts. One skilled in the art will understand that the specific formulation of salts required can be adjusted depending on the food product in question and the desired end-product characteristics.

It should be understood that changes in the characteristics of the final product, such as changes in color, taste, and consistency can be adjusted by various means. For example, color characteristics in potato chips can be adjusted by controlling the amount of sugars in the starting product. Some flavor characteristics can be changed by the addition of various

flavoring agents to the end product. The physical texture of the product can be adjusted by, for example, the addition of leavening agents or various emulsifiers.

While the invention has been particularly shown and described with reference to one or more embodiments, it will be understood by those skilled in the art that various approaches to the reduction of acrylamide in thermally processed foods may be made without departing from the spirit and scope of this invention. For example, while the process has been disclosed herein with regard to potato products, the process can also be used in processing of food products made from corn, barley, wheat, rye, rice, oats, millet, and other starch-based grains. In addition to fabricated potato chips, the invention can be used in making corn chips and other types of snack chips, as well as in cereals, cookies, crackers, hard pretzels, breads and rolls, the breading for breaded meats, and other foods containing asparagine and a reducing sugar. In each of these foods, the cation can be added during the mixing of the dough used to make the product, so that the added cation is available during cooking to provide a reduction in the level of acrylamide. Further, the addition of a divalent or trivalent cation can be combined with other strategies for the reduction of acrylamide to produce an acceptable acrylamide level without adversely affecting the taste, color, odor, or other characteristics of an individual food.

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CLAIMS:

What is claimed is:

1. A method of lowering the level of acrylamide produced by the thermal processing of a potato chip manufactured from a dough comprising a starch-based material having free asparagine, said method comprising the steps of:

- 5 a) adding a cation, having a valence of at least two, to said dough; and
 b) thermally processing said dough to produce a potato chip;

 wherein said cation is added in an amount sufficient to reduce the final level of acrylamide in said potato chip to a level that is lower than if the cation had not been added at step a).

2. The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said potato chip by at least 20 percent.

3. The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said potato chip by at least 35 percent.

4. The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said potato chip by about 50 percent.

5. The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said potato chip by a range of 50 to 95 percent.

6. The method of Claim 1, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of at least 1:5.
7. The method of Claim 1, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of at least 1:3.
8. The method of Claim 1, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of about 1:2.
9. The method of Claim 1, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of about 1:1.
10. The method of Claim 1, wherein said adding step a) adds a calcium ion to said dough, said calcium ion being part of a salt selected from the group of calcium chloride, calcium lactate, calcium citrate, calcium malate, calcium gluconate, calcium phosphate, calcium acetate, calcium sodium EDTA, calcium glycerophosphate, calcium hydroxide, calcium lactobionate, calcium oxide, calcium propionate, calcium carbonate, and calcium stearoyl lactate.
11. The method of Claim 1, wherein said adding step a) adds a magnesium ion to said dough, said magnesium ion being part of a salt selected from the group of magnesium chloride, magnesium citrate, magnesium lactate, magnesium malate, magnesium gluconate, magnesium phosphate, magnesium hydroxide, magnesium carbonate, and magnesium sulfate.
12. The method of Claim 1, wherein said adding step a) adds an aluminum ion to said dough, said ion being part of a salt selected from the group of aluminum chloride hexahydrate, aluminum chloride, aluminum hydroxide, ammonium alum, potassium alum, sodium alum, and aluminum sulfate.
13. The method of Claim 1, wherein said adding step a) adds an iron salt to said dough, said salt being selected from the group of ferric chloride, ferrous gluconate, ferric ammonium citrate, ferric pyrophosphate, ferrous fumarate, ferrous lactate, and ferrous sulfate.

14. The method of Claim 1, wherein said adding step a) adds a copper ion to said dough, said copper ion being part of a salt selected from the group of cupric chloride, cupric gluconate, and cupric sulfate.
15. The method of Claim 1, wherein said thermally processing step b) comprises frying said dough.
16. The method of Claim 1, wherein said thermally processing step b) comprises baking said dough.
17. The potato chip produced by the method of Claim 1.

18. A method of preparing fabricated potato chips, said method comprising the steps of:
- a) preparing a mixture comprising potato flakes, water, and an ingredient that produces a cation having a valence of at least two, said ingredient selected from the group of salts consisting of calcium salts, magnesium salts, aluminum salts, iron salts, and copper salts;
 - b) sheeting and cutting said mixture to form cut pieces; and
 - c) thermally processing said cut pieces, wherein said ingredient reduces the formation of acrylamide in said fabricated potato chips.
- 5
19. The method of Claim 18, wherein said thermal processing of step c) comprises baking.
20. The method of Claim 18, wherein said thermal processing of step c) comprises frying.
21. The method of Claim 18, wherein the formation of acrylamide in said fabricated potato chips is reduced by at least 50 percent over fabricated potato chips prepared without said cation.
22. A fabricated potato chip produced by the method of Claim 18.

23. A method of lowering the level of acrylamide produced by the thermal processing of a chip manufactured from a dough comprising a corn-based material having free asparagine, said method comprising the steps of:

- 5 a) adding a cation, having a valence of at least two, to said dough; and
 b) thermally processing said dough to produce a chip;
 wherein said cation is added in an amount sufficient to reduce the final level of acrylamide in said chip to a level that is lower than if the cation had not been added at step a).

24. The method of Claim 23, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said chip by at least 20 percent.

25. The method of Claim 23, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said chip by at least 35 percent.

26. The method of Claim 23, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said chip by about 50 percent.

27. The method of Claim 23, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said chip by a range of 50 to 95 percent.

28. The method of Claim 23, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of at least 1:5.

29. The method of Claim 23, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of at least 1:3.

30. The method of Claim 23, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of about 1:2.

31. The method of Claim 23, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of about 1:1.

32. The method of Claim 23, wherein said adding step a) adds a calcium ion to said dough, said calcium ion being part of a salt selected from the group of calcium chloride, calcium lactate, calcium citrate, calcium malate, calcium gluconate, calcium phosphate, calcium acetate, calcium sodium EDTA, calcium glycerophosphate, calcium hydroxide, calcium lactobionate, calcium oxide, calcium propionate, calcium carbonate, and calcium stearyl lactate.
33. The method of Claim 23, wherein said adding step a) adds a magnesium ion to said dough, said magnesium ion being part of a salt selected from the group of magnesium chloride, magnesium citrate, magnesium lactate, magnesium malate, magnesium gluconate, magnesium phosphate, magnesium hydroxide, magnesium carbonate, and magnesium sulfate.
34. The method of Claim 23, wherein said adding step a) adds an aluminum ion to said dough, said ion being part of a salt selected from the group of aluminum chloride hexahydrate, aluminum chloride, aluminum hydroxide, ammonium alum, potassium alum, sodium alum, and aluminum sulfate.
35. The method of Claim 23, wherein said adding step a) adds an iron salt to said dough, said salt being selected from the group of ferric chloride, ferrous gluconate, ferric ammonium citrate, ferric pyrophosphate, ferrous fumarate, ferrous lactate, and ferrous sulfate.
36. The method of Claim 23, wherein said adding step a) adds a copper ion to said dough, said copper ion being part of a salt selected from the group of cupric chloride, cupric gluconate, and cupric sulfate.
37. The method of Claim 23, wherein said thermally processing step b) comprises frying said dough.
38. The method of Claim 23, wherein said thermally processing step b) comprises baking said dough.
39. The chip produced by the method of Claim 23.

40. The method of Claim 23 wherein the chip is a corn chip.
41. The method of Claim 23 wherein the chip is a tortilla chip.

METHOD FOR REDUCING ACRYLAMIDE FORMATION IN THERMALLY PROCESSED FOODS

ABSTRACT OF THE DISCLOSURE

In fabricated, thermally processed foods, the addition of one of a select group of divalent or trivalent cations to the recipe for the food inhibits the formation of acrylamide during the thermal processing. The cation can come from the group including calcium, magnesium, copper, aluminum, copper, and iron salts.

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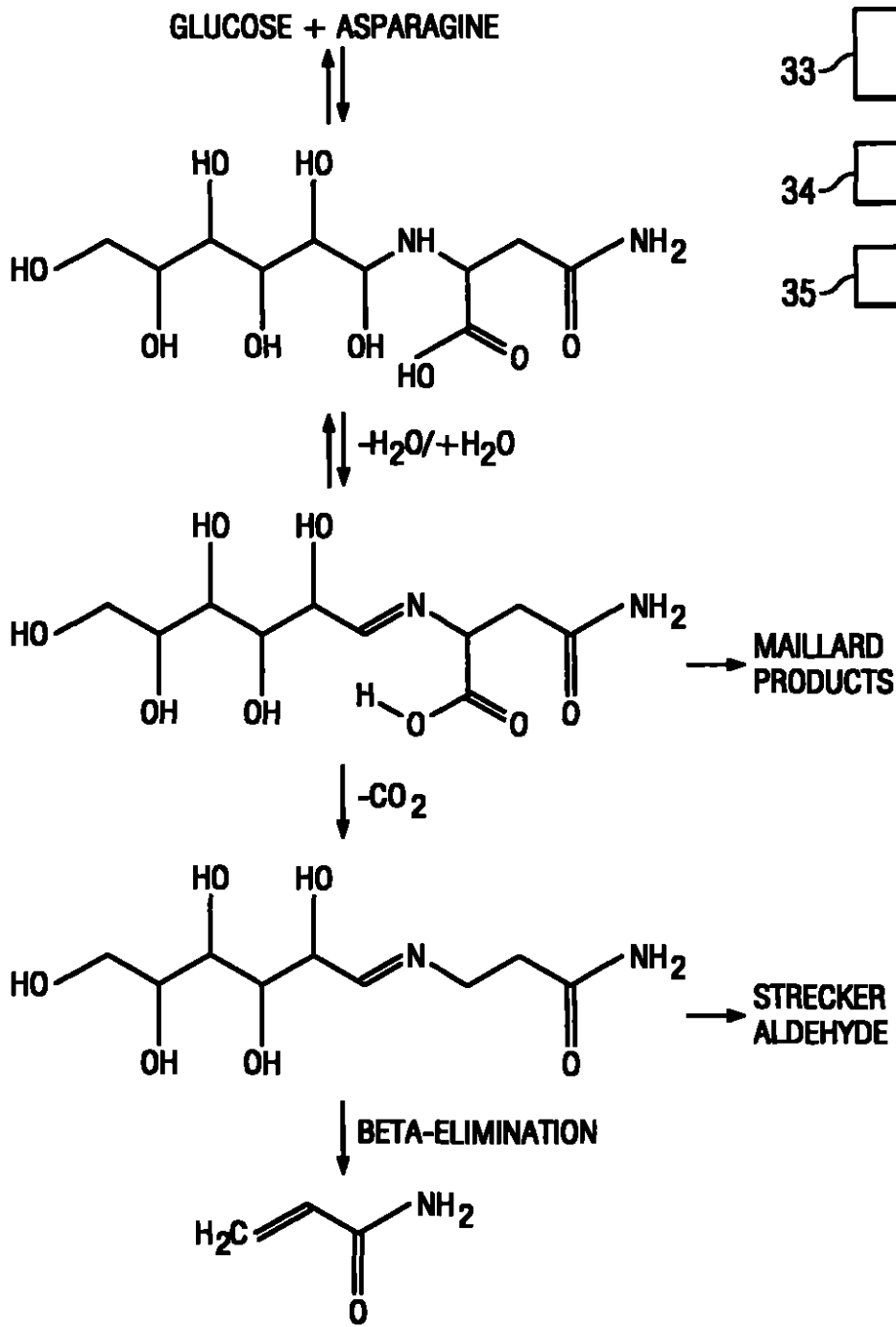


FIG. 1

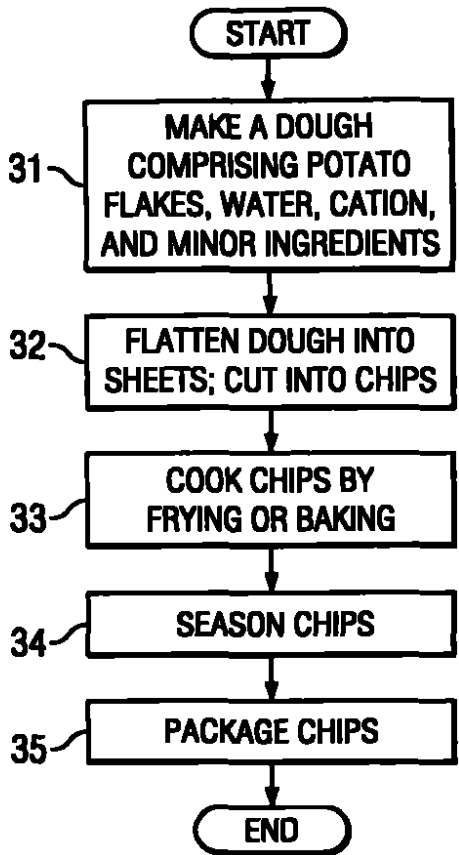


FIG. 2

PATENT COOPERATION TREATY

PCT

NOTIFICATION CONCERNING
SUBMISSION OR TRANSMITTAL
OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

From the INTERNATIONAL BUREAU

To:

CAHOON, Colln, P.
Carstens Yee & Cahoon
P.O. Box 802334
Dallas, TX 75380
United States of America

RECEIVED

MAY 26 2004

U.S.P.

doctored

Date of mailing (day/month/year) 13 May 2004 (13.05.2004)	
Applicant's or agent's file reference CFLAY.00179P	IMPORTANT NOTIFICATION
International application No. PCT/US2004/003448	International filing date (day/month/year) 08 February 2004 (08.02.2004)
International publication date (day/month/year) Not yet published	Priority date (day/month/year) 21 February 2003 (21.02.2003)
Applicant FRITO-LAY NORTH AMERICA, INC. formerly known as RECOT, INC. et al	

1. By means of this Form, which replaces any previously issued notification concerning submission or transmittal of priority documents, the applicant is hereby notified of the date of receipt by the International Bureau of the priority document(s) relating to all earlier application(s) whose priority is claimed. Unless otherwise indicated by the letters "NR", in the right-hand column or by an asterisk appearing next to a date of receipt, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).
2. (If applicable) The letters "NR" appearing in the right-hand column denote a priority document which, on the date of mailing of this Form, had not yet been received by the International Bureau under Rule 17.1(a) or (b). Where, under Rule 17.1(a), the priority document must be submitted by the applicant to the receiving Office or the International Bureau, but the applicant fails to submit the priority document within the applicable time limit under that Rule, the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.
3. (If applicable) An asterisk(*) appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b) (the priority document was received after the time limit prescribed in Rule 17.1(a) or the request to prepare and transmit the priority document was submitted to the receiving Office after the applicable time limit under Rule 17.1(b)). Even though the priority document was not furnished in compliance with Rule 17.1(a) or (b), the International Bureau will nevertheless transmit a copy of the document to the designated Office, for their consideration. In case such a copy is not accepted by the designated Office as priority document, Rule 17.1(c) provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

Priority date	Priority application No.	Country or regional Office or PCT receiving Office	Date of receipt of priority document
21 Febr 2003 (21.02.2003)	10/372,154	US	03 May 2004 (03.05.2004)

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. (41-22) 338.90.90	Authorized officer Elisabeth SASON (Fax 338 9090) Telephone No. (41-22) 338 9916
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PATENT COOPERATION TREATY

PCT

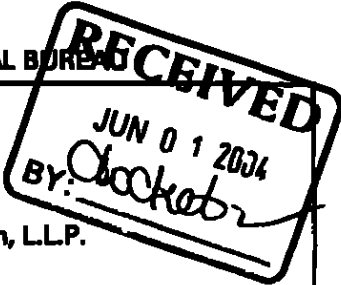
NOTIFICATION OF RECEIPT OF
RECORD COPY

(PCT Rule 24.2(a))

From the INTERNATIONAL BUREAU

To:

CAHOON, Colin, P.
Carstens Yee & Cahoon, L.L.P.
P.O. Box 802334
Dallas, TX 75380
United States of America



Date of mailing (day/month/year) 13 May 2004 (13.05.2004)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference CFLAY.00179P	International application No. PCT/US2004/003448

The applicant is hereby notified that the International Bureau has received the record copy of the international application as detailed below.

Name(s) of the applicant(s) and State(s) for which they are applicants:

FRITO-LAY NORTH AMERICA, INC. formerly known as RECOT, INC. (for all designated
States except US)

ELDER, Vincent, Allen et al (for US)

International filing date : 06 February 2004 (06.02.2004)
Priority date(s) claimed : 21 February 2003 (21.02.2003)
Date of receipt of the record copy
by the International Bureau : 26 April 2004 (26.04.2004)
List of designated Offices :

AP : BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW
EA : AM, AZ, BY, KG, KZ, MD, RU, TJ, TM
EP : AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR
OA : BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG
National : AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM,
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS,
LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK,
SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. (41-22) 338.90.90	Authorized officer: Elisabeth SASON (Fax 338 9090) Telephone No. (41-22) 338 9915
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Continuation of Form PCT/IB/301

NOTIFICATION OF RECEIPT OF RECORD COPY

Date of mailing (day/month/year) 13 May 2004 (13.05.2004)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference CFLAY.00179P	International application No. PCT/US2004/003448

ATTENTION

The applicant should carefully check the data appearing in this Notification. In case of any discrepancy between these data and the indications in the international application, the applicant should immediately inform the International Bureau.

In addition, the applicant's attention is drawn to the information contained in the Annex, relating to:

- ☒ time limits for entry into the national phase - see updated important information (as of April 2002)
- ☒ requirements regarding priority documents (if applicable)

A copy of this Notification is being sent to the receiving Office and to the International Searching Authority.

INFORMATION ON TIME LIMITS FOR ENTERING THE NATIONAL PHASE

The applicant is reminded that the "national phase" must be entered before each of the designated Offices indicated on the cover sheet of this Notification by paying national fees and furnishing translations, as prescribed by Articles 22 and 38 and the applicable national laws. In addition, the applicant may also have to comply with other special requirements applicable in certain Offices. It is the applicant's responsibility to ensure the necessary steps to enter the national phase are taken in a timely fashion. Most Offices do not issue reminders to applicants in connection with the entry into the national phase.

The applicable time limit for entering the national phase will, subject to what is said in the following paragraph, be 30 MONTHS from the priority date, not only in respect of any elected Office if a demand for international preliminary examination is filed before the expiration of 18 months from the priority date (see Article 39(1)), but also in respect of any designated Office, in the absence of filing of such demand, where Article 22(1) as modified with effect from 1 April 2002 applies in respect of that designated Office. For further details, see PCT Gazette No. 44/2001 of 1 November 2001, pages 18828, 18932 and 18934, as well as the PCT Newsletter, October and November 2001 and February 2002 issues.

In practice, time limits other than the 30-month time limit will continue to apply, for various periods of time, in respect of certain designated or elected Offices. For regular updates on the applicable time limits (20, 21, 30 or 31 months, or other time limits), Office by Office, refer to the PCT Gazette ("Section IV" part published on a weekly basis), to the PCT Newsletter (on a monthly basis) and to the relevant National Chapters in Volume II of the PCT Applicant's Guide (the paper version of which is updated usually twice a year and the Internet version of which is updated usually on a weekly basis). Finally, a cumulative table of all applicable time limits for entering the national phase is available from WIPO's Internet site, via links from various pages the site including those of the Gazette, Newsletter and Guide, at <http://www.wipo.int/pct/en/index.html>.

Information about the requirements for filing a demand for international preliminary examination is set out in the PCT Applicant's Guide, Volume I/A, Chapter IX. Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination (at present, all PCT Contracting States are bound by Chapter II).

REQUIREMENTS REGARDING PRIORITY DOCUMENTS

For applicants who have not yet complied with the requirements regarding priority documents, the following is recalled.

Where the priority of an earlier national, regional or international application is claimed, the applicant must submit a copy of the said earlier application, certified by the authority with which it was filed ("the priority document") to the receiving Office (which will transmit it to the International Bureau) or directly to the International Bureau, before the expiration of 18 months from the priority date, provided that any such priority document may still be submitted to the International Bureau before that date of international publication of the international application, in which case that document will be considered to have been received by the International Bureau on the last day of the 18-month time limit (Rule 17.1(a)).

Where the priority document is issued by the receiving Office, the applicant may, instead of submitting the priority document, request the receiving Office to prepare and transmit the priority document to the International Bureau. Such request must be made before the expiration of the 18-month time limit and may be subjected by the receiving Office to the payment of a fee (Rule 17.1(b)).

If the priority document concerned is not submitted to the International Bureau or if the request to the receiving Office to prepare and transmit the priority document has not been made (and the corresponding fee, if any, paid) within the applicable time limit indicated under the preceding paragraphs, any designated State may disregard the priority claim, provided that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within the time limit which is reasonable under the circumstances (Rule 17.1(c)).

Where several priorities are claimed, the priority date to be considered for the purposes of computing the 18-month time limit (and all other PCT time limits) is the filing date of the earliest application whose priority is claimed (Article 2(x)(b)).

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To:
COLIN P. CAHOON
CARSTENS, YEE & CAHOON, LLP
PO BOX 802334
DALLAS, TX 75380

RECEIVED
AUG 26 2004
Jocket
BY: _____

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NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL SEARCH REPORT AND
THE WRITTEN OPINION OF THE INTERNATIONAL
SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Date of mailing
(day/month/year) **24 AUG 2004**

Applicant's or agent's file reference CPAY.00179P	FOR FURTHER ACTION See paragraphs 1 and 4 below
International application No. PCT/US04/03448	International filing date (day/month/year) 06 February 2004 (06.02.2004)
Applicant FRITO-LAY NORTH AMERICAS, INC.	

1. ☐ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

Filing of amendments and statement under Article 19:
The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

Where? Directly to the International Bureau of WIPO, 34 chemin des Colombettes
1211 Geneva 20, Switzerland, Facsimile No.: +41 22 740 14 35

For more detailed instructions, see the notes on the accompanying sheet.
2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.
3. ☐ With regard to the protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:
 - ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.
 - ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.
4. **Reminders**
Shortly after the expiration of 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90bis.1 and 90bis.3, respectively, before the completion of the technical preparations for international publication.

The applicant may submit comments on an informal basis on the written opinion of the International Searching Authority to the International Bureau. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established. These comments would also be made available to the public but not before the expiration of 30 months from the priority date.

Within 19 months from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later); otherwise, the applicant must, within 20 months from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices.

In respect of other designated Offices, the time limit of 30 months (or later) will apply even if no demand is filed within 19 months.

See the Annex to Form PCT/IB/301 and, for details about the applicable time limits, Office by Office, see the *PCT Applicant's Guide*, Volume II, National Chapters and the WIPO Internet site.

Name and mailing address of the ISA/ US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (703) 305-3230	Authorized officer Keith Hendricks Telephone No. (571) 272-1700
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Form PCT/ISA/220 (January 2004)

(See notes on accompanying sheet)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference CFAY.00179P	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, Item 5 below.
International application No. PCT/US04/03448	International filing date (day/month/year) 06 February 2004 (06.02.2004)	(Earliest) Priority Date (day/month/year) 21 February 2003 (21.02.2003)
Applicant FRITO-LAY NORTH AMERICAS, UNC		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets.



It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the Report

a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.



the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing:



contained in the international application in written form.



filed together with the international application in computer readable form.



furnished subsequently to this Authority in written form.



furnished subsequently to this Authority in computer readable form.



the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.



the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

2. ☒ Certain claims were found unsearchable (See Box I).

3. ☐ Unity of invention is lacking (See Box II).

4. With regard to the title,



the text is approved as submitted by the applicant.



the text has been established by this Authority to read as follows:

5. With regard to the abstract,



the text is approved as submitted by the applicant.



the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No. _____



as suggested by the applicant.



because the applicant failed to suggest a figure.



because this figure better characterizes the invention.



None of the figures

INTERNATIONAL SEARCH REPORT

International application No.

PCT/USD4/03448

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : A23L 1/29, 1/304, 1/305, 1/015, 1/217, 3/358; A21D 2/02, 2/06, 8/02
US CL : 426/72, 74, 549, 556, 560, 652, 653, 618, 619, 620, 622

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 426/72, 74, 549, 556, 560, 652, 653, 618, 619, 620, 622

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
calcium, aluminum, magnesium, iron, copper, fry\$ or fired, cereal, grain, bread, dough, chip, potato, cornElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WEST

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X — Y	US 5,514,387 A (ZIMMERMAN et al) 07 May 1996, see col. 6, 12 and 20	1-10, 16, 21-24, 26 25
X — Y	US 2002/0015759 A1 (PROSISE et al) 07 February 2002, see cols. 3, 5, 23 and example 21	1-19, 21-23, 26-31 25
X — Y	US 6,210,720 B1 (LEUSNER et al) 03 April 2001, see cols. 4-5 and 7-9	1-10, 15-17, 20, 23, 26 25
X — Y	GB 335,214 A (DAPPER et al) 19 September 1930, see entire document	1-11, 16-17, 26 25



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T"

later document published after the international filing date or priority date and not in conflict with the application but cited to underpin the principle or theory underlying the invention

"X"

document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y"

document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"Δ"

document member of the same patent family

Date of the actual completion of the international search

13 August 2004 (13.08.2004)

Date of mailing of the international search report

24 AUG 2004

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Facsimile No. (703) 305-3230

Authorized officer

Marian Knobe

Telephone No. 571-272-1700

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

91

To:
COLIN P. CAHOON
CARSTENS, YEE & CAHOON, LLP
PO BOX 802334
DALLAS, TX 75380

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing
(day/month/year) **24 AUG 2004**

Applicant's or agent's file reference

FOR FURTHER ACTION
See paragraph 2 below

CFAY.00179P

International application No.

International filing date (day/month/year)

Priority date (day/month/year)

PCT/US04/03448

06 February 2004 (06.02.2004)

21 February 2003 (21.02.2003)

International Patent Classification (IPC) or both national classification and IPC

IPC(7): A23L 1/29, 1/304, 1/305, 1/015, 1/217, 3/358; A21D 2/02, 2/06, 8/02 and US Cl.: 426/ 72, 74, 549, 556, 560, 652, 653, 618, 619, 620, 622

Applicant

FRITO-LAY NORTH AMERICAS, INC.

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA/ US

Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
Facsimile No. (703) 305-3230

Authorized officer

Keith Hendricks

Telephone No. (571) 272-1700

pat

Form PCT/ISA/237 (cover sheet) (January 2004)

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US04/03448

Box No. I Basis of this opinion

1. With regard to the language, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ This opinion has been established on the basis of a translation from the original language into the following language _____, which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).

2. With regard to any nucleotide and/or amino acid sequence disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

a. type of material

☐ a sequence listing

☐ table(s) related to the sequence listing

b. format of material

☐ in written format

☐ in computer readable form

c. time of filing/furnishing

☐ contained in international application as filed.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/USD403448

Box No. V Reasoned statement under Rule 43 bis.1(a) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims <u>25</u>	YES
	Claims <u>1-24 and 26-31</u>	NO
Inventive step (IS)	Claims <u>NONE</u>	YES
	Claims <u>1-31</u>	NO
Industrial applicability (IA)	Claims <u>1-31</u>	YES
	Claims <u>NONE</u>	NO

2. Citations and explanations:

Please See Continuation Sheet Claims 1-31 meet the criteria set out in PCT Article 33(4), and thus possess industrial applicability because the subject matter claimed can be made or used in industry.

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US04/03448

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the questions whether the claims are fully supported by the description, are made:

Claims 1-31 are objected to under PCT Rule 66.2(a)(v) as lacking clarity under PCT Article 6 because said claims are indefinite for the following reason(s):

Within the claims, the terms "lowering", and "reduce" are relative terms which render the claims indefinite. The specification does not provide a standard for ascertaining the requisite degree. It is unclear over what original amount the acrylamide concentrations are reduced or lowered. For example, claim 1 recites "a method of lowering the level of acrylamide in a thermally processed food", yet the thermally processed food is not the starting material processed within the claimed method, in order for the (original) acrylamide amount to be "lowered." The process may provide a reduced amount of acrylamide in a food product as compared to the same food product which has been similarly-processed, except for the step(s) of adding the cation; however, it does not appear that a food product actually undergoes a reduction in the amount of acrylamide it contains.

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US04/03448

Supplemental Box
In case the space in any of the preceding boxes is not sufficient.

V. 2. Citations and Explanations:

(I) Claims 1-10, 16, 21-24 and 26 lack novelty under PCT Article 33(2) as being anticipated by Zimmerman et al. (US PAT 5,514,387).

Zimmerman et al. disclose a "calcium-enriched baked good and method of making", which comprises adding a calcium compound to the flour or dough ingredients. At column 6, it is stated that "the calcium component may be one or more edible acidic, neutral or basic inorganic or acid salts", such as calcium citrate or calcium malate (col. 6, lines 51-56). "The flour component may be any comminuted cereal grain or edible seed or vegetable meal", including flour and starches from corn, wheat, potato and rice (top col. 12). Reducing sugars such as fructose may be added to the flour component mixture as well. The dough compositions are then baked at temperatures above 250°F, or 121°C (col. 20). The process may be used to form "cookies, brownies, snacks, snack chips, bagel chips, Melba toast, pretzels and the like" (abstract and col. 6).

As stated in the first paragraph of column 5, "calcium carbonate is the preferred calcium component for enriching the calcium content of baked goods in accordance with the present invention."

Specific amounts of calcium carbonate are provided therein. Thus, the instantly-claimed invention is anticipated by the reference. As the examined claims do not recite specific ranges or amounts of the added cations, and encompass broad ranges of the cations, so long as they provide a "reduced" amount of acrylamide in the thermally processed food, the ranges recited in the reference would be expected to meet the instant claim limitations. Note that the amounts recited in the reference meet or exceed the amounts exemplified by applicant's examples in the specification, being the best available amounts to compare. Regarding claims 6-9, it is noted that free asparagine occurs in many vegetables, including high amounts in cereal grain products and potato, and thus this interaction between the free asparagine and cation would naturally take place upon the addition of the magnesium carbonate or calcium carbonate to the flour dough product, as performed in the reference.

(II) Claims 1-19, 21-23 and 26-31 lack novelty under PCT Article 33(2) as being anticipated by Prossie et al. (US 6,716,462).

Prossie et al. disclose snack foods which "provide a balanced mix of an amino acid source, fat, and carbohydrates" (abstract). Columns 3 and 5 recite various snacks which may be produced by the invention, including baked and fried snack foods such as potato crisps, corn chips, crackers, cookies and pretzels. Each of these requires the processing of a starch-based dough.

Column 23 discloses the fortification of the snack food dough with various minerals and their salts. "Embodiments of the present invention may be fortified with minerals such as calcium, phosphorus, magnesium, iron, zinc, iodine, selenium, copper, manganese, fluoride, chromium, molybdenum, sodium, potassium, and chloride."

Specific amounts of calcium, magnesium, iron, copper, phosphorus, and zinc are provided therein. Furthermore, the salts of these minerals may be utilized. "The source of the mineral salt, both those with established U.S. RDA levels or with safe and adequate intake levels, as well as those with no as yet established human requirement, used in the practice of this invention, can be any of the well known salts including carbonate, oxide, hydroxide, chloride, sulfate, phosphate, pyrophosphate, gluconate, lactate, acetate, fumarate, citrate, malate, amino acids and the like for the cationic minerals and sodium, potassium, calcium, magnesium and the like for the anionic minerals. However, the particular salt used and the level will depend upon their interaction with other food product ingredients. Elemental iron (electrolytic or reduced iron) is another preferred source of iron."

Example 21 provides for a fabricated potato crisp made according to the methods outlined in the reference. Example one provides an exemplified amount of sodium aluminum phosphate, at 0.76 %.

016

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.
PCT/US04/03448

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

(iii) Claims 1-11, 16-17 and 26 lack novelty under PCT Article 33(2) as being anticipated by Dapper (GB 335,214). Dapper discloses the addition of magnesium carbonate or calcium carbonate to flour or dough components, for use in producing baked goods. The exemplified quantity disclosed incorporates 50 grams of magnesium carbonate per 100 kg of flour. Thus, applicant's claims are anticipated by the reference.

(iv) Claims 1-10, 15-17, 20, 23 and 26 lack novelty under PCT Article 33(2) as being anticipated by Leusner et al. (US 6,210,720). Leusner et al. disclose calcium fortified ready-to-eat cereal products. These products are made by producing a dough from various cereal grains such as wheat, rice, oats or barley (col. 7). The products may be baked, extruded, puffed or fried (bottom col. 8 through mid-col. 10). The preferred calcium source is calcium carbonate, but may also include calcium phosphate (col. 5). Specific amounts of these mineral salts are provided at columns 4-5. The cereal dough may also be formed as "half-products", which are subsequently formed into other foodstuffs. "Also, the present invention can be used to provide pretzel snack products fortified with calcium" (top col. 9). Furthermore, the "finished products are remarkably free of the undesirable discoloration heretofore associated with finished light colored dried cereal products high in calcium content."

(v) Claim 25 lacks an inventive step under PCT Article 33(3) as being obvious over any of the following: Zimmerman et al., Prosser et al., Dapper, or Leusner et al.

Claim 25 is directed to a "breeding for a meat product." The definition of a breeding is open to interpretation, and yet is commonly accepted in the art as a collection of bread crumbs, or small crumbled pieces of another cooked grain product, which are applied as a coating to various foodstuffs, including meat. While the prior art references do not specifically recite the use of the cooked dough material as a breeding, it would have been obvious to one of ordinary skill in the art to have utilized these materials as such, given this common and well-known utility of the product. Furthermore, as the disclosed products would naturally form crumb pieces themselves, there is nothing in the instant claim which would differentiate the invention from the prior art. It is noted that the coating of a meat product would not materially affect the composition of the breeding, *per se*. Since the prior art structure is capable of performing the intended use, it meets the claim.



US005514387A

United States Patent [19]
Zimmerman et al.

[11] **Patent Number:** **5,514,387**
[45] **Date of Patent:** **May 7, 1996**

M

[54] **CALCIUM-ENRICHED BAKED GOOD PRODUCTION AND METHOD OF MAKING**

[75] **Inventors:** Ellen L. Zimmerman, Morristown; Julia M. Carey, Madison; Louise Shale; Harry Levine, both of Morris Plains, all of N.J.

[73] **Assignee:** Nabisco, Inc., Parsippany, N.J.

[21] **Appl. No.:** 350,004

[22] **Filed:** Nov. 29, 1994

[51] **Int. Cl.⁶** _____ A23L 1/035; A23L 1/304

[52] **U.S. Cl.** _____ 426/74; 426/19; 426/20; 426/349; 426/654; 426/661; 426/662

[58] **Field of Search** _____ 426/19, 20, 549, 426/661, 662, 654, 74

[56] **References Cited**

U.S. PATENT DOCUMENTS

2,871,123	1/1959	Bauer et al.	
2,970,915	2/1961	Fennel	
3,443,238	5/1969	Eggen et al.	426/74
3,490,916	1/1970	Hoskins	
3,919,434	11/1975	Thun et al.	
4,196,226	4/1980	Benjamin et al.	
4,396,633	8/1983	Rosenthal et al.	
4,488,408	8/1984	Brown et al.	
4,562,080	12/1985	Thun	
4,688,519	5/1987	Darby et al.	
4,673,583	6/1987	Kurwin et al.	
4,676,872	7/1987	Darby et al.	
4,701,329	10/1987	Nahel et al.	
4,737,375	4/1988	Nahel et al.	
4,740,380	4/1988	McIntosh et al.	
4,783,996	8/1988	McIntosh et al.	
4,777,845	10/1988	Vandeweyer et al.	
4,784,871	11/1988	Fack	
4,786,510	11/1988	Nahel et al.	
4,840,814	6/1989	Harris et al.	
4,851,343	7/1989	Anderson et al.	
4,859,473	8/1989	Archimowicz et al.	
4,871,354	10/1989	Kahle et al.	
4,984,485	2/1990	Hirshman et al.	
5,066,499	11/1991	Archimowicz et al.	
5,080,921	1/1992	Reimer	
5,082,684	1/1992	Feng	
5,108,764	4/1992	Crain et al.	
5,120,361	6/1992	Ellen et al.	

5,133,984	7/1992	Murphy et al.	
5,154,942	10/1992	Blanchey et al.	
5,182,739	11/1992	Norman et al.	
5,176,927	1/1993	Blumstein et al.	
5,186,983	2/1993	For et al.	
5,194,270	3/1993	Caste et al.	426/74
5,200,215	4/1993	Shale et al.	
5,254,336	10/1993	Boston	
5,382,502	11/1994	Shale et al.	

FOREIGN PATENT DOCUMENTS

WO91/18514 12/1991 WIFO.

OTHER PUBLICATIONS

Atwell, et al., *The Terminology and Methodology Associated with Basic Starch Phenomena*, Cereal Foods World, vol. 33, No. 2, pp. 306-311 (1988).

Primary Examiner—Helen Fritz

[57] **ABSTRACT**

The calcium content of crackers and other baked goods is substantially increased without adversely affecting texture by the use of an emulsifier composition to reduce hardness and dry mouthfeel caused by increased levels of calcium. Exemplary amounts of the emulsifier composition for achieving tenderization of the calcium fortified crackers and other baked goods may be from about 3% by weight to about 45% by weight, based upon the weight of the calcium component. Calcium carbonate is the preferred calcium enrichment component. The amount of the calcium enrichment component for providing more than 10% of the U.S. R.D.A. of 1000 mg of calcium per 15 gram serving may be from about 3% by weight to about 30% by weight, preferably from about 5% by weight to about 15% by weight, based upon the total weight of the flour. For making conventional or full-fatted baked goods such as crackers, the calcium enriched doughs of the present invention contain effective emulsifying amounts of: a) at least one polyoxyethylene sorbitan fatty acid ester, preferably polysorbate 60, and b) at least one stearyl lactylate, preferably sodium stearyl lactylate. The reduced fat, low-fat, and no-fat calcium enriched doughs of the present invention most preferably additionally contain at least one lecithin. Other full-fat, reduced fat, low-fat, and no-fat baked goods may be fortified with calcium in accordance with the present invention include cookies, brownies, snacks, snack chips, bagel chips, Melba toast, pretzels, and the like.

36 Claims, No Drawings

5,514,387

1

CALCIUM-ENRICHED BAKED GOOD PRODUCTION AND METHOD OF MAKING

FIELD OF THE INVENTION

The present invention relates to the tenderization of calcium-enriched crackers and other baked goods produced on a mass production, continuous basis. The calcium fortified baked products produced in accordance with the present invention include conventional or full-fat crackers, snacks, cookies, pretzels and snack chips, and reduced fat, low-fat, and no-fat baked goods.

BACKGROUND OF THE INVENTION

Calcium plays an important role in blood coagulation, nerve transmission, muscle contraction, and heart function. Protection against high blood pressure, colon cancer, and the degenerative bone disease known as osteoporosis have been attributed to calcium. Approximately one percent of the body's calcium circulates in the blood and the rest is present in bones and teeth. The U.S. Recommended Daily Allowance (R.D.A.) of calcium is 1000 mg for adults and children 12 or more years of age. The R.D.A. for pregnant and lactating women is 1200 mg. However, the average calcium intake is only about one-third of the required daily allowance. If dietary sources of calcium do not provide sufficient amounts of calcium to the blood, calcium is depleted from the bones to compensate for the insufficient amounts. Age related bone loss and fracture rates in patients with osteoporosis may be reduced with high dietary intake of calcium.

The ability of different individuals to utilize the calcium in food may vary considerably. For example, a high protein diet may result in about 15% of the dietary calcium being absorbed. A low protein diet may result in only about 5% of the dietary calcium being absorbed. Phytic acid in cereal grains interferes with calcium absorption by forming insoluble calcium phytates in the intestine. Oxalates in foods, such as spinach and rhubarb, may similarly interfere with calcium absorption.

Other intestinal factors that influence the absorption of calcium include pH, the calcium:phosphorus ratio, the presence of free fatty acids which occur when fat absorption is impaired, and the amount of vitamin D. Generally, the more alkaline the contents of the intestine, the less soluble are the calcium salts. Also, a high calcium:phosphorus ratio favors the formation of tricalcium phosphate rather than the more soluble, better absorbed forms. If either calcium or phosphorus is taken in excess, excretion of the other is increased. The optimal ratio is 1:1 when the intake of vitamin D is adequate. On the other hand, vitamin D promotes the absorption of calcium from the intestine.

Although milk has been a major source of calcium for infants and young children, many teenagers and adult Americans are consuming lesser amounts of it. The calcium content of milk and other beverages may be increased to facilitate meeting of the U.S. R.D.A. for calcium.

For example, calcium enrichment or fortification of milk is disclosed in U.S. Pat. Nos. 2,871,123, 4,701,329, 4,840,814, and 4,851,243. In U.S. Pat. No. 2,871,123 calcium carbonate is used as a calcium source in the production of a canned calcium-enriched concentrated milk product for dilution to make infant formula. Chondroitin gum is used for suspension of the calcium carbonate. U.S. Pat. Nos. 4,701,329 and 4,851,243 disclose the production of calcium-enriched and phosphorus-enriched fortified milk by the

2

addition of tri-basic calcium phosphate, caseinogen and guar gum to fresh milk, affecting hydration of the gums, and ensuring uniform distribution of the added materials in the milk. U.S. Pat. No. 4,840,814, discloses the preparation of calcium-enriched milk or toned milk by adding a water soluble calcium salt of an organic acid to thermally sterilized milk or toned milk, and adjusting the pH value of the obtained mixture to 6.6 or above.

Beverages and beverage concentrates additionally supplemented with solubilized calcium are disclosed in U.S. Pat. Nos. 4,737,375 and 4,740,380. In U.S. Pat. No. 4,737,375 the beverages and concentrates are substantially free of a sugar alcohol and contain specified levels of total edible acids selected from mixtures of citric, malic and phosphoric acid. U.S. Pat. No. 4,740,380 discloses a clear, calcium-fortified aqueous acidic beverage. The beverage comprises an aqueous solution of an organic calcium compound such as calcium gluconate at a pH of about 4 and below wherein the calcium compound content does not exceed the solubility limit of the compound in water. An inorganic calcium salt can be used alone or in combination with an organic calcium compound to form an acidic beverage provided the pH is adjusted with an organic acid.

However, when incorporating calcium into liquids, the source of calcium, usually an inorganic salt in finely divided form, tends to settle out upon extended storage. Also, the use of soluble sources of calcium or even the use of suspended sources of calcium tends to result in off flavors, adverse appearance, and undesirable increases in viscosity. Generally, the more soluble the salt or the more finely divided it is so as to improve suspendability, the quicker or more easily its taste will be detected. Also, solubilization of the calcium increases the likelihood of it being complexed with or interacting with other components of the beverage or of other foods consumed with it. The complexation or interaction of the calcium may result in it being less susceptible to absorption into the blood.

Calcium enrichment of other foods such as bean curd, yogurt, and cereal grains is disclosed in U.S. Pat. Nos. 4,676,583, 4,784,871, and 4,765,996, respectively. U.S. Pat. No. 4,676,583 discloses the production of an aseptic calcium-enriched soy bean curd by adding a calcium hydroxide-sucrose complex as coagulant to the soy bean milk, stabilizing the resulting mixture by heating, adjusting the pH value of the sterilized product to weakly acidic, charging the sterilized product into a container under an aseptic condition and sealing the opening of the container. The calcium hydroxide-sucrose complex is coagulated with the soybean milk by heating. When the calcium hydroxide-sucrose complex used as coagulant is insufficient to provide the required extent of calcium enrichment, calcium lactate may be added in an aseptic atmosphere after the sterilization process at the time of pH adjustment. According to U.S. Pat. No. 4,784,871 a calcium fortified yogurt is produced by adding an acid soluble calcium salt to fruit flavoring which is subsequently combined with a yogurt base. In U.S. Pat. No. 4,765,996 polished rice or barley is enriched with nutrients which are fixed in and on the grains by coating an oil/fat and/or a wax on the grains, coating the same with a hydrophilic emulsifier and further coating them with a starch-based coating agent.

Calcium compounds have been utilized in baked goods, such as crackers, as components of leavening agents, pH adjusters, yeast foods, and for their nutritive value. U.S. Pat. No. 4,196,226 discloses a leavening acid comprising alkali metal aluminum phosphate granules having a calcium rich outer surface for improving flow and dusting properties. The product may be used as a leavening acid in moist doughs,

and liquid batters such as pancake batters. U.S. Pat. No. 4,678,672 to Darby et al discloses the use of calcium and ammonium carbonates and bicarbonates in leavening systems for the production of reduced calorie crackers. Various emulsifiers are disclosed as replacements for fat. Magnesium and/or calcium carbonates are taught as acid-neutralizing constituents in British patent 335,214 for dough or flour compositions which contain permalphates and bromates. Calcium carbonate is disclosed as a bread improver in U.S. Pat. No. 2,970,915. It is also taught as a buffering agent for a liquid yeast brew in U.S. Pat. No. 3,490,916. The dough-up stage addition of calcium carbonate for its nutritive value in the production of reduced fat or no-added fat crackers, is disclosed in U.S. Pat. No. 5,108,764 to Craig, U.S. Pat. Nos. 4,839,473 and 5,066,499 to Arcimowicz et al disclose the addition of calcium carbonate to the dough-up stage for its nutritive value in the production of low sodium crackers.

The delivery of dietary calcium using crackers and other low moisture content baked goods as a medium has significant advantages over the use of milk, other dairy products such as yogurt, beverages, tofu, and whole grains. Crackers generally exhibit much longer shelf lives than do dairy products such as milk and yogurt. Settling out of calcium salts from solution or suspension during product storage is not encountered when using crackers as a dietary source of calcium. Also, crackers and other baked goods have broad appeal to many segments of the population. However, commercially available crackers generally provide only up to about 3% of the U.S. R.D.A. of calcium per serving. It has been found that the incorporation of calcium in crackers in amounts to provide more than 10% of the U.S. R.D.A. of 1000 mg calcium per serving results in a hard cracker texture.

Also, reducing the fat content of crackers and other baked goods results in a harder texture as disclosed in co-pending, commonly assigned U.S. application Ser. No. 08/351,039 for "Tenderized Baked Good Production With Reduced Fat, Low-Fat, Or No Added Fat" filed Nov. 29, 1994 in the names of Ellen L. Zimmerman, Julia M. Carey, Louise Hilde, and Harry Levine, which application is incorporated herein by reference in its entirety.

In the preparation of baked goods, fat lubricates and reduces viscosity of the dough. Fat retards starch from swelling, and from gelatinizing (including the second stage of gelatinization known as pasting). It also provides flavor and tenderness to the final product. Methods for making reduced fat, low-fat, or fat-free (no added fat) baked goods must somehow compensate for the multiple functions of fat when reducing or eliminating fat.

In producing crackers on a mass production basis, a cracker dough must be continuously sheetable, and it should preferably be capable of being laminated upon itself. The baked product should be non-brittle, so as to be transferable between conveyor belts and packaging equipment without excessive breakage.

Water can be used to reduce viscosity and to provide adequate lubrication to the dough in the absence of fat, but water cannot be used as the sole means to provide tenderness to the final product. Fat-free crackers made only with water as the fat replacement are flinty and so absorptive as to cause unpleasant dryness in the mouth upon eating.

As disclosed in U.S. Pat. No. 5,108,764 to Craig, et al., a major source of the textural problem in crackers is believed to be excessive gelatinization of starch in crackers made with extra water without adding fat. Excessive gelatinization

of starch during baking makes the cracker flinty and very moisture-absorbent. Retention of water in the cracker dough during baking causes excessive gelatinization and the resultant inferior cracker. Thus, when preparing crackers, unlike preparing bread, starch gelatinization is to be limited. For example, in full-fatted crackers, 75% of the starch may be gelatinized. Removal of the fat may result in an increase of gelatinization to 85% or more, with a resultant cardboard-like texture.

In the process of U.S. Pat. No. 5,108,764, the added fat or shortening content of a mass-produced cracker is reduced using water and an enzyme composition that hydrolyzes non-cellulosic cell wall polysaccharides. The enzymatic treatment and the amount of water are such so as to avoid excessive gelatinization during baking.

The use of various emulsifier systems to reduce fat in foods is disclosed in International Publication No. WO 91/18514, published Dec. 12, 1991, U.S. Pat. No. 5,234,356 to Bosken, U.S. Pat. Nos. 4,678,672 and 4,668,519 to Darby, et al., U.S. Pat. No. 5,080,921 to Reimer, U.S. Pat. No. 5,082,684 to Pung, U.S. Pat. No. 4,468,408 to Bosco, et al., U.S. Pat. No. 3,919,434 to Thom, et al., U.S. Pat. No. 5,160,739 to Nemmen, et al., and U.S. Pat. No. 5,154,942 to Hickey, et al.

In embodiments of the present invention, an emulsifier composition is used to provide an unexpectedly soft and tender texture and enhanced flavor to calcium-enriched crackers and other baked products which provide more than 10% of the U.S. R.D.A. of 1000 mg of calcium per serving. The tenderized calcium fortified crackers and other baked goods of the present invention include calcium enriched reduced fat, low-fat, and no-fat baked products as well as conventional, full-fatted crackers and other baked goods which contain substantial amounts of ungelatinized starch. Dough key times and dough machinability are not adversely affected, even though the doughs contain substantial amounts of calcium and even though their added fat level may be substantially reduced or completely eliminated.

SUMMARY OF THE INVENTION

The calcium content of crackers and other baked goods is substantially increased without adversely affecting texture by the use of an emulsifier composition to reduce hardness and dry mouthfeel caused by increased levels of calcium. Exemplary amounts of the emulsifier composition for achieving tenderization of the calcium fortified crackers and other baked goods may be from about 3% by weight to about 45% by weight, based upon the weight of the calcium component. In conventional or full-fatted crackers and other baked goods, emulsifier amounts at the lower end of the range are generally used. Exemplary amounts of the emulsifier for use in calcium enriched full fatted products may range from about 3% by weight to about 20% by weight, preferably from about 5% to about 15% by weight, based upon the weight of the calcium component. As the fat content of the baked good is reduced, generally higher amounts of the emulsifier may be used to reduce hardness caused by both calcium enrichment and fat reduction. For example, exemplary amounts of the emulsifier for use in calcium enriched no-fat crackers and other baked goods may range from about 15% by weight to about 45% by weight, based upon the weight of the calcium component. The calcium-enriched crackers and other baked goods of the present invention provide more than 10%, preferably at least 20% of the U.S. R.D.A. of 1000 mg of calcium per serving.

The source of calcium for providing calcium enrichment to the baked goods of the present invention is preferably an insoluble, tasteless or bland calcium salt which does not adversely affect pH, flavor, or color of the baked goods. In addition, the calcium component, added in the dough-up stage of fermented crackers or other fermented baked goods, preferably does not interfere with neutralization of acids produced during fermentation. Low solubility of the calcium component is preferred to reduce the risk of undesirable complexation or interaction with dough components such as gluten which may hinder dough machinability or which may reduce absorption of the calcium into the blood. Also, low solubility of the calcium component reduces its dissolution in the mouth during consumption of the baked good which reduces the detection of any off-flavors. Calcium carbonate is the preferred calcium component for enriching the calcium content of baked goods in accordance with the present invention. Exemplary amounts of the calcium enrichment component for providing more than 10% of the U.S. R.D.A. of 1000 mg of calcium per 15 gram serving are from about 3% by weight to about 30% by weight, preferably from about 5% by weight to about 15% by weight, based upon the total weight of the flour.

In preferred embodiments for making conventional or full-fat baked goods such as conventional crackers, the calcium enriched doughs of the present invention contain effective emulsifying amounts of: a) at least one polyoxyethylene sorbitan fatty acid ester, preferably polysorbate 60, and b) at least one stearoyl lactylate, preferably sodium stearoyl lactylate. The ratio (w/w) of the weight of sodium stearoyl lactylate and/or other stearoyl lactylates to the weight of the polysorbate 60 and/or other polyoxyethylene sorbitan fatty acid ester components may be from about 4.65-0.5:1, preferably from about 3.5-1.15:1.

The reduced fat, low-fat, and no-fat calcium enriched doughs of the present invention must preferably contain effective emulsifying amounts of at least one of each of three emulsifier components as disclosed in said copending, commonly assigned U.S. application Ser. No. 08/351,039, for "Standardized Baked Good Production With Reduced Fat, Low-Fat, Or No Added Fat" filed Nov. 29, 1994 in the names of Ellen L. Zimmerman, Julie M. Chang, Louise Glade, and Harry Levine. As disclosed therein, these emulsifier compositions contain at least one of each of the three emulsifier components: (1) polyoxyethylene sorbitan fatty acid esters, (2) lecithins, and (3) stearoyl lactylates. In preferred embodiments, the polyoxyethylene sorbitan fatty acid ester component is polysorbate 60, which is used with lecithin and sodium stearoyl lactylate. The amount of polysorbate 60 and/or other polyoxyethylene sorbitan fatty acid ester components may be at least about 15% by weight, preferably from about 20% by weight to about 40% by weight. The amount of lecithin may be at least about 5% by weight, preferably from about 10% by weight to about 25% by weight. The amount of sodium stearoyl lactylate and/or other stearoyl lactylates may be at least about 20% by weight, preferably from about 35% by weight to about 70% by weight. The percentages of the three emulsifier components, such as polysorbate 60, lecithin, and sodium stearoyl lactylate, add up to 100% by weight. The three component emulsifier compositions may also be used in the preparation of conventional or full-fat calcium enriched crackers and other full-fat calcium enriched baked goods.

The emulsifier components, such as polysorbate 60, sodium stearoyl lactylate, and the optional lecithin may be pre-mixed and then mixed with the flour, or they may be separately admixed with the flour. In preferred embodi-

ments, the polysorbate 60 is present in or pre-mixed with a natural flavorant, and then the premix is admixed with the flour.

The unexpectedly soft, tender, non-brittle texture of calcium enriched crackers of the present invention lasts for extended periods of time, for example, at least two months, preferably at least six months, in closed packaging. The emulsifier composition does not impart a soapy or off-flavor and the calcium component does not impart a chalky flavor or dry mouthfeel to the baked good. In preferred embodiments, cracker flavor is enhanced by the use of a natural flavorant.

The crackers produced in accordance with the present invention may be chemically leavened or unfermented full-fat, reduced fat, low-fat, or no-fat crackers. Fermented crackers, such as soda crackers, which are full-fatted or having reduced fat, low-fat or no added fat may also be produced in accordance with the present invention. Exemplary of other full-fat, reduced fat, low-fat, and no-fat baked goods which may be fortified with calcium in accordance with the present invention include cookies, brownies, snacks, snack chips, bagel chips, Melba toast, pretzels, and the like.

DETAILED DESCRIPTION OF THE INVENTION

The calcium content of crackers and other baked goods is substantially increased in accordance with the present invention by blending into a dough or batter at least one edible, preferably bland, insoluble calcium compound and an emulsifier composition to reduce hardness and dry mouthfeel caused by the incorporation of the calcium in the baked good. The emulsifier composition does not impart a soapy or off-flavor to the baked good, and it does not produce an excessively blistered surface. The unexpectedly soft, tender, non-brittle texture is exhibited for at least two months, preferably at least six months, in proper, air-tight packaging. In embodiments of the present invention the calcium level of conventional or full-fatted crackers, reduced fat crackers, low-fat crackers and no-fat crackers may be increased from approximately 0-3% of U.S. R.D.A. per 15 gram serving or reference amount to a product containing more than 10%, preferably at least 20% of U.S. R.D.A. of 1000 mg calcium in a 15 gram serving or reference amount. Similar levels of calcium enrichment may also be achieved in other full-fat, reduced fat, low-fat, and no-fat baked goods such as cookies, brownies, snacks, snack chips or chip-like products, bagel chips, Melba toast, pretzels, and the like.

The calcium component may be one or more edible acidic, neutral or basic inorganic or acid salts. Exemplary calcium components include calcium carbonate, tricalcium phosphate, calcium phosphate, calcium hydrogen phosphate, calcium dihydrogen phosphate, calcium hydroxide, calcium citrate, calcium malate, and mixtures thereof. Low solubility of the calcium component is preferred to reduce the risk of undesirable complexation or interaction with dough components such as gluten which may hinder dough machinability or which may reduce absorption of the calcium into the blood. Also, low solubility of the calcium component reduces its dissolution in the mouth during consumption of the baked product which reduces the detection of any off-flavors. The source of calcium for providing calcium enrichment to the crackers of the present invention is preferably an insoluble, tasteless or bland, alkaline calcium salt or compound which does not adversely affect pH,

flavor, or color of the baked good. In addition, the calcium component, added in the dough-up stage of fermented crackers or other fermented baked goods, preferably does not interfere with the desired neutralization of acids produced during fermentation. Exemplary of edible, bland, insoluble calcium components which may be used in preferred embodiments of the invention are calcium carbonate, tricalcium phosphate, and mixtures thereof. Calcium carbonate is the most preferred calcium component for enriching the calcium content of crackers in accordance with the present invention.

A preferred source of calcium carbonate is ground, food grade limestone. The ground limestone may have a calcium carbonate content of at least about 94% by weight. It is generally obtained by crushing, grinding and classifying naturally occurring limestones (calcite), beneficiated by flotation and/or air classification. It is a white to off-white, microcrystalline powder, odorless, tasteless and stable in air. It is insoluble in water and alcohol. It is soluble in dilute acetic acid, dilute hydrochloric acid and in nitric acid. The ground limestone, as well as other calcium compounds utilized in the present invention, may have a particle size distribution of: a) less than or equal to about 0.2% by weight retained on a 200 mesh U.S. Standard Sieve, and b) at least about 90% by weight, preferably at least about 98% by weight, passing through a 325 mesh U.S. Standard Sieve.

Exemplary amounts of the calcium enrichment component, such as calcium carbonate, for providing more than 10% of the U.S. R.D.A. of 1000 mg of calcium per 15 gram serving are from about 3% by weight to about 30% by weight, preferably from about 5% by weight to about 15% by weight, based upon the total weight of the flour.

The emulsifier compositions used in the present invention to reduce hardness and dry mouthfeel preferably comprise effective emulsifying amounts of: a) at least one polyoxyethylene sorbitan fatty acid ester, preferably polysorbate 60, and b) at least one stearyl lactylate, preferably sodium stearyl lactylate. The ratio (wt) of the weight of sodium stearyl lactylate and/or other stearyl lactylates to the weight of the polysorbate 60 and/or other polyoxyethylene sorbitan fatty acid ester components may be from about 4.65-0.3:1, preferably from about 3.5-1.15:1.

Additional emulsifiers, such as lecithin, mono- and/or di-glycerides, sorbitan monoesters, diacetyl tartaric acid esters of mono- and diglycerides, or mixtures thereof may be used provided they do not adversely affect flavor, appearance or texture, or calcium absorption. In full-fatted or conventional crackers or other baked goods which have not had their fat content substantially reduced, excessive use of emulsifiers may deleteriously affect dough machinability or baked good quality. For example, excessive use of emulsifiers may unduly decrease cracker crispness, increase blistering, create a non-uniform cell structure, or provide excessive softness or fragility for mass packaging operations.

In producing calcium enriched reduced fat, low-fat, and no-fat baked goods the emulsifier compositions preferably contain at least one lecithin in addition to at least one polyoxyethylene sorbitan fatty acid ester, and at least one stearyl lactylate, as disclosed in said copending, commonly assigned U.S. application Ser. No. 08/351,059, for "Tenderized Baked Good Production With Reduced Fat, Low-Fat, Or No Added Fat" filed Nov. 29, 1994 in the names of Ellen L. Zimmerman, Julia M. Carey, Louise Sieck, and Harry Levine. As disclosed therein, the three-component emulsifier system is used to replace a portion or all of the

oleaginous composition. The emulsifier combination provides an unexpectedly superior, soft and tender texture to reduced-fat, low-fat, and no-fat baked goods having substantial amounts of ungelatinized starch and relatively low moisture contents. As disclosed therein, these emulsifier compositions contain effective emulsifying amounts of at least one of each of the three emulsifier components: (1) polyoxyethylene sorbitan fatty acid ester, (2) lecithin, and (3) stearyl lactylate. In preferred embodiments, the polyoxyethylene sorbitan fatty acid ester component is polysorbate 60, which is used with lecithin and sodium stearyl lactylate. The amount of polysorbate 60 and/or other polyoxyethylene sorbitan fatty acid ester components may be at least about 15 % by weight, preferably from about 20% by weight to about 40% by weight. The amount of lecithin may be at least about 5% by weight, preferably from about 10% by weight to about 25% by weight. The amount of sodium stearyl lactylate and/or other stearyl lactylates may be at least about 20% by weight, preferably from about 35% by weight to about 70% by weight. The percentages of the three emulsifier components, such as polysorbate 60, lecithin, and sodium stearyl lactylate, add up to 100% by weight. The three component emulsifier compositions may also be used in the preparation of conventional or full-fatted calcium-enriched and other baked goods.

Exemplary of the polyoxyethylene sorbitan fatty acid esters which may be used are water-soluble polyesters such as polyoxyethylene (20) sorbitan monoesters (polysorbate 60), polyoxyethylene (20) sorbitan monoesters (polysorbate 80), and mixtures thereof. Polysorbate 60 is preferred.

Polysorbate 60, polyoxyethylene (20) sorbitan monoester, is a hydrophilic emulsifier which is a mixture of stearate and palmitate partial esters of sorbitol and sorbitol polyhydrides condensed or copolymerized with approximately 20 moles of ethylene oxide (C_2H_4O) for each mole of sorbitol and its mono- and dihydrides. It is a lemon- to orange-colored, oily liquid or semi-gel having a faint, characteristic odor and a warm, somewhat bitter taste. It is soluble in water, saline, ethyl acetate, and toluene, but is soluble only at low levels in mineral and vegetable oils. Polysorbate 60 is commercially available under the trademark Tween 60 from ICI-Atlas.

Polysorbate 80, polyoxyethylene (20) sorbitan monoester, is a hydrophilic emulsifier which is a mixture of oleate partial esters of sorbitol and sorbitol polyhydrides condensed or copolymerized with approximately 20 moles of ethylene oxide (C_2H_4O) for each mole of sorbitol and its mono- and dihydrides. It is a yellow- to orange-colored, oily liquid having a faint, characteristic odor and a warm, somewhat bitter taste. It is very soluble in water, producing an odorless, nearly colorless solution, and is soluble in ethanol, cottonseed oil, corn oil, methanol, ethyl acetate and toluene. Polysorbate 80 is commercially available under the trademark Tween 80 from ICI-Atlas.

Exemplary of the stearyl lactylate component are alkali and alkaline-earth stearyl lactylates such as sodium stearyl lactylate, calcium stearyl lactylate, and mixtures thereof. Sodium stearyl lactylate is preferred.

Lecithin, or phosphatidylcholine, is a phospholipid found in all living organisms (plants and animals). Lecithin is a mixture of the diglycerides of stearic, palmitic, and oleic acids, linked to the choline ester of phosphoric acid. Examples of natural lecithins which may be used include those derived from plants such as soybeans, rapeseed, sunflower, or corn, and those derived from animal sources such as egg yolk. Soybean-oil-derived lecithins are preferred.

Commercially available lecithin is preferred for use in the present invention. Commercial grades generally contain about 2.2% phosphorus. Lecithin is prepared commercially primarily from soybean oil. It exists preformed as a contaminant in crude soybean oil, and the commercial method of preparation involves precipitation from the oil and subsequent purification. It may be further processed by bleaching, fractionation, hydrolysis, acetylation, extraction, hydroxylation, and the like. Soybean lecithin may contain about 11.7% palmitic acid, about 4% stearic acid, about 8.6% palmitoleic acid, about 9.8% oleic acid, about 55% linoleic acid, about 4% linolenic acid, and about 5.9% C₂₂ to C₂₄ acids, including arachidonic acid.

Commercial grades of lecithin are classed according to total phosphatides, color, and fluidity. The amount of phosphatides in commercial lecithin generally ranges between about 54% and about 72%. The product specifications usually report the concentration of phosphatides as "percent acetone-insolubles." Color is stated as unbleached, single bleached, and double bleached. The bleaching process tends to reduce the effectiveness of the lecithin as a surface-active material. The consistency will be "plastic" or "fluid".

Lecithin is available as a regular waxy solid or as "fluid," a molasses-like syrup. Fluidization may be attained by addition of 2-5% fatty acids and/or by mechanical means. The lecithin is a waxy mass when the acid value is about 20. It is a pourable, thick fluid when the acid value is around 30. The color of lecithin is sandy white when freshly made, but rapidly becomes yellow to brown in air. It may have an iodine value of about 95% and a saponification value of about 196. Lecithin is insoluble but swells in water and in NaCl solution, forming a colloidal suspension.

In preferred embodiments of the present invention, commercially available, fluidized, soybean-oil-derived lecithin is employed. Exemplary of a preferred fluid lecithin is an unbleached lecithin, derived from the phosphatides of phospholipids of soybean oil, which is semi-solid but pourable at room temperature. The Brookfield viscosity at 77° F. of the oil-based product may be about 5300 (±200) cpa, and it may be light tan to yellow in color. The moisture content of the fluid lecithin may be less than or equal to 1% by weight, and its acetone-insoluble matter (phosphatides) may be at least 62% by weight. The hexane-soluble matter may be 0.3% by weight maximum, and the acid value may be 32 maximum.

Exemplary amounts of the emulsifier composition for achieving tenderization of the calcium fortified crackers or other baked goods may be from about 3% by weight to about 45% by weight, based upon the weight of the calcium component. In conventional or full-fatted baked goods, emulsifier amounts at the lower end of the range are generally used. Exemplary amounts of the emulsifier composition for use in calcium enriched full fat/ products may range from about 3% by weight to about 20% by weight, preferably from about 5% to about 15% by weight, based upon the weight of the calcium component. As the fat content of the baked good is reduced, generally higher amounts of the emulsifier composition may be used to reduce hardness caused by both calcium enrichment and fat reduction. For example, exemplary amounts of the emulsifier for use in calcium enriched no-fat baked goods such as crackers, may range from about 15% by weight to about 45% by weight, based upon the weight of the calcium component.

The emulsifier components, such as polysorbate 60, soybean lecithin, and sodium stearoyl lactylate, may be incorporated into the dough separately or as a premix. They are

preferably separately added to the flour. In embodiments of the invention, the emulsifier components may be used in a total amount of from about 0.15% by weight to about 2.5% by weight of the total amount of flour used to form the machineable dough or batter. Generally, as the calcium content is increased and the fat content is decreased, the amount of emulsifier used to obtain a soft, tender texture may be increased.

The emulsifier components may be premixed with, or present in, other dough or batter ingredients, such as a flavorant. In preferred embodiments, a natural flavorant is premixed with polysorbate 60, wherein the polysorbate 60 serves as a carrier, alone or with other carriers, for the flavorant to enhance flavor of the baked product. The polysorbate may, for example, amount to about 20-35% by weight of the total flavorant composition.

The three component emulsifier system used to replace a portion or all of the oleaginous composition provides an unexpectedly superior, soft and tender texture to reduced-fat, low-fat, and no-fat baked goods having substantial amounts of ungelatinized starch and relatively low moisture contents. The emulsifier composition increases the tenderness and softness of the baked good and increases the air-holding capacity, the lubricity, lay time, and machineability of the dough, which would otherwise be diminished by the lower levels of oleaginous composition and higher levels of water. In embodiments of the invention, calcium enriched baked goods in which about 15% or more of the starch is ungelatinized may have their fat content substantially reduced or even eliminated, without substantially adversely affecting dough machineability or baked-good texture, appearance, taste, and shelf-life. In preferred embodiments, the percentage of ungelatinized starch approaches or is substantially the same as that of the full-fatted product.

By interacting with water, the emulsifier composition provides a liquid phase which provides lubricity and air-entrapment capability to the dough. It also helps to reduce excessive starch gelatinization during baking. This avoids a hard, stinky texture in the relatively low moisture-content baked product. The emulsifier composition does not impart a soapy or off-flavor to the baked good, and it does not produce an excessively blistered surface. The unexpectedly soft, tender, non-brittle texture is exhibited for at least two months, preferably at least six months, in proper, air-tight packaging.

Generally, starch gelatinization occurs when: a) water in a sufficient amount, generally at least about 25 to 30% by weight, based upon the weight of the starch, is added to and mixed with starch and, b) the temperature of the starch-water mixture is raised to at least about 80° C. (176° F.), preferably 100° C. (212° F.) or more. The gelatinization temperature depends upon the amount of water available for reaction with the starch. The lower the amount of available water, generally, the higher the gelatinization temperature. Gelatinization may be defined as the collapse (disruption) of molecular order within the starch granule, manifested in irreversible changes in properties such as granular swelling, native-crystallite melting, loss of birefringence, and starch solubilization. The point of the initial stage of gelatinization and the range over which it occurs are governed by starch concentration, method of observation, granule type, and heterogeneity within the granule population under observation. Pasting is the second-stage phenomenon following the first stage of gelatinization in the dissolution of starch. It involves increased granular swelling, condensation of molecular components (i.e. amylose, followed by amylopectin) from the granule, and eventually, total disruption of the

grams. See Atwell et al., "The Terminology And Methodology Associated With Basic Starch Phenomena," *Cereal Foods World*, Vol. 33, No. 3, Pgs. 306-311 (March 1988).

The emulsifier composition, it is believed, complexes with amylose, which is mobilized and made available during the first stage of starch gelatinization. In the second stage of gelatinization, or during pasting, the amylose is hindered from pasting because it is complexed with the emulsifier composition. As a result, the overall extent of starch gelatinization is hindered by the formation of the complex or complexes. Adverse effects on texture of baked goods which would otherwise result from excessive gelatinization in the presence of water during baking are thereby avoided.

As used herein, a reduced-fat food product is a product having its fat content reduced by at least 25% by weight from the standard or conventional product. A low-fat product has a fat content of less than or equal to three grams of fat per reference amount or label serving. However, for small reference amounts (that is, reference amounts of 30 grams or less or two tablespoons or less), a low-fat product has a fat content of less than or equal to 3 grams per 50 grams of product. A no-fat or zero-fat product has a fat content of less than 0.5 grams of fat per reference amount and per label serving. For accompaniment crackers, such as a saltine cracker, the reference amount is 15 grams. For crackers used as snacks and for cookies, the reference amount is 30 grams. Thus, the fat content of a low-fat cracker or cookie would therefore be less than or equal to 3 grams of fat per 50 grams or less than or equal to about 6% fat, based upon the total weight of the final product. A no-fat accompaniment cracker would have a fat content of less than 0.5 grams per 15 grams or less than about 3.33%, based upon the weight of the final product.

Oleaginous compositions which may be used to obtain the calcium fortified full-fat, reduced-fat or low-fat baked goods of the present invention may include any known shortening or fat blends or compositions useful for baking applications, and they may include conventional food-grade emulsifiers. Vegetable oils, lard, marine oils, and mixtures thereof, which are fractionated, partially hydrogenated, and/or interesterified, are exemplary of the shortenings or fats which may be used in the present invention. Edible reduced- or low-calorie, or non-digestible fats, fat substitutes, or synthetic fats, such as sucrose polyester, which are process-compatible may also be used. Mixtures of hard and soft fats or shortenings and oils may be used to achieve a desired consistency or melting profile in the oleaginous composition. Exemplary of the edible triglycerides which can be used to obtain the oleaginous compositions for use in the present invention include naturally occurring triglycerides derived from vegetable sources such as soybean oil, palm kernel oil, palm oil, rapeseed oil, safflower oil, sesame oil, sunflower seed oil, and mixtures thereof. Marine and animal oils such as anchovy oil, menhaden oil, herring oil, lard, and tallow may also be used. Synthetic triglycerides, as well as natural triglycerides of fatty acids, may also be used to obtain the oleaginous composition. The fatty acids may have a chain length of from 8 to 24 carbon atoms. Solid or semi-solid shortenings or fats at room temperatures of, for example, from about 75° F. to about 95° F. may be used. Preferred oleaginous compositions for use in the present invention comprise purified soybean oil in which the lecithin has been removed during purification. The shortening or fat content of the calcium enriched cracker doughs of the present invention may range from about 0 to about 40% by weight, based upon the weight of the dough. The shortening or fat content of the calcium enriched cracker doughs is

generally less than about 12% by weight, based upon the weight of the dough.

The flour component or flouraceous materials may be any comminuted cereal grain or edible seed or vegetable meal, derivatives thereof and mixtures thereof. Exemplary of the flour component or flouraceous materials which may be used are wheat flour, corn flour, corn meal flour, oat flour, barley flour, rye flour, rice flour, potato flour, grain sorghum flour, tapioca flour, graham flour, or starches, such as corn starch, wheat starch, rice starch, potato starch, tapioca starch, physically and/or chemically modified flours or starches, such as pregelatinized starches, and mixtures thereof. The flour may be bleached or unbleached. Wheat flour or mixtures of wheat flour with other grain flours are preferred. The amount of flour used in the compositions of the present invention ranges, for example, from about 30% by weight to about 80% by weight, preferably from about 45% by weight to about 75% by weight, based upon the weight of the dough. Unless otherwise indicated, all weight percentages are based upon the total weight of all ingredients forming the doughs or formulations of the present invention, except for inclusions such as flavor chips, nuts, raisins, and the like. Thus, "the weight of the dough" does not include the weight of inclusions.

The flour may be replaced in whole or in part by flour substitutes or bulking agents, such as polydextrose, hydrocellulose, microcrystalline cellulose, mixtures thereof, and the like. Corn bran, wheat bran, oat bran, rice bran, molasses thereof, and the like may also be substituted in whole or in part for the flour, for making a fiber-enriched product, to enhance color, or to affect texture.

Corn flour and/or wheat bran may be used, for example, to enhance color and affect texture. Exemplary amounts range up to about 15% by weight corn flour and up to about 20% by weight wheat bran, the percentages being based upon the total weight of ingredients forming the dough. In preferred embodiments of the invention, the corn flour and wheat bran may each comprise from about 1 to about 10% by weight, based upon the weight of the dough.

Process-compatible ingredients, which can be used to modify the texture of the products produced in the present invention, include sugars such as sucrose, fructose, lactose, dextrose, galactose, maltodextrins, corn syrup solids, hydrogenated starch hydrolyzates, protein hydrolyzates, glucose syrup, mixtures thereof, and the like. Reducing sugars, such as fructose, maltose, lactose, and dextrose, or mixtures of reducing sugars may be used to promote browning. Fructose is the preferred reducing sugar, because of its ready availability and its generally more enhanced browning and flavor-development effects. Exemplary sources of fructose include invert syrup, high fructose corn syrup, molasses, brown sugar, maple syrup, mixtures thereof, and the like.

The texturizing ingredient, such as sugar, may be added with the other ingredients in either solid or crystalline form, such as crystalline or granulated sucrose, granulated brown sugar, or crystalline fructose, or in liquid form, such as sucrose syrup or high fructose corn syrup. In embodiments of the invention, humectant sugars, such as high fructose corn syrup, maltose, sorbose, galactose, corn syrup, glucose syrup, invert syrup, honey, molasses, fructose, lactose, dextrose, and mixtures thereof, may be used to promote chewiness in the baked product.

In addition to the humectant sugars, other humectants, or aqueous solutions of humectants which are not sugars or possess a low degree of sweetness relative to sucrose, may also be employed in the dough. For example, glycerol, sugar

alcohols such as mannitol, maltitol, xylitol and sorbitol, and other polyols, may be used as humectants. Additional examples of humectant polyols (i.e. polyhydric alcohols) include glycols, for example propylene glycol, and hydrogenated glucose syrups. Other humectants include sugar esters, dextrins, hydrogenated starch hydrolysates, and other starch hydrolysis products.

In embodiments of the present invention, the total sugar solids content, or the total solid ingredient content, of the doughs of the present invention may range from zero up to about 50% by weight, based upon the weight of the dough.

The moisture contents of the doughs of the present invention should be sufficient to provide the desired consistency to enable proper forming, machining, and cutting of the dough. The total moisture content of the doughs of the present invention will include any water included as a separately added ingredient, as well as the moisture provided by flour (which usually contains about 12% to about 14% by weight moisture), and the moisture content of other dough additives included in the formulation, such as high fructose corn syrup, invert syrups, or other liquid humectants.

Taking into account all sources of moisture in the dough or batter, including separately added water, the total moisture content of the doughs or batters of the present invention is generally less than about 50% by weight, preferably less than about 33% by weight, based upon the weight of the dough or batter. The cracker doughs of the present invention generally have a moisture content of about 25% by weight to about 33% by weight, based upon the weight of the dough. Cookie doughs of the present invention may have a moisture content of less than about 30% by weight, generally from about 10% by weight to about 20% by weight, based upon the weight of the dough.

Preferably, minimal amounts of water are used to form the dough, so as to limit starch gelatinization. In embodiments of the present invention, the water content of a full-fat, reduced-fat, low-fat, or no-fat cracker dough may be reduced: a) without substantially increasing the viscosity or consistency of the dough, and b) without substantially increasing the gelatinization of the starch, compared to the full-fat, reduced-fat, low-fat, or no-fat dough which does not contain the emulsifier system. Exemplary reductions in the dough water content may range from about 4% by weight to about 15% by weight of the water used in the dough without the emulsifier system.

In addition to the foregoing, the doughs of the invention may include other additives conventionally employed in crackers and cookies. Such additives may include, for example, milk by-products, egg or egg by-products, cheese, cocoa, vanilla or other flavorings, as well as inclusions such as nuts, raisins, coconut, flavored chips such as chocolate chips, butterscotch chips and caramel chips, and the like in conventional amounts.

A source of protein, which is suitable for inclusion in baked goods, may be included in the doughs of the present invention to promote Maillard browning. The source of protein may include non-fat dry milk solids, dried or powdered eggs, whey protein, and the like. The amount of the proteinaceous source may, for example, range up to about 5% by weight, based upon the weight of the dough.

The dough compositions of the present invention may contain up to about 5% by weight of a leavening system, based upon the weight of the dough. Exemplary of chemical leavening agents or pH-adjusting agents which may be used include alkaline materials and acidic materials such as

sodium bicarbonate, ammonium bicarbonate, calcium acid phosphate, sodium acid pyrophosphate, diammonium phosphate, tartaric acid, and the like. Yeast may be used alone or in combination with chemical leavening agents.

In embodiments of the present invention, enzymatic treatment may be used to alter the water-binding non-cellulosic, cell-wall polysaccharides such as pectins and/or hemicelluloses in the dough environment. Pectins, for example, hold a lot of water, even though they amount to only a minor fraction of the dough. Hydrolyzing the pectins, or other hemicelluloses so they permit release of water from the dough before the starch gelatinization temperature is reached during baking, helps to lower the amount of gelatinization of starch. Water released from the pectins, but not from the dough during baking, may interact with the emulsifier composition. This may contribute to, or provide a portion of, the liquid phase which lubricates the dough and entraps air.

The enzymes may be used at temperatures and pH conditions normally recommended by their manufacturers, or at conditions which are optimal for pectinase or other hemicellulase activities. The enzymes may be acidic, neutral, or alkaline. Exemplary commercially available enzyme preparations which may be used in the present invention are: (1) PEN #3 Liquid Concentrate, manufactured by Quest International Bioproducts Group, 1833 37th Street, Sacramento, Fla., and (2) Multifect XL and Cytolase 123 (also known as GC123), manufactured by Genencor, Inc., 180 Kimball Way, South San Francisco, Calif. 94080. These enzyme preparations are cellulases from the microorganism *Trichoderma reesei*, which possess powerful pectinase-degrading activity. They are believed to comprise endo-cellulase, beta-glucanase, pectinase, and beta-glucosidase. According to Genencor literature, when GC123 is evaluated in cereal grain applications, the enzyme should be added at about 0.2 percent w/w based on grain. It is indicated that, in many applications, this dosage can be substantially reduced. It is further indicated that optimal operating pH for the important activities in GC123 is generally centered around pH 4.8, and that considerable flexibility exists. Typically, it is reported, pH adjustment is not required when treating cereal grains suspended in tap water (pH approximately 6.2). According to the Genencor literature, optimal activity is generally found at about 50° to 60° C. (122° to 140° F.). The enzymes, it is stated, are also active at lower temperatures, but work less quickly. Higher temperatures (to approximately 70° C.) may be used for short incubation times, but the activity is soon lost due to thermal inactivation.

The pectinase content of hemicellulase enzymes is preferably measured as xylanase units of activity (XAU). The assay principle is this: xylanase activity is determined by the manufacturer with a simple colorimetric assay. A commercially available, soluble, dyed xylan is hydrolyzed, and the small molecular weight fragments are not precipitated by ethanol, leaving a colored supernatant. Xylanase activity of PEN #3 concentrate, for example, is about 10,250±750 XAU/ml. Exemplary amounts of the enzyme composition used in the present invention may range from about 200 to about 1500 XAU/lb flour, preferably from about 900 to about 1300 XAU/lb flour.

The enzyme may be added in liquid or powdered form. Liquid forms which have been diluted with water are preferred for facilitation of homogeneous distribution throughout the dough. Exemplary amounts of the enzyme composition used in the present invention, presented in aqueous solution, may be about 0.1% by weight to about

0.4% by weight of solution, based on the total weight of the flour. The enzyme solution may be prepared by dissolving about 1 part by weight of enzyme concentrate with about 9 parts by weight of water.

Enzymes have optimal environments in which they function best. Care should be taken, with regard to enzyme treatment, to create a suitable environment for the enzyme. The pH of certain leavening agents is high, so they preferably should not be admixed with the enzyme in a concentrated manner. For example, in producing an unfermented cracker, the leavening agent is preferably well dispersed with the other ingredients, prior to the addition of the enzyme.

The machineable calcium enriched, full-fat, no-fat, low-fat, and reduced-fat doughs of the present invention are continuously sheetable using counter-rotating rolls. The cracker dough sheet can be continuously laminated upon itself to form from 3 to 8 laminas, for example. The laminated cracker doughs are capable of being reduced in thickness by counter-rotating rolls, to obtain a sheet which may be cut into pieces by reciprocating or rotary cutters, for example. Plastic cutters, such as nylon or polycarbonate cutters, or plastic-coated steel cutters, such as Teflon-coated steel cutters, may be used to reduce dough adherence. Conventional cracker manufacturing equipment, such as gauge rollers, laminators, and cutters, may be used in the present invention.

The calcium enriched cookie doughs may be sheeted by counter-rotating rollers and cut into pieces by rotary or reciprocating cutters. The cookie doughs may also be formed into pieces by wire-cutting or rotary-mixing.

In embodiments of the present invention, the machineable full-fat, no-fat, low-fat, and reduced-fat or shortening-content doughs may have an LFRA value of about 100 grams to about 1200 grams, preferably from about 400 grams to about 800 grams. LFRA is an acronym for Leatherhead Food Research Association, the manufacturer of a texture analyzer. As used herein, the LFRA value represents the resistance of the dough to deformation by a 0.5"-diameter ball probe moving at a constant rate of 2 millimeters per second for a set distance of 15 millimeters into the dough.

The baked products of the present invention have a relative vapor pressure ("water activity") of less than about 0.7, preferably less than about 0.6, to assure microbial shelf-stability. The water content of the cracker, snack, snack or fabricated chip, pretzel, bagel chip, and Melba toast products is generally less than about 6% by weight, for example, from about 0.25% by weight to about 4% by weight, based upon the weight of the baked product, exclusive of inclusions. The pH of the calcium enriched crackers may generally be from about 6.4 to about 8.1.

Cookies, brownies and cake products generally have a moisture content of less than about 20% by weight, for example, from about 2% by weight to about 9% by weight for cookies, based upon the weight of the baked product, exclusive of inclusions.

Starch gelatinization (measured by differential scanning calorimetry) in the baked products of the present invention may generally be less than about 80% for crackers and snacks and less than about 10% for cookies.

Fermented Cracker Production

Conventional or full-fat calcium enriched crackers and fat-free, reduced-fat, and low-fat fermented calcium enriched crackers are produced using a sponge stage and a

dough-up stage. The basic ingredients in the preparation of a sponge are flour and water. The fermentation agents are yeast and bacteria. The yeast, flour, and the surfaces of the trough in which the sponge is formed can serve as sources of microflora. It is preferable to use a starter or inoculum from a previous batch of sponge to serve as a source of bacteria. A sponge flour is generally relatively strong, unleached, with an ash content of 0.39 to 0.49%. It may have a protein content of about 7.5 to 13.0% and an acid viscosity value in the range of about 60° to 90°M. A sponge may be produced by combining the flour, water, yeast, and bacterial source in a mixer, such as a spiral mixer or upright mixer.

It is preferable to add all of the water in the sponge-forming stage, to avoid an extra step in the dough-forming stage. However, a portion of the water may be added to the sponge in the dough-forming stage, in a manner which avoids disturbing the substantially uniform distribution of the leavening agents.

Exemplary relative amounts of the ingredients, which may be used in the formation of the sponge, are from about 60 to about 70% by weight flour, from about 25 to about 35% by weight water, from about 0.05 to about 1% by weight yeast, from about 0 to about 2% by weight diastatic malt or proteolytic enzyme, from about 0 to about 2% by weight yeast food, from about 0 to about 3% by weight of cracker meal, and from about 0 to about 2% by weight of starter or ferment. All percentages are based upon the total weight of the ingredients used to form the sponge. Known buffers can be added as needed to obtain a pH of about 5 to about 6.5 at the start of the fermentation. Various flours can be used, such as wheat, oat, rice, Graham and mixtures thereof, but wheat flour or mixtures thereof with one or more other flours are preferred.

Fermentation times (also referred to herein as sponge times) are those conventionally used in the art. In the case of soda crackers or saltines, and the many variants of these products, such as oyster (soup) crackers, club crackers, cheese crackers, and the like, sponge times of about 2 to 24 hours are typically used.

In preparing the sponge, no special order of mixing is required. Conventional processes can be used. Generally, the flour is dumped into a trough, a portion of the water containing dispersed yeast and buffer is added, the remaining ingredients of the sponge are added, and then the balance of the water is added. The sponge ingredients are mixed until substantial homogeneity is achieved.

When doughing-up the sponge, dough ingredients for mixing into the fermented sponge generally include flour and sodium bicarbonate. In producing full-fat, reduced-fat or low-fat crackers, the shortening or fat may also be added in the dough-up stage. The addition of fat or shortening in the preparation of the sponge may decrease fermentation activity. Minor amounts of water, sodium chloride, ammonium bicarbonate, and/or other leavening agents and pH adjusting agents may be added in the dough-up stage. The calcium component, such as calcium carbonate, for fortifying the products of the present invention with calcium is added in the dough-up stage so as not to interfere with the fermentation in the sponge stage. It is preferable to include all of the water as an ingredient of the sponge. The dough-up flour may generally be weaker than the sponge flour, and may typically have an ash content of about 0.45%, and an acid viscosity value of about 40° to 60°M. Wheat flour and mixtures thereof with at least one other flour are preferred.

The relative amounts of the sponge ingredients to the dough ingredients may generally be such that the weight-

percent of flour used to form the sponge is from about 60% to about 75% by weight of the total amount of flour which is used.

The emulsifiers used in the present invention are added in the dough-up stage, so as to ensure maximum fermentation. The liquid or "wet" emulsifiers, such as fluidized lecithin and polysorbates, are preferably added on the surface of the sponge, prior to flour addition. Keeping the "wet" ingredients in contact with the sponge minimizes lumping, as could otherwise occur if these ingredients were added on top of the flour in the dough-up stage. The stearoyl lactylates may be added on top of the dough-up flour, along with other dry ingredients such as salt, leavening agents, and the calcium component. Any shortening or fat included in the formulation may be added last.

Hemicelluloses may be added during sponge preparation, during sponge fermentation, or at a later time. However, adding the hemicelluloses at dough-up is preferred, to avoid the possibility of interference with the sponge-fermentation process. For example, pectinase is preferably added to the surface of the sponge, in a solution for even dispersion and avoidance of lumping, prior to flour addition. When, for example, pectinases are used which work best at pH's of about 4.5 or 5, alkaline leavening agents, e.g. sodium bicarbonate, and alkaline calcium components preferably should be maintained separate from the pectinase for as long as possible, to obtain consistently optimal results.

The dough-up ingredients and the sponge are then mixed to obtain a dough of substantial homogeneity. After mixing, the dough is proofed, or allowed to ferment further, as is conventional in the cracker art. The viscosity of the dough is also decreasing during this time. Typical proofing times range from about 2 hours to about 5 hours, most typically about four hours. Generally, the temperature of the sponge before doughing, the temperature of the dough after doughing, and the temperature of the dough at the dough-forming machine are substantially the same.

The proofed dough is machined and baked in the conventional manner for the preparation of fermented crackers. Soda crackers, for example, may be formed from a continuous sheet of dough which is laminated or lapped before being cut. The dough pieces are formed by a stamping device, such as a reciprocating cutter or rotary cutter, which does not entirely sever the individual crackers from the sheet. The crackers remain in a substantially continuous sheet through the band oven. The cutter may also puncture the dough pieces to form dock holes for the prevention of uneven or excessive expansion in the oven. After baking, the individual crackers are separated from the substantially continuous sheet. The optional topping salt is generally applied after stamping and before baking.

The baked product is generally dried during the baking step or in a subsequent drying step to a moisture content of about 2% to about 4 % by weight, based upon the final weight of the cracker. In embodiments of the invention optional topping or spray oil may be applied to the baked product.

A problem may arise with the shelf-life of fat-free crackers. They can go rancid more rapidly than crackers made with fat. This is believed to be because fat or shortening retards oxygenation and peroxide formation at points of concentration in naturally occurring grain lipids. Lipids are naturally present in grains such as wheat and wheat products such as flour. It is these lipids which can go rancid when fat-free crackers are made. At some point in the process, an antioxidant agent such as naturally occurring anti-ox-

idants, including citric acid or tocopherols, or BHT, BHA or TBHQ, or mixtures thereof, can be added to prevent rancidity.

Unfermented Cracker Production

In preparing full-fat, no-fat, low-fat, and reduced-fat, unfermented calcium enriched crackers by the method of the present invention, the ingredients used may be basically the same as when preparing fermented crackers, except that no yeast or bacteria is employed. Thus, the ingredients of the dough may comprise flour, water, optional shortening or fat, sodium bicarbonate and a food-grade acidic compound to effect leavening. Proteolytic, amylolytic, and pectinase enzymes may be used. The flour used in unfermented crackers does not generally need to be as strong as the sponge flour used in fermented crackers, although the flour should be moderately strong. Advantageously, the dough used to prepare the unfermented crackers comprises malt.

In addition to the aforementioned ingredients, doughs used to prepare unfermented crackers of the snack type by the method of the present invention may contain one or more sugars. For example, the sugar may be added as a substitute of sucrose with at least one humectant sugar, such as high fructose corn syrup, cane syrup, or glucose syrup. Exemplary amounts of the sugars used per 100 parts by weight of flour in the dough may be from about 4 to about 12 parts by weight of sucrose and from about 1 to about 5 parts by weight of one or more humectant sugars.

When producing unfermented crackers by the method of the present invention, the conventional mixing steps of a creaming stage followed by a dough-up stage may be employed. In the creaming stage, all the ingredients, including the emulsifiers of the present invention, may, for example, be creamed, except for the wheat flour, calcium component of the present invention, leavening agents, liquid pectinase, and a portion of the water. In the dough-up stage, the flour may be added, followed by the leavening agents and optional enzymes, added, with the remaining water on top of the flour. The calcium component is preferably added in the dough-up stage. In embodiments of the invention, the calcium component or a portion thereof may be added in the creaming stage. To ensure uniform distribution of the minor ingredients throughout the dough, the flour added in the dough-up stage is preferably distributed substantially uniformly over the surface of the substantially homogeneous mixture formed in the creaming stage. The dough is generally proofed for about 0.5 to about 4.0 hours, although longer and shorter times are possible. The dough may then be sheeted, optionally laminated, then cut and baked. The final moisture content may, for example, be less than about 2.5% by weight.

Cookie Production

The calcium enriched cookie doughs or batters of the present invention may be prepared by admixing any shortening or fat with the sugars, flavorings, gums, emulsifiers, and other texturizing ingredients in a conventional upright dough-mixer to obtain a substantially homogeneous mixture. Water, and wheat flour or other flours, and the calcium component may then be admixed with the substantially homogeneous mixture in a second mixing stage. Preservatives and leavening agents may be added in the first or second mixing stage. In embodiments where a humectant is used, it may be conveniently mixed in during the first mixing stage of the dough preparation. The humectant, and at least

part of any sucrose which is used, may also be conveniently admixed with the ingredients in a third mixing stage to obtain a substantially homogeneous, porous batter or dough.

In embodiments of the present invention, the total sugar-solids content, or the texturizing ingredient content, of the cookie doughs, batters, or dough-like mixtures of the present invention may, for example, be at least about 10% by weight, and may, for example, go up to about 50% by weight, based upon the weight of the dough, batter, or dough-like mixture (exclusive of inclusions).

On the basis of 100 pounds of the total amount of flour component in the cookie dough or batter, a humectant, plus any sucrose or other sweetener employed (e.g. artificial sweetener) in the formulation, may be present in amounts ranging from about 25 to about 175 pounds, depending on the degree of sweetness and humectant properties desired in the baked product.

If flavor chips or fruit pieces are to be added to the cookie dough or batter, they are preferably added, as the last ingredient, to the dough with minimal mixing, so as to avoid smearing of the flavor chips or pieces into the dough or batter.

The doughs or batters are generally prepared at a temperature of less than about 115° F. They may be cooled using ice as a portion of the added water. Solid or liquid carbon dioxide may also be used to cool the dough or batter. Exemplary dough or batter temperatures may range from about 60° F. to about 77° F. Before being shaped or extruded, the dough or batter may be permitted to lay flat about 20 minutes to about 120 minutes to hydrate and achieve optimum consistency, in order to control oven spread and to facilitate transfer and forming operations.

The doughs or batters may be shaped or formed into pieces using conventional cookie-dough-forming and shaping-equipment. For example, the doughs may be sheared between counter-rotating rollers and cut using rotary or reciprocating cutters. They may be formed into pieces by wire-cutting, rotary-molding, enrobing, encrusting, and the like.

In embodiments of the present invention, a cylinder press, an extruder, or continuous mixer may be utilized to form the dough or dough-like mixture into a continuous rope. Preferably, the screws of the extruder will be co-rotating, i.e., rotating in the same direction. Co-rotating twin-screw elements generally provide thorough mixing and conveying of the components, with the elements of one screw continuously wiping the other screw. This is particularly advantageous when the composition being mixed has a relatively high viscosity.

Suitable extruders which may be used in the present invention include: (1) WENGER model series TX by Wenger of Baboia, Kans., (2) model series MFF by Baker Perkins, (3) model series BC by Cramet Laine of Paris, France, and (4) model series ZSK or Conforma by Werner and Pfleiderer. Single-screw extruders, including those with a screw that oscillates horizontally during rotation (i.e. a Buss kneader by Buss of Pfullen, Switzerland), may also be used in accordance with the present invention.

A continuous mixer for use in the present invention comprises co-rotating screws and jacketed barrels with heating and/or cooling means. A continuous mixer is similar in construction to a cooker-extruder, except that for the same screw diameter, a continuous mixer has a greater free internal volume and thus operates to mix and convey ingredients at relatively lower pressures and shear than does an

extruder, to obtain a substantially homogeneous output. A continuous mixer which may be used is model ZPM-120 by Werner and Pfleiderer.

Filled products may be produced in accordance with the present invention by constructing the dough, batter, or dough-like mixture with filler materials. The co-extrudate may be formed by the use of a concentric die or a tube inserted within the die orifice. Filled products may also be produced by transporting the dough-like mixture to a conventional enrobing or encrusting machine, such as produced by the Rhon Manufacturing Company, for filling with a filler material. The filled dough pieces may have a weight ratio of the filler to the casing dough within the range from about 0.4-1.6:1.

Examples of fillers which may be used include chocolate, vanilla, butterscotch, fruit, peanut butter, and cheese-flavored fillings. The filling material may also be a separately produced dough or batter, for the production of multi-flavored, multi-colored, or multi-textured cookie products. The preferred fillers for use in the present invention are low-fat or fat-free fillers. The fillers may be uncooked or cooked prior to co-extrusion with the doughs of the present invention. Exemplary fillers which may be used are disclosed in U.S. Pat. No. 4,562,080.

The cutting of dough ropes or extrudates before or after baking may be performed by a guillotine-cutter, a band-cutter, fluid-jet cutter, or the like.

The time and temperature of baking are adjusted in accordance with conventional techniques, to provide a shelf-stable moisture content. For example, in crisp variety cookies, the moisture content may be less than about 5% by weight. Soft cookies, cakes and brownies may have higher moisture contents. For example, the soft baked products may have moisture contents of about 5% to 10% by weight or more, based upon the weight of the baked good, inclusive of fillers and inclusions such as flavor chips, raisins and fruit pieces. For example, a fruit-filled, soft, moist cookie or cake may have a moisture content of about 15% by weight or more, based upon the total weight of the cookie. Moisture contents may be determined by first grinding the cookies or other baked product and then using conventional moisture-analysis techniques on the ground sample. Exemplary of such techniques are Babender (wet at 145° C., for 12 minutes) analysis or vacuum-oven (wet at 70° C., for 24 hours) analysis, with appropriate correction. In embodiments of the invention, the reduced-fat, no-fat or low-fat products may exhibit a cookie crumb-like structure, appearance, texture and structural integrity. Starch gelatinization (measured by differential scanning calorimetry) in cookie products of the present invention may be less than about 10%.

The cookie doughs and/or fillers may include anti-mycotics or preservatives, such as calcium propionate, potassium sorbate, sorbic acid, and the like. Exemplary amounts may range up to about 1% by weight of the dough or filler, to assure microbial shelf-stability. While baking times and temperatures will vary for different dough or batter formulations, oven types, etc., in general, commercial cookies, brownies and cake-baking times may range from about 5 minutes to about 15 minutes, and baking temperatures for cookies, brownies, and cakes may range from about 250° F. (121° C.) to about 600° F. (315° C.).

The cookie dough or batter compositions of the present invention may be used for the production of bar-type cookies, drop-type cookies such as chocolate chip cookies, oatmeal cookies, sugar cookies, fruit cookies, sandwich cookies, brownies, and the like.

The present invention is further illustrated in the following examples, where all parts, ratios, and percentages are by weight, and all temperatures are in ° F., unless otherwise stated:

EXAMPLE 1

The ingredients and their relative amounts, which may be used to produce a calcium enriched, full-fat or conventional, fermented cracker dough bakeable to a cracker which provides at least 20% of the U.S. R.D.A. of 1000 mg of calcium per 15 gram serving are:

Sponge Ingredients	Parts by Weight
Wheat flour (about 13% by weight water)	64
Buckley Milk flour (about 10% by weight water)	0.3
Yeast	0.75
Sodium acetate (acetate and previous batch starts)	1.8
Water	28.7
TOTAL	95.55

The sponge is formed by dumping the flour into an upright mixer. The remaining ingredients are added to a mixing tank and blended, then added to the flour in the upright mixer. The mixture in the upright mixer is blended, covered, and fermented or proofed for 10 to 14 hours.

Following this 10-14 hour fermentation, dough-up of the sponge may be effected with the following dough-up ingredients:

Dough-Up Ingredients	Parts by Weight
Wheat flour (about 13% by weight water)	36
Soybean oil, purified	7.5
Mixer ingredients (salt and sodium bicarbonate)	2.55
Sodium stearoyl lactate	0.25
Ground limestone (about 94% by weight calcium carbonate)	1.625
Polyorbate 60	0.125
Natural flavorant	0.975
TOTAL	59.405

Topping Ingredients	Parts by weight
Salt	3.0
Soybean oil, purified	2.5

The polyorbate 60 and natural flavorant are added to the top of the sponge, then the dough-up flour is added on top of this. The polyorbate 60 is added as a viscous liquid premix with the natural flavorant. The premix is commercially available as a natural flavor composition from Bush Borden Allen, Chicago, Illinois. In addition to the polyorbate 60 carrier, the natural flavor composition includes water, soybean oil, sesame oil, partially hydrogenated corn oil, TBHQ as an antioxidant, and sodium benzoate as a preservative. The premix has a white to off-white color and a fat-like flavor and odor.

The ground limestone (at least 94% by weight calcium carbonate) is a commercially available product produced by crushing, grinding and classifying naturally occurring lime-

stone (calcite), beneficiated by flotation and/or air classification. It is a white to off-white, microcrystalline powder, odorless, tasteless and stable in air. It is insoluble in water and alcohol. It is soluble in dilute acetic acid, dilute hydrochloric acid and in nitric acid. The ground limestone, has a particle size distribution of: a) less than or equal to about 0.2% by weight retained on a 200 mesh U.S. Standard Sieve, and b) at least about 98% by weight, passing through a 325 mesh U.S. Standard Sieve.

The salt, sodium bicarbonate, ground limestone (calcium carbonate), and sodium stearoyl lactate are added on top of the dough-up flour, followed by addition of the soybean oil. The dough is mixed, then proofed for 2-5 hours. The proofed dough is then sheeted, the sheeted dough is laminated, reduced in thickness between counter-rotating reduction rolls, and then cut into pieces using a rotary cutter. The cut pieces are baked to a moisture content of about 2.0% by weight to about 4.0% by weight and a pH of about 6.8 to 8.0. The topping salt and topping oil may then be applied to obtain the finished product.

EXAMPLE 2

The ingredients and their relative amounts, which may be used to produce a calcium enriched, fat-free, fermented cracker dough bakeable to a cracker which provides at least 20% of the U.S. R.D.A. of 1000 mg of calcium per 15 gram serving, are:

Sponge Ingredients	Parts by Weight
Wheat flour (about 13% by weight water)	64
Buckley Milk flour (about 10% by weight water)	0.32
Yeast	0.1
Sodium acetate (acetate and previous batch starts)	1
Cooking salt	1
Water	30.4
TOTAL	97.82

The sponge may be formed by dumping the flour into an upright mixer. The remaining ingredients may be added to a mixing tank and blended, then added to the flour in the upright mixer. The mixture in the upright mixer may be blended, covered, and fermented or proofed for 17 to 22 hours.

Following this 17-22 hour fermentation, dough-up of the sponge may be effected with the following dough-up ingredients:

Dough-up Ingredients	Parts by Weight
Wheat flour (about 13% by weight water)	36
Ground limestone (calcium carbonate) of Example 1	1.625
Liquid soybean acetate	0.25
Mixer ingredients (salt and sodium bicarbonate)	1.44
Sodium stearoyl lactate	0.50
Food antioxidant system suitable (ascorbic acid or other antioxidant)	0.125
Polyorbate 60	0.25
Natural flavorant	0.75
TOTAL	44.84

The xylanase, lichen, polysorbate 60 and natural flavorant may be added to the top of the sponge, then the dough-up flour may be added on top of this. The source of xylanase used may be PEN 83 liquid concentrate. It has an activity of about 10250±750 XAU per ml and is sold by Qant International Bioproducts Group, 1833 57th Street, Sarasota, Fla. The liquid xylanase solution may be prepared by adding 1 part by weight of PEN liquid concentrate with 9 parts by weight of water. The amount of xylanase which would be added is equivalent to about 1162 XAU/lb flour, based on the manufacturer's colorimetric method as previously described for determining that activity. (XAU means xylanase activity units.) The polysorbate 60 may be added as a viscous liquid premix with the natural flavorant. The premix is commercially available as a natural flavor composition from Bush Boake Allen, Chicago, Ill. In addition to the polysorbate 60 carrier, the natural flavor composition includes water, soybean oil, sesame oil, partially hydrogenated corn oil, TBHQ as an antioxidant, and sodium benzoate as a preservative. The premix has a white to off-white color and a fat-like flavor and odor. The sodium stearoyl lactylate may be added on top of the dough-up flour, followed by addition of the salt, sodium bicarbonate, and ground limestone (calcium carbonate). The dough may be mixed, then proofed for 2-4 hours. The proofed dough may then be sheeted, the sheeted dough may be laminated, reduced in thickness between counter-rotating reduction rolls, and may then be cut into pieces using a rotary cutter. The cut pieces may be baked to a moisture content of about 2.5% by weight to about 4.0% by weight and a pH of about 7.0 to 8.4.

EXAMPLE 3

The ingredients and their relative amounts, which may be used to produce a 35%-reduced-fat, unfermented cracker which provides at least mg of calcium per 15 gram serving, are:

Dough Ingredients	Parts by weight
Wheat flour (about 15% by weight water)	100
Ground limestone (calcium carbonate) of Example 1	6.0
Soybean oil	1.35
Soybean oil, purified	1.00
Whey powder	1.00
Glucose syrup (40 DEAR DE)	1.70
Mixer ingredients (salt, water, yeast, enzymes, proteins)	2.00
Ammonium bicarbonate	1.30
Sodium bicarbonate	0.30
Sodium stearoyl lactylate	0.30
Field withdrawn soybean lecithin (as in Example 2)	0.125
Polysorbate 60	0.25
Natural flavorant (as in Example 1)	0.75
Water	32.5
TOTAL	137.115

Topping Ingredients	Parts by weight
Salt	2.30
Glutenin (soybean spray oil)	0.75

The dough may be formed by first creaming all the dough ingredients except the wheat flour, the soybean, proteins, leavening agents, and a portion of the water. The polysorbate 60 and natural flavorant may be added as the commercially available premix of Example 1. The flour may be added to

the creamed mixture, then the calcium carbonate and sodium bicarbonate may be sieved on top of the flour, followed by mixing. Then the proteins and soybean enzymes and ammonium bicarbonate (each dispersed in a separate portion of the remaining water) may be added. The ingredients may be mixed, then proofed for 2-4 hours. The proofed dough may then be sheeted, laminated, reduced in thickness between counter-rotating rolls, cut into pieces with a rotary cutter, and baked to a moisture content of about 0.5% by weight to about 2.5% by weight and a pH of about 6.6 to 8.2. The topping ingredients may then be applied to obtain a finished calcium enriched cracker having a 35% reduction in fat content.

EXAMPLE 4

The ingredients and their relative amounts, which may be used to produce a calcium enriched, low-fat, fermented cracker dough bakeable to a cracker which provides at least of the U.S. R.D.A. of 1000 mg of calcium per 15 gram serving are:

Sponge Ingredients	Parts by Weight
Wheat flour (about 15% by weight water)	64
Bakery salt flour (about 10% by weight water)	1.5
Yeast	0.75
Sucker solution (yeast and potassium lactate)	1.8
Water	20
TOTAL	94.85

The sponge is formed by dumping the flour into an upright or spindle mixer. The remaining ingredients are added to a mixing tank and blended, then added to the flour in the upright mixer. The mixture in the upright mixer is blended, covered, and fermented or proofed for 10 to 14 hours.

Following this 10-14 hour fermentation, dough-up of the sponge may be effected with the following dough-up ingredients:

Dough-Up Ingredients	Parts by Weight
Wheat flour (about 15% by weight water)	36
Soybean oil, purified	1.40
Mixer ingredients (salt and sodium bicarbonate)	1.16
Sodium stearoyl lactylate	0.5
Ground limestone (calcium carbonate) of Example 1	1.625
Polysorbate 60	0.25
Natural flavorant	0.75
TOTAL	51.405

Topping Ingredients	Parts by weight
Salt	3.0
Soybean oil, purified	2.5

The polysorbate 60 and natural flavorant are added to the top of the sponge, then the dough-up flour is added on top of this. The polysorbate 60 is added as a viscous liquid premix with the natural flavorant. The premix is commercially available as a natural flavor composition from Bush Boake Allen, Chicago, Ill. In addition to the polysorbate 60

carrier, the natural flavor composition includes water, soybean oil, sesame oil, partially hydrogenated corn oil, TBHQ as an antioxidant, and sodium benzoate as a preservative. The premix has a white to off-white color and a fat-like flavor and odor.

The salt, sodium bicarbonate, ground limestone (calcium carbonate), and sodium stearoyl lactylate are added on top of the dough-up flour, followed by addition of the soybean oil. The dough is mixed, then proofed for 2-5 hours. The proofed dough is then sheeted, the sheeted dough is laminated, reduced in thickness between counter-rotating reduction rolls, and then cut into pieces using a rotary cutter. The cut pieces are baked to a moisture content of about 2.0% by weight to about 4.0% by weight and a pH of about 6.8 to 8.0. The topping salt and topping oil may then be applied to obtain the finished low-fat product.

What is claimed is:

1. A dough for producing a calcium enriched baked good which provides at least about 10% of the 1000 mg U.S. R.D.A. of calcium per 15 gram serving, the dough comprising flour, water, from about 3% by weight to about 30% by weight of a calcium component for providing at least about 10% of the U.S. R.D.A. of 1,000 mg. of calcium per 15 gram serving, said weight percentages of the calcium component being based upon the weight of said flour, and an emulsifier composition which reduces hardness and dry mouthfeel of said baked good caused by said calcium component, said emulsifier composition comprising: a) an effective emulsifying amount of at least one polyoxyethylene sorbitan fatty acid ester, and b) an effective emulsifying amount of at least one stearoyl lactylate, the amount of the emulsifier composition being from about 3% by weight to about 45% by weight, based upon the weight of said calcium component, and the moisture content of said dough being less than about 50% by weight based upon the weight of the dough.

2. A dough as claimed in claim 1 wherein said polyoxyethylene sorbitan fatty acid ester is polysorbate 60, and said stearoyl lactylate is sodium stearoyl lactylate.

3. A dough as claimed in claim 1 wherein the ratio of the weight of said at least one stearoyl lactylate to the weight of said at least one polyoxyethylene sorbitan fatty acid ester component is from about 4.63-0.5:1.

4. A dough as claimed in claim 1 wherein the ratio of the weight of said at least one stearoyl lactylate to the weight of said at least one polyoxyethylene sorbitan fatty acid ester component is from about 3.5-1.15:1, and the amount of the emulsifier composition is from about 5% by weight to about 15% by weight, based upon the weight of said calcium component.

5. A dough as claimed in claim 1 wherein said calcium component is calcium carbonate.

6. A dough as claimed in claim 1 wherein said calcium component provides at least 200 mg of calcium per 15 grams of said baked good.

7. A dough as claimed in claim 1 wherein the amount of said calcium component is from about 5% by weight to about 15% by weight, based upon the total weight of the flour.

8. A dough as claimed in claim 1 wherein said emulsifier composition further comprises an effective emulsifying amount of at least one lecithin.

9. A dough as claimed in claim 8 which is bakeable to a no-fat baked good.

10. A dough as claimed in claim 8 which is bakeable to a low-fat baked good.

11. A dough as claimed in claim 8 wherein said polyoxyethylene sorbitan fatty acid ester is polysorbate 60, said lecithin is fluidized soybean lecithin, and said stearoyl lactylate is sodium stearoyl lactylate.

12. A dough as claimed in claim 11 which is bakeable to a no-fat baked good and wherein the amount of polysorbate

60 is from about 20% by weight to about 40% by weight, the amount of lecithin is from about 10% by weight to about 25% by weight, and the amount of sodium stearoyl lactylate is from about 35% by weight to about 70% by weight, said percentages adding up to 100% by weight.

13. A dough as claimed in claim 1 wherein the fat content of the baked good is less than about 3.33% by weight, based upon the weight of the baked good.

14. A dough as claimed in claim 1 wherein said dough moisture content is less than about 35% by weight, based upon the weight of the dough.

15. A dough as claimed in claim 1 wherein said dough is a cracker dough having a moisture content of about 25% by weight to about 33% by weight, based upon the weight of the dough.

16. A dough as claimed in claim 1 wherein the calcium-enriched baked good has a moisture content of less than about 6% by weight based upon the weight of the baked good and starch gelatinization of the baked good is less than about 80%.

17. A cracker dough for producing a calcium enriched cracker which provides at least about 10% of the 1000 mg U.S. R.D.A. of calcium per 15 gram serving, the dough comprising flour, water, from about 3% by weight to about 30% by weight of a calcium component for providing at least about 10% of the U.S. R.D.A. of 1,000 mg. of calcium per 15 gram serving, said weight percentages of the calcium component being based upon the weight of said flour, and an emulsifier composition which reduces hardness and dry mouthfeel of said cracker caused by said calcium component, said emulsifier composition comprising:

a) an effective emulsifying amount of at least one polyoxyethylene sorbitan fatty acid ester, and

b) an effective emulsifying amount of at least one stearoyl lactylate, the amount of the emulsifier composition being from about 3% by weight to about 45% by weight, based upon the weight of said calcium component, the ratio of the weight of said at least one stearoyl lactylate to the weight of said at least one polyoxyethylene sorbitan fatty acid ester component being from about 4.63-0.5:1, and the water content of said dough being less than about 50% by weight based upon the weight of the dough.

18. A cracker dough as claimed in claim 17 wherein said polyoxyethylene sorbitan fatty acid ester is polysorbate 60, and said stearoyl lactylate is sodium stearoyl lactylate.

19. A cracker dough as claimed in claim 17 wherein said calcium component comprises calcium carbonate.

20. A cracker dough as claimed in claim 17 wherein said calcium component provides at least 200 mg of calcium per 15 grams of said baked good.

21. A dough as claimed in claim 19 wherein the amount of said calcium carbonate is from about 5% by weight to about 15% by weight, based upon the total weight of the flour.

22. A calcium enriched cracker which provides at least about 20% of the 1000 mg U.S. R.D.A. of calcium per 15 gram serving, said cracker comprising flour, water, from about 3% by weight to about 30% by weight of calcium carbonate, said weight percentages of calcium carbonate being based upon the weight of said flour, and an emulsifier composition which reduces hardness and dry mouthfeel of said cracker caused by said calcium carbonate, said emulsifier composition comprising:

a) an effective emulsifying amount of at least one polyoxyethylene sorbitan fatty acid ester, and

b) an effective emulsifying amount of at least one stearoyl lactylate, the amount of the emulsifier composition being from about 3% by weight to about 45% by

weight, based upon the weight of said calcium carbonate, and the moisture content of said cracker being less than about 6% by weight.

23. A dough, for producing reduced-fat, low-fat or no-fat calcium enriched crackers which provide at least about 200 mg of calcium per 15 gram serving, comprising flour, water, from about 3% by weight to about 30% by weight of calcium carbonate, said weight percentages being based upon the weight of said flour, and effective amounts of polyorbate 60, lecithin, and sodium stearoyl lactylate, wherein the moisture content of the dough is less than about 50% by weight based upon the weight of the dough, the amount of polyorbate 60 is at least about 15% by weight, the amount of lecithin is at least about 5% by weight, and the amount of sodium stearoyl lactylate is at least about 20% by weight, said percentages of the emulsifiers adding up to 100% by weight.

24. A method for producing a calcium enriched baked good which provides at least about 10% of the 1000 mg U.S. R.D.A. of calcium per 15 gram serving, the method comprising admixing flour, water, from about 3% by weight to about 30% by weight of a calcium component for providing at least about 10% of the U.S. R.D.A. of 1,000 mg. of calcium per 15 gram serving, said weight percentages of calcium component being based upon the weight of said flour, and an emulsifier composition to form a machineable dough having a moisture content of less than about 30% by weight based upon the weight of the dough, said emulsifier composition reducing hardness and dry mouthfeel of said baked good caused by said calcium component, said emulsifier composition comprising:

- a) an effective emulsifying amount of at least one polyoxyethylene sorbitan fatty acid ester, and
- b) an effective emulsifying amount of at least one stearoyl lactylate, the amount of the emulsifier composition being from about 3% by weight to about 45% by weight, based upon the weight of said calcium component, forming said dough into pieces, and baking said pieces to obtain a tender texture.

25. A method as claimed in claim 24 wherein said dough is sheeted, laminated, and then cut into pieces.

26. A method as claimed in claim 24 wherein said dough is formed into pieces by rotary-molding or by wire-cutting.

27. A method as claimed in claim 24 wherein said calcium component comprises calcium carbonate and said calcium carbonate provides at least 200 mg of calcium per 15 grams of said baked good.

28. A method for producing a reduced-fat, low-fat, or no-fat calcium enriched baked good having at least about 15% ungelatinized starch and which provides at least about 100 mg calcium per 15 gram serving, the method comprising admixing flour, water, a calcium component for providing at least about 10% of the U.S. R.D.A. of 1,000 mg. of calcium per 15 gram serving, and emulsifiers to form a machineable dough having a moisture content of less than about 50% by weight based upon the weight of the dough, wherein said emulsifiers comprise:

- a) at least about 15% by weight of at least one polyoxyethylene sorbitan fatty acid ester,
- b) at least about 5% by weight of at least one lecithin, and
- c) at least about 20% by weight of at least one stearoyl lactylate, said weight percentages of emulsifiers adding up to 100% by weight, the amount of said calcium

component being from about 3% by weight to about 30% by weight, based upon the weight of said flour; the total amount of said emulsifiers being from about 3% by weight to about 45% by weight of said calcium component, forming said dough into pieces, and baking said pieces to obtain a tender texture.

29. A method as claimed in claim 28 wherein said polyoxyethylene sorbitan fatty acid ester is polyorbate 60, said lecithin is fluidized soybean lecithin, said stearoyl lactylate is sodium stearoyl lactylate, and said calcium component comprises calcium carbonate.

30. A method as claimed in claim 29 wherein said dough is a cracker dough, and the cracker dough is sheeted, laminated, and then cut into pieces.

31. A method as claimed in claim 30 wherein a pantothenic enzyme is admixed with said flour to form said machineable dough.

32. A method as claimed in claim 30 wherein said dough is a fermented dough.

33. A method as claimed in claim 32 wherein said emulsifiers, said calcium component, and a pantothenic enzyme are added in the dough-up stage of producing the fermented dough.

34. A method as claimed in claim 33, wherein the dough is baked to obtain a low-fat cracker.

35. A method for producing calcium enriched soda cracker which provides at least about 200 mg of calcium per 15 gram serving comprising:

- (a) admixing flour and water to form a sponge,
- (b) admixing flour, a calcium component for providing at least about 20% of the U.S. R.D.A. of 1,000 mg. of calcium per 15 gram serving, and an emulsifier composition with said sponge to form a machineable dough having a moisture content of less than about 50% by weight based upon the weight of the dough, the amount of said calcium component being from about 3% by weight to about 30% by weight, based upon the weight of said flour, said emulsifier composition reducing hardness and dry mouthfeel of said cracker caused by said calcium component said emulsifier composition comprising:
 - a) an effective emulsifying amount of at least one polyoxyethylene sorbitan fatty acid ester, and
 - b) an effective emulsifying amount of at least one stearoyl lactylate, the amount of the emulsifier composition being from about 3% by weight to about 45% by weight, based upon the weight of said calcium component,
- (c) sheeting said dough,
- (d) cutting said sheeted dough into pieces, and
- (e) baking the pieces.

36. A method as claimed in claim 35 wherein the ratio of the weight of said at least one stearoyl lactylate to the weight of said at least one polyoxyethylene sorbitan fatty acid ester component is from about 3.5-1.15:1, the amount of the emulsifier composition is from about 5% by weight to about 15% by weight, based upon the weight of said calcium component, and said calcium component comprises calcium carbonate.

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US 20020015759A1

(19) **United States**
(12) **Patent Application Publication**
Prosser et al.

(10) Pub. No.: **US 2002/0015759 A1**
(43) Pub. Date: **Feb. 7, 2002**

(54) **NUTRITIONALLY BALANCED
TRADITIONAL SNACK FOODS**

Related U.S. Application Data

(76) **Inventors:** Robert Lawrence Prosser, Cincinnati, OH (US); Christopher Randall Beharry, Cincinnati, OH (US); Joseph James Elson, St. Bernard, OH (US); Ralph Lawrence Heimers JR., Cincinnati, OH (US); Jeffrey John Kester, West Chester, OH (US); Raymond Louis Nishoff, West Chester, OH (US); Robert Joseph Sarason, Loveland, OH (US); Suzanne Ellen Weisheit Slin, Cincinnati, OH (US); Thomas Joseph Wolmester, Cincinnati, OH (US); Vince York-Luong Wong, Hamilton, OH (US)

(63) Non-provisional of provisional application No. 60/196,878, filed on Apr. 12, 2000.

Publication Classification

(51) Int. Cl.⁷ _____ A23L 1/30
(52) U.S. Cl. _____ 426/72; 426/808; 426/637; 426/74; 426/549

Correspondence Address:
THE PROCTER & GAMBLE COMPANY
PATENT DIVISION
WINTON HILL TECHNICAL CENTER
6871 CENTER HILL ROAD
CINCINNATI, OH 45224 (US)

(57) **ABSTRACT**

Appealing traditional nutritious snacks and mixes from which consumers can prepare appealing traditional nutritious snacks are disclosed. These snacks and mixes offer an alternative to appealing but unhealthy snacks. The nutritious snacks of the present invention are traditional in form, provide a balanced mix of an amino acid source, fat, and carbohydrates and typically have an appeal similar to that of unhealthy snacks of similar form. Thus, the snacks and snack mixes of the present invention resolve the dilemma that consumers are currently faced with—healthy eating or enjoying what you eat. Processes for making and methods of using appealing traditional nutritious snacks and mixes from which consumers can prepare appealing traditional nutritious snacks are also disclosed.

(21) Appl. No.: **09/827,436**
(22) Filed: **Apr. 6, 2001**

NUTRITIONALLY BALANCED TRADITIONAL SNACK FOODS

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application Ser. No. 60/196,878 filed on Apr. 12, 2001, in the name of Prosser et al.

FIELD OF THE INVENTION

[0002] The present invention relates to nutritious snack compositions, and mixes from which nutritious snack compositions can be prepared. Most specifically, the present invention relates to traditional snacks having balanced nutritional profiles. Processes for making nutritious snack compositions and mixes used to prepare nutritious snack compositions, as well as methods of using said nutritious snack compositions, are also disclosed.

BACKGROUND OF THE INVENTION

[0003] It is common for snacks to be convenient and tasty but unhealthy, like candy bars, cheese crackers, and similar traditional snacks; inconvenient to prepare or perishable like fruits and vegetables; or nutritious and convenient but unappealing like health foods. Due to health concerns, many consumers initially turn to health food bars or drinks but, due to the undesirable flavor, texture or appearance of these products, soon find themselves replacing these products with traditional snacks.

[0004] Although traditional snacks are appealing, they have a negative impact on the physical and mental health of consumers. In particular, it is appreciated that the high fat and calorie load and low dietary fiber level of traditional snacks can contribute to obesity and many of the chronic diseases, such as coronary heart disease, stroke, diabetes, and certain types of cancer. The following list of traditional snacks highlights the significant fat content, calorie contribution from fat, and minimal dietary fiber content of traditional snack foods (Pennington, J., *Bower & Church's Food Values of Portions Commonly Used*, 17th edition, 1998, Lippincott, Philadelphia).

Food Item	Serving Size (Ounces)	Total Kcal	Grams Fat	% Kcal from Fat	Grams Fiber
Reckless Candy Bar	61	282	15	46.3	1.5
Reckless Mini Mini Crackers	30	160	9.0	50.6	1.0
Reckless Peanut Butter Mini Mini	31	150	8.0	48.0	1.0
Little Cheese On Wheat Crackers	37	181	9.0	44.8	—
Little Peanut Butter On Wheat Crackers	37	192	11	51.6	—

[0005] It is known that many consumers prefer traditional snacks to nutritious foods. It is also known that consumers associate the form of a snack food with the enjoyment of the eating experience. Thus, consumers are more likely to consume a snack that is nutritious, and thereby obtain the benefits of the nutritious snack, when the nutritious snack is similar, at least in form, to an appealing but unhealthy

traditional snack. In short, many consumers associate snack appeal with snack form. As a result, what is needed is one or more snack foods having balanced nutritional profiles and the form of a traditional snack.

[0006] Unfortunately, numerous technical obstacles have blocked the development of nutritionally balanced traditional snacks. In particular, previous attempts at producing acid snacks have resulted in products that have poor textures, tastes and appearances. The following sampling of technical challenges and obstacles clarify why the food industry has failed to provide the consumer with nutritionally balanced traditional snacks.

[0007] The key technical challenge associated with producing nutritionally balanced snack foods and mixes is achieving fat reduction, while at the same time incorporating sufficient amounts of protein and dietary fiber to achieve a balanced nutritional profile. This challenge is multidimensional as it has numerous formulation and process facets. It is known that snack food formulations tend to be high in fat and carbohydrate, while being low in dietary fiber and protein, thus they are nutritionally unbalanced. Also, it is known that decreasing a snack food's fat level while increasing its dietary fiber and protein levels can, depending on the magnitude of changes, seriously compromise processability, taste and texture. These same barriers have kept mixes, from which the consumer could produce nutritionally balanced traditional snacks, from the consumer.

[0008] Specifically, digestible fat reduction has proven to be a formulation and process obstacle for the food industry. In fact, the literature has noted that consumers have been complaining, even if they have not been fully articulating, "that something is missing" in their low-fat, low-calorie foods. According to the literature, that something may be an opioid stimulator as an opioid-releasing effect has been correlated to combinations of sugar and fat. (Adam Drewnowski, *Trends in Food Science & Technology*, April, 1992). Drewnowski noted that high-sugar, high-fat foods figure most heavily in food cravings and overeating. Naloxone administrations reduced the appeal of such foods in a study group of binge eaters. Conversely, Drewnowski cites clinical studies linking opiate addiction (to substances like opium and heroin) to sweet cravings. In short, fully duplicating the sensation of fat alone may prove a chimera until other taste stimulating components, combination of components or processes are identified. When the difficulties associated with formulating a low fat snack are combined with the difficulties associated with formulating high protein and fiber snacks, such as off-tastes and the loss of dough elasticity, the magnitude of the challenge associated with formulating nutritionally balanced traditional snacks becomes apparent.

[0009] In addition to formulation hurdles, the snack food industry has been faced with serious processing challenges. For example, many processes used to produce snacks require frying—a process that results in snacks having a 30-50% fat content. In an effort to reduce fat levels the food industry has resorted to baking processes. While baked snacks such as potato or corn chips have reduced fat contents, they tend to be less palatable as they are very dry, and have poor mouth feels and flavor displays. Thus, it is known that attempting to improve a single parameter of a snack typically requires that at least one other desirable

parameter be sacrificed. As a result, the challenge of producing a nutritionally balanced fried snack has gone unanswered, as it requires a reduction in digestible fat and a significant increase in protein and fiber.

[0010] An additional processing challenge exists for baked goods, as the incorporation of high levels of protein and dietary fiber results in the loss of dough elasticity. Here, the snack fails to process well as there are generally not enough structure forming components left in the formulation to permit dough sheeting. When combined with formulation challenges mentioned above, it is obvious why the food industry has failed to provide nutritionally balanced traditional baked snacks.

[0011] In summary, while not an exhaustive list, the sampling of challenges and obstacles detailed above clarify why the food industry has been unable to provide the consumer with nutritionally balanced traditional snacks. As a result, there remains a need for one or more nutritionally balanced traditional snacks.

[0012] Applicants have extensively researched the psychology of eating, the nutritional needs of consumers, and the processing characteristics of nutritious materials. From these efforts, Applicants have recognized the need for one or more nutritionally balanced traditional snack foods. Surprisingly, despite numerous technical hurdles, Applicants have developed multiple embodiments of nutritionally balanced snack foods. The majority of these embodiments have an appeal that is similar to their fat and sugar laden, unhealthy counterparts. Specific embodiments of Applicants' invention include, but are not limited to, potato chips, crackers, dips, crackers and dip contained in separate compartments of a single package, filled crackers, cookies and mixes that allow the consumer to prepare said appealing nutritious snacks.

[0013] Thus, an object of the present invention is to provide a genus of nutritionally balanced traditional snack foods.

[0014] Another object of the present invention is to provide a genus of nutritionally balanced traditional snack foods that have an appeal that is the same or similar to traditional snack foods. Another object of the present invention is to provide a genus of mixes that consumers can use to prepare nutritionally balanced traditional snack foods.

[0015] Another object of this invention is to provide processes for making nutritionally balanced traditional snack foods; and mixes that consumers can use to prepare said foods.

[0016] Still another object of this invention is to provide methods of using said nutritionally balanced traditional snack foods and mixes to improve the health of a mammal, particularly a human.

[0017] These and other objects will become apparent from the following detailed description.

SUMMARY OF THE INVENTION

[0018] The present invention concerns nutritionally balanced traditional snack foods having water activities less than 0.90 and comprising, on a 30-gram reference basis:

- [0019] a.) at least 5 grams of amino acid source;
- [0020] b.) less than 3 grams of digestible fat; and

[0021] c.) a carbohydrate that provides the balance of the total caloric value of said snack foods and at least about 2.5 grams of dietary fiber.

Definitions

[0022] As used herein, the term "traditional snack" means: 1) baked goods selected from the group consisting of cookies, brownies, filled crackers, snack cakes, pies, granola bars, and toaster pastries; 2) salted snacks selected from the group consisting of potato chips, corn chips, tortilla chips, filled extruded snacks, aerobed extruded snacks and pretzels; 3) specialty snacks selected from the group consisting of dips, spreads, meat snacks and rice/torn cakes; and 4) confectionary snacks. For purposes of this invention, cereals are not considered to be a traditional snack, as they are normally considered and consumed as a main meal or breakfast food.

[0023] As used herein, the term "nutritionally balanced", when used to describe a food, means that a single serving or reference serving of the food provides a nutritionally desirable level of fat, protein or amino acid source, and dietary fiber.

[0024] As used herein, the term "an amino acid source" means a material containing amino acids. Said amino acid source may include or be derived from, but is not limited to, plant proteins, animal proteins, proteins from single cell organisms and free amino acids.

[0025] As used herein, the term "fat" refers to the total amount of digestible, partially digestible and nondigestible fats or oils that are present in the embodiments of the present invention.

[0026] As used herein, the terms "lipid", "fat" and "oil" are synonymous.

[0027] As used herein, the term "carbohydrate" refers to the total amount of sugar alcohols, monosaccharides, disaccharides, oligosaccharides, digestible, partially digestible and non-digestible polysaccharides; and lignin or lignin like materials that are present in the embodiments of the present invention.

[0028] As used herein, the term "dietary fiber" refers to the group of food components derived from plant material, or analogous carbohydrates, that are resistant to digestion and absorption in the human small intestine. This includes various polysaccharides, oligosaccharides, polyfructans, and lignins that are resistant to digestion. The term analogous carbohydrates in the above definition refers to carbohydrate compounds that may not be specifically derived from plant material, however, are resistant to digestion and absorption in the human small intestine (e.g., a synthetic non-digestible polysaccharide or oligosaccharide, such as polydextrose).

[0029] As used herein, the terms "total dietary fiber" and "dietary fiber" are synonymous.

[0030] As used herein, the term "ready-to-eat" when used to describe a food, means that after manufacture and packaging, the food product requires no additional processing, including but not limited to cooking, baking, microwaving, boiling, frying; or combination with components outside of the product's packaging to achieve the novel combination of

balanced nutrition and product form that Applicants are claiming. However, this does not rule out that one or all of the parameters of Applicants' nutritious traditional snack compositions may be improved when said compositions are processed further or combined with other foods.

[0031] As used herein, the term "substantially anhydrous" means having a water activity of less than about 0.3.

[0032] As used herein, the term "predominately anhydrous" means having a water activity of less than about 0.6.

[0033] As used herein, the articles a and an when used in a claim, for example, "an amino acid source" or "a fat" is understood to mean one or more of the material that is claimed or described.

[0034] As used herein, the term "active level", as it relates to the amount of desired material in an ingredient, refers to the level of the desired material in the ingredient, as measured by the methods for quantifying components of Applicants' invention, as detailed in the present application. For example, for fiber containing ingredients, the active level would be the actual percent fiber in the ingredient, as measured by the method for quantifying fiber as detailed in the present application.

[0035] Publications, patents, and patent applications are referred to throughout this disclosure. All references cited herein are hereby incorporated by reference.

[0036] All percentages and ratios are calculated by weight unless otherwise indicated. All percentages and ratios are calculated based on the total composition unless otherwise indicated.

[0037] Unless otherwise noted, all component or composition levels are in reference to the active level of that component or composition, and are exclusive of impurities, for example, residual solvents or by-products, which may be present in commercially available sources.

DETAILED DESCRIPTION OF THE INVENTION

[0038] Providing nutritionally balanced traditional snacks and mixes from which said snacks can be made has been a challenge that has not been met by the food industry. Before a solution to the above referenced problems can be appreciated, it is important to understand how snack foods are classified and the magnitude of the complexities arising from product structure, composition and processing.

Snack Food Classifications

[0039] Snacks are generally divided into 5 broad groups: baked goods, salted snacks, specialty snacks, confectionery snacks, and naturally occurring snacks. Baked goods include but are not limited to cookies, crackers, sweet goods, snack cakes, pies, granola/snack bars, and toaster pastries. Salted snacks include but are not limited to potato chips, corn chips, tortilla chips, extruded snacks, popcorn, pretzels, potato crisps, and nuts. Specialty snacks include but are not limited to dips, dried/fruit snacks, meat snacks, pork rinds, health food bars such as Power Bars® and rice/corn cakes. Confectionery snacks include various forms of candy. Naturally occurring snack foods include nuts, dried fruits and vegetables. Traditional snacks cut across the 5 groups as they comprise select species of snacks, including but not limited

to cookies, brownies, filled crackers, snack cakes, pies, potato crisps, corn chips, tortilla chips, filled extruded snacks, enrobed extruded snacks, pretzels, spreads or dips, rice/corn cakes and confectionery snacks.

[0040] Unfortunately numerous obstacles and technical challenges have kept the most desirable nutritionally balanced traditional snacks and mixes from the consumer. The key obstacle associated with producing nutritionally balanced snack foods and mixes is achieving fat reduction, while at the same time incorporating sufficient amounts of protein and dietary fiber to achieve a balanced nutritional profile. The problems associated with fat reduction and increased protein and fiber levels can be classified as either formulation or process challenges. In short, even if taste criteria are placed aside, there are numerous technical hurdles to overcome before a nutritionally balanced traditional snack or mix can be produced.

Formulation & Nutritional Components

[0041] The key formulation obstacle associated with producing nutritionally balanced traditional snack foods and mixes is achieving fat reduction, while at the same time incorporating sufficient amounts of protein and dietary fiber to achieve a balanced nutritional profile. Traditional snack foods typically contain 30-50% fat. The high fat levels may result from the product's formulation or may be introduced in a frying or seasoning process. Thus, for snacks, such as salted snacks, reducing the fat level to the recommended 3 grams per serving requires either a change in formulation or processing. The standard industry "fix" to the fat reduction problem is to bake rather than fry snacks. While baked snacks, such as potato chips or corn chips, have reduced fat contents they tend to be unpalatable as they are very dry, and have poor mouth melts and flavor displays.

[0042] Even traditional baked snacks such as crackers, filled crackers, and cookies may contain high levels of fat (20-30%). In most cases, fat is intentionally added to the dough during formulation to enhance processability or taste, indirectly added as inherent fat or is topically sprayed on after baking. Unfortunately, with baked snacks there are no known process alternatives to baking.

[0043] Despite the food industry's failure to resolve the above mentioned fat reduction problems, Applicants have discovered that fat reduction can be achieved and taste, texture and processability maintained, if the correct combination of processing and formulation changes are made. While not to be bound by theory, Applicants believe that the substitution of a baking process in place of frying results in structural differences in snack products that lead to poor tastes and textures. Furthermore, Applicants believe that the structural differences are caused due to heat transfer differences between the two processes. As a result of this realization, Applicants experimented with nondigestible lipids, partially digestible lipids and mixtures thereof and determined that these lipids have similar heat transfer characteristics as digestible lipids. Thus, Applicants realized that a frying process, wherein the digestible lipids are replaced with nondigestible lipids, partially digestible lipids or mixtures thereof, would result in a snack having the desired structure without the digestible fat that is imparted by traditional frying processes. In short, in processes wherein digestible fats are used, Applicants have altered said pro-

comes so that nondigestible lipids, partially digestible lipids or mixtures thereof could be used and product processability, texture and taste maintained.

[0044] Although Applicants' process improvements can reduce the fat content of snacks, many times, particularly in the area of filled and baked snacks, formulation changes must be made if target digestible fat contents of less than 3 grams per serving are to be reached. Thus, Applicants have formulated snacks of the present invention using nondigestible lipids, partially digestible lipids or mixtures thereof in place of digestible lipids. Non-digestible lipids, partially digestible lipids or mixtures thereof may be used to replace the removed digestible fat on a weight percent to weight percent basis, to improve texture and taste. In addition, Applicants recognized that a significant amount of fat is imparted to snacks as a result of the high levels of inherent fat in snack food components. In many cases, as with nuts, this inherent fat is difficult to remove. Thus, Applicants have formulated to allow the use of defatted components. In addition, when defatted components were not commercially available, such as peanuts, Applicants have developed methods for producing said defatted components.

[0045] Finally, when the use of non-digestible lipids, partially digestible lipids or mixtures thereof is precluded by regulatory or processing concerns, water continuous fillings, such as fruit fillings having water activities of less than 0.90 may be used to enhance lubricity of a product. For example the taste and texture of a filled bar, wherein the crumb contains less than 3.0 grams of triglyceride fat per serving, is improved by selecting a water continuous filling. Wherein a non-perishable product is desired, it is preferred that the filling's water activity be sufficiently low to prevent the growth of most pathogenic and spoilage bacteria.

[0046] When water based fillings cannot be used, a tasty, substantially anhydrous, nutritionally balanced snack can be formed from a continuous phase that comprises a glassy structure above its transition point. The glassy structure comprises sugars, polysaccharides and mixtures thereof, rather than starches that have a fast mouth melt. The glassy structure is based on continuous phase of an amorphous glass that is interrupted by particles of dietary fiber and protein isolates. The amorphous glass may be formed by a variety of sugars or maltodextrin combinations. Snack forms that are produced using this technology can range from very sweet to savory. Flavors and "bite" may be added topically, or be contained within the structure. Snacks of this type are obtained by baking, or extrusion, followed by a baking or drying step.

[0047] In addition to fat reduction, Applicants developed formulation guidelines and processes that allow for the incorporation of high levels of protein and fiber in traditional snacks while still maintaining acceptable processability, taste and texture. The high levels of protein and fiber that are required to produce nutritionally balanced foods displace other ingredients, such as fat and carbohydrates, that are normally required to produce a product. For example, when formulating a nutritionally balanced cheese filled sandwich cracker, 15-20% of a traditional, nutritionally unbalanced formulation is replaced with dietary fiber and protein. The loss of fat and carbohydrates, coupled with the increased protein and fiber, results in a product having poor appeal and processability. However, the impact of the increased protein

and fiber can be minimized by selecting proteins and fibers that have a functionality that is similar to that of the components they are replacing. For example, when a soluble dietary fiber is used in a filling, care should be taken to select one having similar properties (particle size, dissolution rate, thickening effect, etc.) as the sugar it is replacing.

[0048] Although attempting to match the functionality of an ingredient that is being replaced improves a food's processability and appeal, a food's processability and appeal can be further improved by the combination of minimizing the addition of nutritional ingredients and selecting nutritional ingredients that have minimal effects on flavor. Applicants have discovered that nutritional ingredients, particularly fiber and protein sources, that have active levels of at least 75% are preferred. Also, the proper use of process and formulation aids is more important as high protein and fiber levels reduce the degrees of processing freedom. By way of example, as flour is reduced, the elasticity and handling properties of dough and thus its processability diminishes. Here, gluten may be added to restore the processability of the dough as gluten is the primary component of flour that gives dough its elasticity and handling properties. Also, concentrated flavor sources may be added to restore flavor lost due to the reduction of flavor components such as cheese powders.

[0049] Finally, Applicants have surprisingly discovered that the positioning of ingredients in a nutritionally balanced food can dramatically impact taste. For example, dietary fiber sources generally have less of a negative effect on a filling than on a crumb structure. Likewise, nutritional protein sources generally function better in the crumb structure than the filling. While not being bound by theory, possible explanations for these phenomena include: that proteins are more like components predominantly found in the crumb and that soluble dietary fibers are more like components, such as sugars, that are predominantly contained in fillings. Also, Applicants have discovered that if a nutritionally balanced food is designed to have a filling, it is best to place as much of the food's vitamins and minerals as possible in the food's filling structure. In summary, Applicants have discovered that when a product has 2 or more phases, the negative impact of gritty ingredients can be minimized by positioning them in the crumb; it is best to position heat sensitive materials, such as vitamins, in the phase that will experience the least degree and duration of thermal energy; and hydrophilic ingredients should be positioned in the most water continuous phase as this will minimize any negative taste impacts arising from the introduction of the hydrophilic ingredients to the product.

[0050] Water Activities

[0051] Embodiments of Applicants' invention have water activities that are less than or equal to 0.90. Other embodiments of Applicants' invention are "non-perishable", thus they have water activities that are sufficiently low to prevent the growth of most pathogenic and spoilage bacteria; i.e., a water activity less than 0.85 (Troller, J. A. 1980, Influence of Water Activity on Microorganisms in Foods, Food Technology, 34:76-80; Troller, J. A. 1989, Water Activity and Food Quality, in "Water and Food Quality", T. M. Hardman, ed., pp. 1-31). Preferably, embodiments of Applicants' invention have water activities low enough to control or prevent the

growth of yeasts and molds; i.e., a water activity less than 0.80, more preferably less than 0.75, and most preferably less than 0.70.

[0053] Amino Acid Source

[0053] An amino acid source is necessary to build and maintain muscle, blood, skin, and other tissues and organs, as well as for the formation of protein antibodies that are part of the immune system. The FDA has specified the Daily Reference Value for protein as 50 g/day (based upon a 2,000 kcal/day diet) and foods that provide at least 5 g protein per serving may be claimed as a "good source" of protein. Since athletes have higher protein requirements than sedentary individuals, the protein recommendations for athletes are approximately 1.5-2.0 times the Recommended Daily Allowance (RDA). See: Lemon, P. (1998) Effects of exercise on dietary protein requirements, *International Journal of Sport Nutrition*, 8:426-447. Due to the high levels of protein that athletes require and the off-flavors of protein supplements, a ready-to-eat, tasty, nutritionally balanced protein source is especially desired by these individuals.

[0054] While protein intakes are generally considered adequate in the United States and other modern countries, products having increased protein levels can be used to reduce fat intakes as high protein products are typically low in fat. In addition, increased consumption of certain vegetable proteins, such as soy proteins, may be desirable due to a hypocholesterolemic effect (Crane, J. R. et al., *Arch Intern Med*, 1999, 159:2070-2076). Also, in many less developed countries protein deficiency, particularly among children, is still a significant nutritional concern. Protein or amino acid deficiency can result in impaired growth and tissue development. Serious protein deficiency in children can result in symptoms which include lack of growth, dermatitis, fatty liver, changes in the texture and pigmentation of hair, and diarrhea with resulting electrolyte loss (Filo, R. L. and Brown, M. L., 1975, *Nutrition: An Integrated Approach*, 2nd ed., Wiley, New York).

[0055] Although increasing a food's protein level can increase the health benefits of the food, increased protein levels detract from a food's taste and texture. For example, highly concentrated protein sources in crumb structures can increase structural formation resulting in excessive hardness. In general, harder structures are more difficult to break down than softer structures, which results in negative mouth melt and flavor display properties during mastication. Also, some protein sources can influence dough-handling properties such as stickiness, which can impede processing the food form. Some nutritional protein sources effect water absorption and can effect dough properties and baking/frying properties. Unfortunately, the current art appears to be devoid of teachings as to the solutions to the type problems that are associated with the addition of high levels of proteins or amino acids to foods.

[0056] Applicants have extensively researched the properties of protein sources. From this research Applicants have noted certain trends in the use of protein sources in the formulation and production of ready-to-eat, nutritionally balanced foods. For example, it has been found that the use of egg white protein in place of soy isolate protein, at about a 10% level, in a cracker dough of this invention, results in a dough so sticky it is nearly impossible to handle in the process. However, the dough is made processable by reduc-

ing its water level by up to about 50%. The finished cracker product using egg white protein and reduced water, versus the soy isolate formulated product, results in a noticeably harder texture and slower mouth melt. Likewise, up to 50% less water is required to maintain processability in a formulation wherein whey isolate protein replaces soy isolate. Also, it should be noted that blends of proteins are preferred as they can actually enhance the dough's processability, and product's taste. For example, a blend of about 2.6 ratio soy isolate to whey isolate (9-11% total added protein, and about 20% added water), results in a dough formulation that processes very well, and a product having a good texture and mouth melt.

[0057] In addition to the dough formulation and processing teachings detailed above, Applicants have discovered that some nutritional protein sources produce more noticeable off-flavors when used in fillings. For example it has been found that whey protein isolate has much less impact on flavor quality in a cheese filling than a similar amount of soy isolate protein. Applicants also discovered that the impact on flavor quality does not seem as apparent when these protein sources are used in a crumb structure. While not being bound by theory, it is thought that off-flavors imparted by ingredients are more noticeable in a lubricious solid filling than in a baked solid or semi-solid crumb structure. In summary, care should be taken to either select protein sources that do not negatively effect flavor quality of the filling, or to include the protein source in the crumb formulation.

[0058] From Applicants' research efforts, Applicants have determined that amino acid sources that can be used to produce the nutritional compositions of the present invention may include or be derived from, but are not limited to, plant proteins, animal proteins, proteins from single cell organisms, free amino acids and mixtures thereof. Non-limiting examples of useful plant derived proteins include: seed proteins that are isolated or derived from legumes, such as soybeans, peanuts, peas and beans; cereal proteins isolated or derived from cereal grains, such as wheat, oats, rice, corn, barley and rye; and mixtures thereof. Non-limiting examples of useful seed proteins include materials selected from the group consisting of soy flour, soy protein concentrate, soy protein isolate, peanut flour and mixtures thereof. Non-limiting examples of useful cereal proteins include materials selected from the group consisting of wheat flour, wheat protein concentrate and mixtures thereof.

[0059] Non-limiting examples of useful animal-derived proteins include, milk proteins that are isolated or derived from bovine milk; muscle tissue proteins that are isolated or derived from mammals, reptiles or amphibians; connective tissue proteins, egg proteins isolated or derived from eggs or components of eggs; and mixtures thereof. Non-limiting examples of useful milk proteins include caseins, such as sodium caseinate and calcium caseinate; and whey proteins, such as beta-lactoglobulin and alpha-lactalbumin. These milk proteins may be derived from whole milk, skim milk, nonfat dry milk solids, whey, whey protein concentrate, whey protein isolate, caseinates, and mixtures thereof. Non-limiting examples of useful connective tissue proteins include collagen, gelatin, elastin and mixtures thereof.

[0060] Additional useful proteins include proteins that are isolated or derived from single cell microorganisms, includ-

ing but not limited to, yeast, bacteria, algae and mixtures thereof; and free amino acids, in particular essential amino acids that can be added to enhance overall protein quality.

[0061] On a 30-gram basis, certain embodiments of Applicants' invention contain at least 5 grams of one or more amino acid sources. In other embodiments of Applicants' invention, each embodiment contains from 5 grams to 10 grams of one or more amino acid sources per 30 grams of embodiment. In still other embodiments of Applicants' invention, each embodiment contains from 5 grams to 7 grams of one or more amino acid sources per 30 grams of embodiment. In still other embodiments of Applicants' invention, each embodiment contains from 5 grams to 6 grams of one or more amino acid sources per 30 grams of embodiment.

[0062] On a 40-gram basis, certain embodiments of Applicants' invention contain at least 5 grams of one or more amino acid sources. In other embodiments of Applicants' invention, each embodiment contains from 5 grams to 13 grams of one or more amino acid sources per 40 grams of embodiment. In still other embodiments of Applicants' invention, each embodiment contains from 5 grams to 9 grams of one or more amino acid sources per 40 grams of embodiment. In still other embodiments of Applicants' invention, each embodiment contains from 5 grams to 7 grams of one or more amino acid sources per 40 grams of embodiment.

[0063] Preferred amino acid sources are proteins having active levels of at least 75% and minimal taste impacts on the final food product. Examples of preferred proteins include: soy protein isolates such as Supro® 661 which has an 85% active level and which is supplied by Protein Technologies of St. Louis, Mo. USA; whey protein isolates such as BIPRO which has an 95% active level and which is supplied by Davisco Foods Int. Inc. of Le Sueur, Minn. USA and egg whites such as Type P-110 (#407) which has an 80% active level and which is supplied by Hemmingsen Foods, Inc. of Rye Brook, N.Y. USA.

[0064] Embodiments of Applicants' invention have an amino acid chemical score greater than 0. In other embodiments of the invention, the amino acid chemical score ranges from 0.60 to 1.00 and in still other embodiments the amino acid chemical score ranges from 0.75 to 1.00. In still other embodiments of the invention the amino acid chemical score ranges from 0.85 to 1.00. Amino acid sources rich in specific amino acids are particularly useful as they can provide the additional benefit of increasing the overall protein quality or amino acid chemical score of a food composition. For example, because peanut protein contains a low lysine level, embodiments of Applicants' invention containing a peanut butter filling may be fortified with an additional amino acid source rich in lysine, such as whey protein, which results in a product having an amino acid score of 1.00.

[0065] Fat

[0066] The American diet currently averages approximately 34% of total caloric intake from fat and approximately 12% of calories from saturated fat (Garrison, R. and Somer, R., *The Nutrition Desk Reference*, 3rd edition, 1995, Keats Publishing, New Canaan, Conn.). Dietary fat intake is important because of the relationship between excessive fat and calorie intake to obesity and the incidence of certain

chronic diseases, such as coronary heart disease, stroke, diabetes, and certain types of cancer, that are among the leading causes of death in the United States and other industrialized countries (*The Surgeon General's Report on Nutrition and Health*, 1988, U.S. Department of Health and Human Services Publication No. 88-50210, Washington, D.C.; National Research Council, 1989, *Diet and Health: Implications for Reducing Chronic Disease Risk*, The Committee on Diet and Health, National Academy Press, Washington, D.C.). The level of dietary fat intake, particularly saturated fat and cholesterol, is strongly linked to the risk of cardiovascular disease and mortality from coronary events. In addition, research has demonstrated a relationship between the level of total fat and saturated fat consumption and the risk of cancers of the digestive tract and endocrine system (e.g., colorectal, breast, and prostate cancers) (Garrison and Somer, 1995).

[0067] Based on the relationship between fat intake and the chronic diseases mentioned above, various professional health organizations (e.g. American Heart Association; American Cancer Society; National Cancer Institute; United States Department of Agriculture) have proposed dietary guidelines stating that the percent of total caloric intake from fat be reduced to less than 30% and the percent of calories from saturated fat decreased to less than 10%. This translates to approximately 3 g or less of digestible fat and 1 g or less of digestible saturated fat per 100 kcal of energy intake.

[0068] On a 30-gram basis, certain embodiments of Applicants' invention contain less than 3 grams of one or more digestible fats. In other embodiments of Applicants' invention, each embodiment contains less than 2 grams of one or more digestible fats per 30 grams of embodiment. In still other embodiments of Applicants' invention, each embodiment contains less than 1 gram of one or more digestible fats per 30 grams of embodiment. In still other embodiments of Applicants' invention, each embodiment contains from 0.01 grams to 3 grams of one or more digestible fats per 30 grams of embodiment.

[0069] On a 30-gram basis, certain embodiments of Applicants' invention contain less than 2 grams of one or more digestible saturated fats. In other embodiments of Applicants' invention, each embodiment contains less than $\frac{1}{2}$ of a gram of one or more digestible saturated fats per 30 grams of embodiment. In still other embodiments of Applicants' invention, each embodiment contains less than $\frac{1}{4}$ of a gram of one or more digestible saturated fats per 30 grams of embodiment. In still other embodiments of Applicants' invention, each embodiment contains from 0.01 grams to 1 gram of one or more digestible saturated fats per 30 grams of embodiment.

[0070] On a 40-gram basis, certain embodiments of Applicants' invention contain less than 3 grams of one or more digestible fats. In other embodiments of Applicants' invention, each embodiment contains less than 2 grams of one or more digestible fats per 40 grams of embodiment. In still other embodiments of Applicants' invention, each embodiment contains less than 1 gram of one or more digestible fats per 40 grams of embodiment. In still other embodiments of Applicants' invention, each embodiment contains from 0.01 grams to 3 grams of one or more digestible fats per 40 grams of embodiment.

[0071] On a 40-gram basis, certain embodiments of Applicants' invention contain less than 2 grams of one or more

digestible saturated fats. In other embodiments of Applicants' invention, each embodiment contains less than $\frac{1}{2}$ of a gram of one or more digestible saturated fats per 40 grams of embodiment. In still other embodiments of Applicants' invention, each embodiment contains less than $\frac{1}{2}$ of a gram of one or more digestible saturated fats per 40 grams of embodiment. In still other embodiments of Applicants' invention, each embodiment contains from 0.01 grams to 1 gram of one or more digestible saturated fats per 40 grams of embodiment.

[0072] On a 50-gram basis, certain embodiments of Applicants' invention contain less than 3 grams of one or more digestible fats. In other embodiments of Applicants' invention, each embodiment contains less than 2 grams of one or more digestible fats per 50 grams of embodiment. In still other embodiments of Applicants' invention, each embodiment contains less than 1 gram of one or more digestible fats per 50 grams of embodiment. In still other embodiments of Applicants' invention, each embodiment contains from 0.01 grams to 3 grams of one or more digestible fats per 50 grams of embodiment.

[0073] On a 50-gram basis, certain embodiments of Applicants' invention contain less than 2 grams of one or more digestible saturated fats. In other embodiments of Applicants' invention, each embodiment contains less than $\frac{1}{2}$ of a gram of one or more digestible saturated fats per 50 grams of embodiment. In still other embodiments of Applicants' invention, each embodiment contains less than $\frac{1}{2}$ of a gram of one or more digestible saturated fats per 50 grams of embodiment. In still other embodiments of Applicants' invention, each embodiment contains from 0.01 grams to 1 gram of one or more digestible saturated fats per 50 grams of embodiment.

[0074] In order to meet the low-fat requirements for a balanced nutritional profile, the digestible fat levels of most foods must be reduced significantly. However, a low level of fat in a crumb structure results in a very dry product during mastication. Also, in an anhydrous (oil continuous) filling, low fat formulations result in very dry, stiff fillings, with poor mouth melt. When the digestible fat level of a product is reduced, the product's texture and taste can be improved by replacing the digestible fat with non-digestible lipids, partially digestible lipids or mixtures thereof on a weight percent to weight percent basis. When the use of non-digestible lipids, partially digestible lipids or mixtures thereof is precluded by regulatory or processing concerns, water continuous fillings, such as fruit fillings having water activities of less than 0.80 may be used to enhance lubricity and thus the texture and taste of the product. For example, the taste system of a filled bar, wherein the crumb contains less than 3.0 grams of triglyceride fat per serving, is improved by selecting a water continuous filling. When a non-perishable product is desired, it is preferred that the filling's water activity be sufficiently low to prevent the growth of most pathogenic and spoilage bacteria.

[0075] When water based fillings cannot be used, and the product is substantially anhydrous, the product's taste may be substantially improved by a continuous phase that comprises a glassy structure below its transition point. It is preferred that the glassy structure comprise sugars, polysaccharides and mixtures thereof, rather than starches that have a fast mouth melt. For example, a snack crisp structure is

formed by a non-traditional composition that is low in fat, and high in protein and dietary fiber. The snack crisp contains none of the traditional structure forming components such as flour or starches. It is based on a continuous phase of an amorphous glass that is interrupted by particles of dietary fiber and protein isolates. These normally unpalatable ingredients are enclosed within an amorphous glass structure having a crispy-crunchy texture and a quick mouth melt. The amorphous glass may be formed by a variety of sugars or maltodextrin combinations. The resulting forms range from very sweet to savory. Flavors and "bits" may be added topically, or be contained within the structure. The snack crisp structure may be attained by baking, or by extrusion, followed by a baking or drying step. The snack crisp provides a tasty, nutritionally balanced food that is capable of contributing high levels of dietary fiber and protein to a diet.

[0076] Fats that can be used to produce the nutritional compositions of the present invention may include or be derived from, but are not limited to, vegetable oils and fats, lardic oils and fats, milk fat, animal fats, marine oils, partially-digestible and non-digestible oils and fats, surface-active lipids and mixtures thereof. Useful vegetable oils and fats include, but are not limited to, triacylglycerols based on C18 monounsaturated fatty acids such as oleic acids, linoleic acids, linolenic acids and mixtures thereof. Non-limiting examples of useful unhydrogenated, partially-hydrogenated and fully-hydrogenated vegetable oils include oils derived or isolated from soybeans, safflowers, olives, coconuts, cottonseeds, palm, peanuts, flaxseeds, sunflowers, rice bran, sesame, rapeseed, cocoa butter and mixtures thereof.

[0077] Useful lardic oils and fats include, but are not limited to, triacylglycerols based on lardic acid having 12 carbons. Non-limiting examples of useful lardic oils and fats include coconut oil, palm kernel oil, babassu oil and mixtures thereof.

[0078] Useful animal fats include, but are not limited to, lard, beef tallow, egg lipids, intrinsic fat in muscle tissue and mixtures thereof.

[0079] Useful marine oils include, but are not limited to, triacylglycerols based on omega-3 polyunsaturated fatty acids such as docosahexaenoic acid C22:6. Non-limiting examples of useful marine oils include menhaden oil, herring oil and mixtures thereof.

[0080] Useful partially-digestible and non-digestible oils and fats include, but are not limited to, polyol fatty acid polyesters, structured triglycerides, plant sterols and sterol esters, other non-digestible lipids such as esterified propylene glycol (EPG), and mixtures thereof. Useful polyol fatty acid polyesters include, but are not limited to, monooxy polyesters, which are sold under the trade name of OleonTM by the Procter & Gamble Company of Cincinnati, Ohio U.S.A. Non-limiting examples of useful structured triglycerides include caproin, salarin and mixtures thereof. Non-limiting examples of useful plant sterols and sterol esters include sitosterol, stigmasterol, campesterol and mixtures thereof.

[0081] Partially-digestible and non-digestible oils and fats are particularly useful as they impart little or no calories to a food product and can impart a hypocholesterolemic capability to foods that incorporate acid fats and oils. Examples

of partially-digestible and non-digestible oils and fats that can provide a food with a hypocholesterolemic capability include, by way of example, sucrose polyesters which are sold under the trade name of Olean™ by the Procter & Gamble Company of Cincinnati, Ohio U.S.A. (See e.g., Gibeck, C. J., Jendacek, R. J., Hogg, E., Allen, C., Bachler, L., and Towlsbury, M. (1983) Sucrose polyester: substitution for dietary fat in hypocaloric diets in the treatment of familial hypercholesterolemia. *Am. J. Clin. Nutr.* 37, 347-354) and plant sterols and plant sterol esters (See Mattson, F. H., Grundy, S. M., and Crouse, J. R. (1982) Optimizing the effect of plant sterols on cholesterol absorption in man. *Am. J. Clin. Nutr.* 35, 697-700; U.S. Pat. No. 3,751,569, B. A. Erickson, Clear cooking and salad oils having hypocholesterolemic properties; Westra, I. A., and Meijer, G. W. (1998) Plant sterol-enriched margarines and reduction of plasma total- and LDL-cholesterol concentrations in normocholesterolemic and mildly hypercholesterolemic subjects. *Eur. J. Clin. Nutr.* 52, 334-343).

[0082] The preferred nondigestible lipid is Olean™, which is sold by the Procter & Gamble Company of Cincinnati, Ohio U.S.A. Preferred partially digestible lipids are structured triglycerides comprising a combination of fluid chain fatty acids (i.e., short-chain saturated or unsaturated fatty acids) with long-chain, saturated fatty acids (chain lengths of C18-C24). An example of a partially digestible lipid is caprenin (Procter & Gamble Company, Cincinnati, Ohio, U.S.A.), which is a structured triglyceride comprised of octanoic acid (C8:0), decanoic acid (C10:0), and behenic acid (C22:0). Other examples are the reduced calorie triglycerides described in U.S. Pat. No. 5,419,925 (Seiden et al., assigned to The Procter & Gamble Company, Cincinnati, Ohio, U.S.A.), which are triglycerides comprised of short chain-length, saturated fatty acids (C6:0-C10:0) and long chain-length, saturated fatty acids (C18:0-C24:0). Another example of partially digestible lipids are the salatrim family of low calorie fats developed by the Nabisco Foods Group (East Hanover, N.J.). The salatrim low-calorie fats are triglycerides comprised of short chain fatty acid maldives (C2:0-C4:0) and long chain, saturated fatty acids (C16:0-C22:0); see Smith et al., "Overview of Salatrim, a Family of Low-Calorie Fats", *J. Agric. Food Chem.*, 42:432-434, (1994); and Softly et al., "Composition of Representative Salatrim Fat Preparations", *J. Agric. Food Chem.*, 42:461-467, (1994). Salatrim is available under the brand name, Bonafat™, from Caltor Food Science (Ardsley, N.Y.). Bonafat™ is a specific component of the salatrim family, comprising acetic (C2:0), propionic (C3:0), butyric (C4:0), and stearic (C18:0) acids.

[0083] Useful surface active lipids are amphiphilic molecules that may be purposefully added to food compositions for their functional performance or to enhance processability. Although these ingredients are adjunct ingredients, they will be detected as digestible fat by Applicants' analytical methods. Examples of surface active lipids are emulsifying agents, which are surface active lipids that stabilize oil-in-water or water-in-oil emulsions by orienting at the oil/water interface and reducing the interfacial tension; and foaming agents, which are surfactants that orient at the gas-water interface to stabilize foams. Surface active lipids may also be added as an inherent component of a food ingredient, such as the phospholipids found in soybean oil and egg yolks (e.g., lecithin). In addition, surface active lipids may be formed in the food as a result of the processing. For

example, free fatty acids are formed in frying oils as a result of hydrolysis of the triglycerides and these fatty acids will be transferred to the fried food along with the oil that is transferred to the food.

[0084] Useful surface-active agents include, but are not limited to, free fatty acids, monoglycerides, diglycerides, phospholipids, sucrose esters, sorbitan esters, polyoxyethylene sorbitan esters, diacetyl tartaric acid esters, polyglycol esters and mixtures thereof.

[0085] Carbohydrate

[0086] As used herein, the term "carbohydrate" refers to the total amount of sugar alcohols, monosaccharides, disaccharides, oligosaccharides, digestible, partially digestible and non-digestible polysaccharides; and lignin or lignin like materials that are present in the embodiments of the present invention.

[0087] Carbohydrates that can be incorporated into the present invention may include, but are not limited to, monosaccharides, disaccharides, oligosaccharides, polysaccharides, sugar alcohols and mixtures thereof. Non-limiting examples of useful monosaccharides include: tetroses such as erythrose; pentoses such as arabinose, xylose, and ribose; and hexoses such as glucose (dextrose), fructose, galactose, mannose, sorbose and tagatose.

[0088] Non-limiting examples of useful disaccharides include: sucrose, maltose, lactose and cellobiose.

[0089] Non-limiting examples of useful oligosaccharides include: fructooligosaccharide; maltotriose; raffinose; stachyose; and corn syrup solids (maltose oligomers with n=4-10).

[0090] Useful polysaccharides include, but are not limited to, digestible polysaccharides and non-digestible polysaccharides. Non-limiting examples of useful digestible polysaccharides include starches that are isolated or derived from cereal grains, legumes, tubers and roots; maltodextrins obtained by the partial hydrolysis of starch; glycogen and mixtures thereof. Non-limiting examples of useful starches include flours from cereals, legumes, tubers and roots; native, unmodified starches, pre-gelatinized starches, chemically modified starches, high amylose starches, waxy starches, and mixtures thereof.

[0091] Useful non-digestible polysaccharides may be water-soluble or water-insoluble. Non-limiting examples of useful water-soluble or predominately water-soluble, non-digestible polysaccharides include: oat bran; barley bran; psyllium; pentosans; plant extracts such as pectins, inulin, and beta-glucan soluble fiber; α -D galactomannans such as guar gum, and locust bean gum; plant exudates such as gum arabic, gum tragacanth, and gum karaya; seaweed extracts such as agar, carrageenans, alginates, and fucellans; cellulose derivatives such as carboxymethylcellulose, hydroxypropyl methylcellulose and methylcellulose; microbial gums such as xanthan gum and gellan gum; hemicelluloses; polydextrose; and mixtures thereof. Non-limiting examples of water-insoluble, and predominately water-insoluble, non-digestible polysaccharides include cellulose, microcrystalline cellulose, bran, resistant starch, and mixtures thereof.

[0092] Useful sugar alcohols include, but are not limited to, glycerol, sorbitol, xylitol, mannitol, maltitol, propylene glycol, erythritol and mixtures thereof.

[0093] Fiber

[0094] Dietary fiber comprises the food components derived from plant material, or analogous carbohydrates, that are resistant to digestion and absorption in the human small intestine. This includes various polysaccharides, oligosaccharides, polyfructans, and lignins that are resistant to digestion. The term analogous carbohydrates refers to carbohydrate compounds that may not be specifically derived from plant material, but that are resistant to digestion and absorption in the human small intestine (e.g., a synthetic non-digestible polysaccharide or oligosaccharide, such as polydextrose). Many fiber constituents are carbohydrates, such as cellulose, hemicellulose, pectin, guar gum and beta-glucan soluble fiber. Lignin, a component of the woody structure of plants, is not considered a classical carbohydrate; however, it is non-digestible and is included in the measurement of total dietary fiber. Thus, for purposes of Applicants' invention, lignin and lignin like materials are classified as carbohydrates.

[0095] Dietary fibers may be further classified into water-soluble (e.g., pectin, guar, beta-glucan soluble fiber) and insoluble (e.g., cellulose) fractions. The current average intake of dietary fiber in the United States is approximately 10 g/day. Recommendations from health professionals are to increase consumption of fiber-rich foods in order to achieve a daily fiber intake of approximately 25-35 grams (Garrison and Sanner, 1995). The United States Food and Drug Administration (FDA) has specified the Daily Reference Value for dietary fiber for use on food labels as 25 g/day (based upon a 2,000 kcal/day diet) (Code of Federal Regulations; 21 CFR § 101.9). Foods that provide at least 2.5 g dietary fiber per serving may be claimed as a "good source" of fiber. A high fiber intake is believed to be beneficial for reducing the risk of cardiovascular diseases, colorectal cancer, constipation, diverticulosis, and other gastrointestinal disorders. For example, certain soluble fibers such as pectin, guar gum, psyllium, and beta-glucan soluble fiber have been shown to provide heart health benefits by reducing serum total and low-density lipoprotein (LDL) cholesterol (Brown, L. et al., *Am J Clin Nutr*; 1999, 69:30-42). While not being limited by theory, the mechanism for this effect is believed to be related to soluble fiber's impact on viscosity of the digesta in the small intestine; i.e., a significant increase in digesta viscosity reduces the reabsorption of bile acids. In addition, certain soluble fibers are partially or completely fermented by microorganisms in the large intestine, producing short-chain fatty acids (acetic, propionic, butyric acids) which are absorbed and may provide an inhibitory effect on cholesterol synthesis in the liver. Again, while not being limited by theory, high fiber diets, particularly those high in insoluble fiber, are believed to reduce the incidence of colon and rectal cancers by promoting an increased transit rate of potential carcinogens through the intestinal tract, diluting the concentration of carcinogenic agents through increased water retention in the stool, and possibly by binding toxic compounds and promoting their elimination.

[0096] Furthermore, choosing a diet that is moderate in sugar content was one of the recommendations in the most recent publication of Dietary Guidelines for Americans (U.S. Department of Agriculture, 4th edition, 1995). An individual can reduce their sugar intake by eating protein and dietary fiber enriched foods, as the percentages of carbohydrates, and possibly simple sugars, in these foods is

reduced. Protein and fiber enriched foods may also benefit diabetics as they must carefully monitor their total carbohydrate intake. Thus, protein and fiber-enriched foods that are relatively low in total carbohydrate content may be a useful addition to their overall dietary plan. An elevated fiber content also benefits diabetics by helping manage blood glucose levels (glycemic control) and postprandial insulin levels (Anderson, J. W. and Akanji, A. O., 1993, in *CRC Handbook of Dietary Fiber in Human Nutrition*, 2nd edition, G. A. Spiller, ed., CRC Press).

[0097] In view of the health benefits associated with ingesting dietary fiber, certain embodiments of Applicants' invention, contain, on a 30-gram basis, at least about 2.5 grams of dietary fiber. Other embodiments of Applicants' invention contain from about 2.5 grams to about 5.0 grams of dietary fiber per 30 grams of embodiment, while still other embodiments of Applicants' invention contain about 2.5 grams to about 3.5 grams of dietary fiber per 30 grams of embodiment.

[0098] On a 40-gram basis, certain embodiments of Applicants' invention contain at least about 2.5 grams of dietary fiber. Other embodiments of Applicants' invention contain from about 2.5 grams to about 6.5 grams of dietary fiber per 40 grams of embodiment, while still other embodiments of Applicants' invention contain about 2.5 grams to about 3.5 grams of dietary fiber per 40 grams of embodiment.

[0099] The dietary fiber used in Applicants' invention comprises from 0% to 100% by weight soluble dietary fiber and from 0% to 100% by weight insoluble dietary fiber. In certain embodiments of Applicants' invention, said dietary fiber comprises from 50% to 100% by weight soluble dietary fiber and from 0% to 50% by weight insoluble dietary fiber. In still other embodiments of Applicants' invention, said dietary fiber comprises from 70% to 100% by weight soluble dietary fiber and from 0% to 30% by weight insoluble dietary fiber.

[0100] Although dietary fiber is a critical component of a nutritionally balanced food, dietary fiber can have adverse effects on taste due to off-flavors that are inherent in fiber sources and the negative textural properties that dietary fiber sources can impart to foods. This is particularly true when fat is replaced with dietary fiber. As a result of Applicants' work, Applicants have discovered that the off-flavor that dietary fibers impart can be minimized by selecting fiber sources having high active levels—active levels of at least 75% are preferred. Also, Applicants have discovered that, for insoluble dietary fibers, key factors affecting taste are particle size and water absorption. Applicants have determined that, in order to avoid producing finished foods having gritty textures, insoluble dietary fibers having particle sizes of less than about 150 microns, and more preferably less than about 50 microns, should be used. In addition, in order to avoid dryness due to saliva absorption during mastication, it is preferred that the water absorption of insoluble dietary fibers be less than about 7.0 grams water per gram of fiber and most preferably less than about 3.5 grams of water per gram of fiber. Examples of insoluble dietary fibers having an active level of at least 75%, a particle size less than 150 microns, preferably less than 50 microns and a water absorption of less than about 7.0 grams water per gram of fiber include: Vitacel® wheat fiber WF-600/30 from J. Rettenmaier & Sohme GmbH & Co. of

Rilwangen/J., Federal Republic of Germany and Centura III pea fiber which can be obtained from Parricim Foods Portage La Prairie, Manitoba, Canada.

[0101] In addition to researching insoluble dietary fibers, Applicants have researched soluble dietary fibers. As a result of this research, Applicants have discovered that, when soluble dietary fibers are in the presence of liquids like saliva, the key factor affecting taste is viscosity. Many dietary fibers have considerable thickening effects when combined with water/saliva. Thickened fillings or thickening that occurs during mastication can produce unpleasant textures, slow mouth melt, and slow the rate of flavor display. In order to avoid undesired thickening, a viscosity effect similar to that of sucrose is preferred. Thus, the viscosity at 25° C. should be less than about 1-2 centipoise for a 10% solution, and less than about 200 centipoise for a 50% solution. It is also preferable that the viscosity remain close to Newtonian. Soluble dietary fibers having an active level of at least 75% and a viscosity effect that is similar to sucrose include maltodextrin dietary fibers such as Fibenol 2 which has an active level (total dietary fiber) of 85% and a viscosity of ~1.5 cp for a 10% solution and which can be obtained from Matsutani Chemical Industry Co., Ltd. of Itami-city Hyogo, Japan; and acylhomogalactan dietary fibers such as Fibenol 3 which has an active level (total dietary fiber) of 85% and a viscosity of ~2.0 cp for a 10% solution and which can be obtained from Larix Inc. of White Bear Lake, Minn.

[0102] Oat bran dietary fiber, such as Oatcor Oat Bran Concentrate (The Quaker Oats Co. Chicago, Ill.) which is rich in beta-glucan soluble fiber (11.5%), is another preferred fiber as it can provide a heart health/cholesterol lowering benefit when present at a level sufficient to provide 0.75 g beta-glucan soluble fiber per 40 gram serving level. The amount of oat bran dietary fiber needed to provide 0.75 g beta-glucan soluble fiber per 40 gram serving level can be determined by determining the amount of beta-glucan soluble fiber per mass unit of oat bran dietary fiber, using the beta-glucan soluble fiber analysis method found in Applicants' Analytical Protocols. Once the amount of beta-glucan soluble fiber per mass unit of oat bran dietary fiber is known, one skilled in the art can calculate how much oat bran dietary fiber to incorporate in a product to achieve the desired level of beta-glucan soluble fiber.

[0103] Applicants have also discovered that, for soluble dietary fibers in predominantly anhydrous foods, key factors affecting taste are particle size, water absorption, and dissolution rates. If the dissolution rate, which is analogous to the rate of hydration, is too slow, soluble fibers having particle sizes greater than 50 microns and most particularly from 50 to 200 microns, will impart a gritty, dry texture to foods—these undesirable textural characteristics are especially noticeable when the fiber is used at a level of more than about 1 gram per serving, and most particularly noticeable above about 2.5 grams per serving. Soluble fibers, especially when present with insoluble fibers or other surrounding matrices, can swell upon hydration and absorb high amounts of water. During mastication, this effect increases the dryness impression and viscosity of the food and thus detracts from a food's flavor display. The resulting dryness impression and increase in viscosity is sensed as an unpleasant thick and often sticky texture that has a poor flavor display. Again, dryness and viscosity issues can be minimized, thus an overall taste improvement can be mal-

ized, by selecting soluble fibers that have a minimal viscosity effect, and a dissolution rate as similar as possible to the rate of sucrose. The rates of dissolution can be compared by observing the dissolution rate of 1 teaspoon soluble fiber in 250 ml of water at 25° C. versus 1 teaspoon sucrose in 250 ml of water at 25° C. The fiber and sugar are slowly added simultaneously to their respective aliquots of water with gentle stirring.

[0104] Adjunct Ingredients

[0105] Adjunct ingredients are necessary for processing and structural development of most foods.

[0106] Examples of typical adjunct ingredients include processing aids, emulsifiers, and leavening agents. As known by those skilled in the art, the required adjunct ingredients that are needed to produce foods vary by food type. Selection of the appropriate type and level of adjunct is easily determined by one skilled in the art as said information is available in reference sources. For example, it is well known that crackers rely heavily on processing aids and leavening agents. Leavening agents provide the internal expansion or rise of the product during baking. Crackers without leavening would be thin and dense and would have an unpleasant eating quality. Processing aids such as reductants and enzymes are required either singularly or in combination to allow adequate machining (i.e., dough sheeting and die cutting), and/or development of necessary structure. They are believed to function by breaking bonds in the gluten complex of the dough (i.e., disulfide cross-linkages and peptide bonds).

[0107] In addition, it is known by those skilled in the art that extruded snacks utilize emulsifiers, and may use leavening agents. The role of the emulsifier is to aid in processing (for example sheeting dough) and the formation of the internal product structure.

[0108] It is also known that cookies rely heavily on the use of leavening agents and emulsifiers. Other baked goods such as brownies, muffins, snack cakes, and pastries also rely on leavening agents and emulsifiers to achieve their desired structure. Snack cakes are at the high end of functionality, as they require the most care in the choice and blends of leavening agents and emulsifiers to achieve their tender highly cellular structure. Brownies are generally at the lower end of functionality, as they typically have a more dense structure.

[0109] Finally, it is known that fillings generally require the use of an emulsifier or whipping agent to aid in processing, texture formation, and mouth melt. For example, peanut butter based fillings may utilize an emulsifier to aid in particle dispersion during processing. Emulsifiers are also used in confectionary fillings to aid in the creation of textures and improve mouth melt. For example, chocolate uses an emulsifier to reduce the level of cocoa butter fat required in its final composition. Some fillings (mugat) utilize whipping agents to incorporate air into the filling in order to attain a desired texture and mouth melt.

[0110] Although the type and level of adjunct ingredients that are needed to produce any specific food product is known by those skilled in the art, Applicants have provided a number of examples wherein the type and level of adjunct ingredients used to produce a variety of foods is listed.

[0111] Additional Ingredients

[0112] Additional ingredients that may be incorporated in Applicants' invention include natural and synthetically prepared flavoring agents, non-caloric sweeteners, bracers, flavanols, natural and synthetically prepared colors, preservatives, acidulants, and food stability anti-oxidants. A flavoring agent is recommended for the embodiments of this invention in order to further enhance their taste. As used herein the term "flavoring agents" encompasses seasonings and spices. Flavors may be added to the initial formulation, or be added topically after the product is produced. Any natural or synthetic flavor agent can be used in the present invention. Fruit flavors, natural botanical flavors, and mixtures thereof can be used as the flavoring agent. Particularly preferred savory flavors are grain based, spice based, and buttery type flavors. Besides these flavors, a variety of sweet flavors such as chocolate, praline, caramel and other fruit flavors can be used such as apple flavors, citrus flavors, grape flavors, raspberry flavors, cranberry flavors, cherry flavors and the like. These fruit flavors can be derived from natural sources such as fruit juices and flavor oils, or else be synthetically prepared. Preferred natural flavors are also vanilla, ginseng, ginkgo, hawthorn, hibiscus, rose hips, chamomile, peppermint, fennel, ginger, licorice, lotus seed, schizandra, saw palmetto, manzanilla, safflower, St. John's Wort, caraway, cardamom, nutmeg, cassia bark, lichen, cinnamon, jasmine, haw, chrysanthemum, water chestnut, sugar cane, lychee, bamboo shoots and the like. Typically the flavoring agents are conventionally available as concentrates or extracts or in the form of synthetically produced flavoring esters, alcohols, aldehydes, terpenes, sesquiterpenes, and the like. When used in any embodiment, flavoring agents are added in effective levels.

[0113] Regardless of the flavoring agent, Applicants recognized that both olfactory and gustatory flavors display best when the interfacial area within the saliva is maximized. This occurs when flavor bearing particles are effectively broken down during mastication. This results in a more rapid partitioning of the flavors into the mouth's saliva and head space where the flavors can be sensed. This effect can be dependent on or enhanced by the food's mouth melt.

[0114] Applicants also recognized that the transfer of flavors to the headspace is greatly facilitated by the flavor compounds first partitioning into the aqueous phase or saliva in the mouth. While not being bound by theory, this is believed to be due to the higher volatility, from water to air versus oil to air, of relatively non-polar flavors. An exception to this is a water continuous food system containing flavors. Otherwise, these flavor compounds usually reside predominantly in the oil or solid phases of a food. Initially, a food's solids can either physically or chemically bind these flavors. The olfactory flavor compounds are usually released and detected by the olfactory system at different rates. This is why some flavors are sensed early in the eating experience, and others later. It is usually the overall perception of the release of these many compounds, over time in the mouth, that produces the characteristic olfactory flavor response, for example, chocolate or buttery.

[0115] Effective levels of non-caloric sweeteners can be used in all embodiments of the present invention to further sweeten said embodiments. Examples of non-caloric sweeteners include saccharose, aspartame, acesulfame, cyclamate,

acesulfame-K, L-aspartyl-L-phenylalanine lower alkyl ester sweeteners, L-aspartyl-D-alanine amides as disclosed in U.S. Pat. No. 4,411,925 to Brennan, et al (1983), L-aspartyl-D-serine amides disclosed in U.S. Pat. No. 4,399,163 to Brennan et al (1983), L-aspartyl-hydroxymethyl alkane amide sweeteners disclosed in U.S. Pat. No. 4,338,346 issued to Brand (1982), L-aspartyl-1-hydroxyethylalkane amide sweeteners disclosed in U.S. Pat. No. 4,423,029 to Rhodi (1983), glycyrrhizine, synthetic alanyl aromatics, etc. Lo Han Gao juice, steviolide and other natural sources of sweeteners can also be used.

[0116] Bracers are another class of optional ingredients that may be incorporated in the present invention. Bracers can be obtained by extraction from a natural source or can be synthetically produced. Any bracer used in any embodiment of the present invention is preferably present in physiologically relevant amounts, which means that the sources used in the practice of this invention provide a safe and effective quantity to achieve mental refreshment and alertness. The methylxanthines: caffeine, theobromine and theophylline, are well known examples of bracers. However, numerous other xanthine derivatives have been isolated or synthesized. See, for example, Brum, Biochem. Pharmacol., 30, 325-333, (1981), describing more than one hundred purine bases and structurally related heterocycles relative to xanthine. One or more of these compounds are present in the coffee bean, tea, kola nut, cacao pod, mate, yampon, guarana paste and yoco. Natural plant extracts are the preferred sources of bracers as they may contain other compounds that delay the bioavailability of the bracer; thus they may provide mental refreshment and alertness without jitters. The most preferred methylxanthine is caffeine. Caffeine can be obtained from the aforementioned plants and their waste or else synthetically prepared. Preferred botanical sources of caffeine that may be used as a complete or partial source of caffeine include green tea, guarana, mate, black tea, cola nuts, cocoa and coffee. Green tea, guarana and mate are the most preferred botanical sources of caffeine. Guarana functions in a manner similar to green tea. Thus, guarana may be used to decrease the bioavailability of caffeine, thereby reducing or eliminating the caffeine jitters. Mate may have the additional benefit of an appetite suppressing effect and may be included for this purpose as well.

[0117] Another class of optional ingredients that may be incorporated in the present invention are flavanols. Flavanols are natural substances present in a variety of plants (e.g. fruits, vegetables, flowers). The flavanols used in the present invention can be extracted from fruit, vegetables, green tea or other natural sources by any suitable method well known to those skilled in the art. For example, extraction with ethyl acetate or chlorinated solvents is one way to isolate flavanols from green tea; or, they may be prepared by synthetic or other appropriate chemical methods. Flavanols, including catechin, epicatechin, and their derivatives, are commercially available.

[0118] Flavanols may be extracted from either a single plant or mixtures of plants. The preferred flavanols are extracted from plants, e.g. green tea and related plants. Many fruits, vegetables, and flowers contain flavanols but to a lesser degree. Plants containing flavanols are known to those skilled in the art. Examples of the most common flavanols which are extracted from tea plants and other members of the catechu gambir (*Uncaria* family) are cat-

echin, epicatechin, gallicotecthin, epigallocatechin, epicatechin gallate, epigallocatechin gallate.

[0119] The preferred source of flavanols is green tea. Green tea, and in particular the flavanols present in green tea, when incorporated into a food, may delay the bioavailability of caffeine—thus reducing or eliminating the caffeine jitters.

[0120] The flavanols used in all embodiments of the present invention can be in the form of a tea extract. The tea extract can be obtained from the extraction of unfermented teas, fermented teas, partially fermented teas and mixtures thereof. Preferably the tea extracts are obtained from the extraction of unfermented and partially fermented teas. The most preferred tea extracts are obtained from green tea. Both hot and cold extracts can be used in the present invention. Suitable methods for obtaining tea extracts are well known; See, for example, U.S. Pat. No. 5,879,733 to Hkassayala, issued Mar. 9, 1999; U.S. Pat. No. 4,935,256 to Tsai, issued June 1990; U.S. Pat. No. 4,680,193 to Lander, issued July 1987; and U.S. Pat. No. 4,668,525 to Caswick, issued May 26, 1987.

[0121] Embodiments of the present invention may optionally be fortified with vitamins and minerals. The U.S. Recommended Dietary Allowances (U.S. RDA) are a set of nutrient standards established by the Food and Nutrition Board of the National Academy of Sciences (Food and Nutrition Board, 1989, *Recommended Dietary Allowances*, 10 ed., National Research Council, National Academy of Sciences, Washington, D.C.). The RDA's for vitamins and minerals represent the average daily intake considered adequate to meet the nutritional needs of most healthy individuals in the United States. The RDA for a particular vitamin or mineral varies depending on age, gender, and physiological state (e.g., pregnant, lactating). The Reference Daily Intakes (RDI) for vitamins and minerals were established by the Food and Drug Administration to reflect the average nutrient allowances for adults and are used for nutrition labeling on food products in the United States. Embodiments of the present invention may optionally contain vitamins selected from the group consisting of vitamins A, D, E, K, C (ascorbic acid), thiamin, riboflavin, niacin, vitamin B₆, folate, vitamin B₁₂, biotin, and pantothenic acid. These vitamin sources are preferably present in nutritionally relevant amounts, which means that the vitamin sources used in the practice of this invention provide a nourishing amount of said vitamins. Preferably, this amount comprises at least about 1% of the U.S. RDA or RDI for said vitamin, more preferably from about 1% to about 100%, and most preferably from about 10% to about 100% of the U.S. RDA or RDI per 30 g reference serving of the finished product. Of course, it is recognized that the preferred daily intake of any vitamin may vary with the user, with greater than U.S. RDA or RDI intakes being beneficial in some circumstances.

[0122] In general, the U.S. RDA for vitamin A ranges from about 375 µg RE (retinol equivalent) to about 1300 µg RE, depending on age and physiological state (Food and Nutrition Board, 1989; Gregory, J. F., 1996, "Vitamins", in *Food Chemistry*, 3rd ed., O. R. Fennema, ed.). The U.S. RDA for vitamin D ranges from about 5 µg to about 10 µg (as cholecalciferol). The U.S. RDA for vitamin E ranges from about 3 mg TE (α-tocopherol equivalent) to about 12 mg TE.

The U.S. RDA for vitamin K ranges from 5 µg to 80 µg. The U.S. RDA of vitamin C ranges from about 30 mg to about 95 mg. The U.S. RDA for thiamin ranges from about 0.3 mg to about 1.6 mg. The U.S. RDA for riboflavin ranges from about 0.4 mg to about 1.8 mg. The U.S. RDA for niacin ranges from about 5 mg to about 20 mg. The U.S. RDA for vitamin B₆ ranges from about 0.3 mg to about 2.2 mg. The U.S. RDA for folate ranges from about 25 µg to about 400 µg. The U.S. RDA for vitamin B₁₂ ranges from about 0.3 µg to about 2.6 µg. The RDI's established by the Food and Drug Administration for various vitamins are as follows (Code of Federal Regulations, Title 21, Section 101.9: *Nutrition Labeling of Food*, 21CFR 101.9, revised as of Apr. 1, 1999): Vitamin A—5,000 International Units (IU; equals 875 µg RE); Vitamin D—400 IU (equals 6.5 µg); Vitamin E—30 IU (equals 9 mg α-tocopherol equivalents); Vitamin K—80 µg; Vitamin C—60 mg; thiamin—1.5 mg; riboflavin—1.7 mg; niacin—20 mg; Vitamin B₆—2.0 mg; folate—400 µg; Vitamin B₁₂—6 µg; biotin—300 µg; pantothenic acid—10 mg.

[0123] Vitamin A precursors (provitamin A, carotenoids) can also be used, including beta-carotene, alpha-carotene, β-apo-8' carotenol, cryptoxanthin and the like. The vitamin A esters (e.g., retinyl palmitate, retinyl acetate) and beta-carotene are highly preferred forms of vitamin A. Vitamin D can be selected from, for example, cholecalciferol (D₃), ergocalciferol (D₂), and their biologically active metabolites and precursors, such as 1-alpha-hydroxy vitamin D, 25-hydroxy vitamin D, 1,25-dihydroxy vitamin D and the like. Vitamin D as cholecalciferol is highly preferred. All-*rac* alpha-tocopherol and RRR-alpha-tocopherol and their esters are highly preferred as a source for vitamin E. Sources of vitamin E include dl-alpha tocopherol (all-*rac*) and its esters, such as dl-α-tocopheryl acetate and succinate, dl-α-tocopherol (RRR) and its esters, d-α-tocopherol and its esters, beta-tocopherol, gamma-tocopherol, and their esters, tocopheryl nicotinate, and the like. Vitamin K can be selected from phyloquinone (K₁), menaquinone (K₂), menadione and their salts and derivatives. Vitamin K₁ is highly preferred. L-ascorbic acid is particularly preferred as a vitamin C source for the present invention. However other forms of vitamin C, for example, D-ascorbic acid, D-dehydroascorbic acid, L-isoascorbic acid, L-dehydroascorbic acid, and esters of ascorbic acid (e.g., ascorbyl palmitate) may also be used. The hydrochloride and nitrate salts of thiamin and thiamin alkyl disulfides such as the propylid-inaldide, tetrahydrofurfuryl disulfide, O-benzoyl disulfide can be used in the present invention. The hydrochloride and nitrate salts of thiamin are highly preferred. The sources of riboflavin are selected, for example, from crystalline riboflavin coenzyme forms of riboflavin such as flavin adenine dinucleotide, flavin adenine mononucleotide, riboflavin 5-phosphate and their salts. Riboflavin is highly preferred. Sources of niacin include nicotinic acid, nicotinamide, the coenzyme forms of niacin such as nicotinamide adenine dinucleotide, and nicotinamide adenine dinucleotide phosphate. Particularly preferred are nicotinamide and nicotinic acid. Vitamin B₆ can be selected from hydrochloride salts or 5-phosphates of pyridoxine, pyridoxamine, pyridoxal. The preferred vitamin B₆ is pyridoxine hydrochloride. The folate can be in the form of folic acid, mono and polyglutamyl folates, dihydro and tetrahydro folates, methyl and formyl folates. Folic acid is a highly preferred form of folate. Sources of vitamin B₁₂ are, for example, cyanocobalamin, methylcobalamin, 5-deoxy-adenosylcobalamin, and the

like. Cyanocobalamin is highly preferred. Sources of biotin can be selected from D-biotin, oxybiotin, biocytin, biotinol and the like. D-biotin and biocytin are highly preferred. For pantothenic acid, the sources can be in the form of salts such as calcium pantothenate or as pantothenol, or in the form of coenzyme A. Calcium pantothenate is a highly preferred source of pantothenic acid.

[0124] Embodiments of the present invention may be fortified with minerals such as calcium, phosphorus, magnesium, iron, zinc, iodine, selenium, copper, manganese, fluoride, chromium, molybdenum, sodium, potassium, and chloride. The mineral sources are preferably present in nutritionally relevant amounts, which means that the mineral sources used in the practice of this invention provide a nourishing amount of said minerals. Preferably, this amount comprises at least about 1% of the U.S. RDA or RDI for these minerals, more preferably from about 1% to about 100%, and most preferably from about 10% to about 100% of the U.S. RDA or RDI per 30 g reference serving of the finished product. Of course, it is recognized that the preferred daily intake of any mineral may vary with the user, with greater than the U.S. RDA or RDI intakes being beneficial in some circumstances.

[0125] In general, the U.S. RDA for calcium ranges from 400 mg for infants to 1200 mg for adults (Food and Nutrition Board, 1989; Gregory, 1996). The U.S. RDA for phosphorus ranges from 300 mg to 1200 mg. The U.S. RDA for magnesium ranges from 40 mg to 400 mg. The U.S. RDA for iron ranges from 6 mg to 30 mg, depending somewhat on age and physiological state. The U.S. RDA for zinc ranges from 5 mg to 19 mg. The U.S. RDA for iodine ranges from 40 µg to 200 µg. The U.S. RDA for selenium ranges from 10 µg to 75 µg. There are no official U.S. RDA ranges specified for copper, manganese, chromium, molybdenum and fluoride. However, the Food and Nutrition Board has specified an estimated safe and adequate daily dietary intake for copper of about 1.5-3.0 mg, for manganese of about 2.0-5.0 mg, for chromium of about 50-300 µg, and for molybdenum of about 75-250 µg. A safe and adequate range for fluoride is 1.5-4.0 mg (Food and Nutrition Board, 1989). There are no official U.S. RDA ranges specified for sodium, potassium and chloride. However, the Food and Nutrition Board has specified an estimated minimum requirement for chloride of 50-750 mg, depending upon age. The RDIs established by the Food and Drug Administration for various minerals are as follows (Code of Federal Regulations, Title 21, Section 101.9: *Nutrition Labeling of Food*, 21 CFR § 101.9, revised as of Apr. 1, 1999): calcium-1000 mg; phosphorus-1000 mg; iron-18 mg; zinc-15 mg; iodine-150 µg; magnesium-400 mg; selenium-70 µg; copper-2.0 mg; manganese-2.0 mg; chromium-120 µg; molybdenum-75 µg; and chloride-3,400 mg. The embodiments of the invention that comprise any of these latter minerals should employ levels known to be safe without risk of toxicity.

[0126] The source of the mineral salt, both those with established U.S. RDA levels or with safe and adequate intake levels, as well as those with no as yet established human requirement, used in the practice of this invention, can be any of the well known salts including carbonate, oxide, hydroxide, chloride, sulfate, phosphate, pyrophosphate, gluconate, lactate, acetate, fumarate, citrate, malate, amino acids and the like for the cationic minerals and sodium, potassium, calcium, magnesium and the like for the

anionic minerals. However, the particular salt used and the level will depend upon their interaction with other food product ingredients. Elemental iron (electrolytic or reduced iron) is another preferred source of iron.

[0127] If desired, coloring agents can also be added to the food compositions of the present invention. Any suitable coloring agents approved for food use can be utilized for the present invention.

[0128] When desired, preservatives, such as sorbic acid, benzoic acid, hexametaphosphate and salts thereof, can be added into embodiments of the present invention.

[0129] Also, if desired, the composition can contain an acidulant including but not limited to malic, citric, tartaric, and fumaric acids and mixtures thereof.

[0130] Organic as well as inorganic edible acids may be used to adjust the pH of Applicants' foods. The preferred acids are edible organic acids that include citric acid, malic acid, fumaric acid, adipic acid, phosphoric acid, gluconic acid, tartaric acid, ascorbic acid.

[0131] Structural Parameters

[0132] A food's flavor display and texture, and thus its taste, are dependent on the food's composition and structural parameters. As a result, the structural parameters detailed below are important to realizing Applicants' invention. Applicants' teachings concern crumb and filling structural parameters as Applicants' invention encompasses single and multiple phase nutritionally balanced traditional snacks.

[0133] Crumb Structures

[0134] Applicants recognized that the crumb structure of a food is central to the food's texture and flavor display. A nutritionally balanced traditional snack's crumb structure is particularly important, as much of the snack's fat and sugar—key materials that can be used to create desired crumb structures—are typically replaced with fiber and protein. In particular, Applicants have found that dense crumb structures result in poor mouth melt and flavor display. As a result, layered or cellular crumb structures are desirable as these structures have low densities. However, even layered or cellular structures can exhibit poor mouth melt if the cell walls are too thick, or too hard to allow good breakdown and hydration during mastication. Cell wall dimensions that result in acceptable textures and mouth melts are dependent on the particular food type. In general, for a given food type, texture and mouth melt can be improved by increasing cell size and decreasing cell wall thickness relative to the cell dimensions; provided the food's structure does not become too expanded, as "syrinx-like" structures result in negative textures for most products. Thus, for expanded extruded foods like corn curls, cell dimensions 10x or greater than the cell walls dimensions are desired. Crackers should have layers (cell walls) of about the same thickness as the void space between the layers.

[0135] In some foods, such as for some cookies, the cells are not well defined visually, but exist as voids within the structure. Microscopically, this is analogous to a network of tunnels and caverns running uniformly throughout the food's internal structure.

[0136] Most crumb structures have a glass transition point, as structure formers like starches and sugars exhibit a glass

transition analogous to that of polymers. Below the transition point, the structure is a "glass". Above the transition point, the structure becomes tough and rubbery, until it becomes soft and even "liquid like" at its extreme. The glass transition point of a starch and sugar based food's crumb structure is primarily determined by the structure's degree of hydration. Specifically, for starch and sugar based foods, increasing the degree of hydration reduces the glass transition point of the crumb structure.

[0137] Below a snack's glass transition point, the snack has a hard, crisp "glassy structure". For Applicants' cracker, cookie, and snack chip embodiments, a glassy structure is desired as it can impart the desired crispness that consumers expect. This is particularly true when the structural geometry (layers or cells) is optimized. While not to be bound by theory, it is believed that the crumb's water activity, which is a function of water content for a given food type, determines the degree of crispness of the crumb.

[0138] For Applicants' confection embodiments, such as granola bars, a tough, rubbery texture is desired. A tough, rubbery structure is obtained by low-moisture sugar continuous structures having a water activity of greater than 0.65. Here, the moisture level on a weight basis is less than or equal to approximately 20%.

[0139] Fluid or Semi-solid Type Structures

[0140] Applicants recognized that when mastication is required, a good mouth melt is desired. Thus, Applicants have determined that the glass transition point is an important parameter for non-oil based filling structures. When a food's non-oil based filling structure is below the glass transition point, it is very viscous and tough. As the filling's structure moves through its glass transition point, it becomes less viscous and eventually, well above the glass transition point, extremely fluid. Applicants have found that for fillings, lubricity, mouth melt and flavor display can be improved if the filling's structure is above its glass transition point. While the optimal degree of hydration and thus the degree to which the filling's structure exceeds its transition point depends on the final product's form, Applicants' research has resulted in the following teachings: fruit fillings should be sufficiently hydrated so that they will be well above their glass transition point—this requires at least a 20% moisture level on a filling's weight basis; confectionery fillings such as caramel and nougat need only be somewhat above their glass transition point—this requires a moisture level of from about 1% to about 10% on a weight basis; and, as a general rule, since it is desired that fillings made with ingredients such as cheese and peanut butter be anhydrous, these fillings do not have an applicable glass transition point.

Analytical Protocols

[0141] Protocols used to determine the levels and types of amino acid sources, fat, carbohydrate and fiber components, as well as the number and percent of calories from each component of Applicants' invention, are as follows:

[0142] 1. Amino acid content: The total amino acid or protein content of a food is calculated after measuring the percent nitrogen content of the food by the Kjeldahl digestion method. The Kjeldahl digestion method used is AOAC Official Method 979.09, "Protein in Grain" (32.2.03; Chap. 32, pg. 23D).

[0143] a.) Percent amino acid or protein is calculated by multiplying the % nitrogen by a conversion factor of 6.25:

$$\% \text{ amino acid or protein} = \% \text{N} \times 6.25$$

[0144] b.) The amino acid or protein content per a given mass of food is calculated as follows:

$$g \text{ amino acid or protein} = (\text{mass of food}) \times (\% \text{ amino acid or protein} / 100)$$

[0145] c.) Calories from amino acid or protein are calculated by multiplying the grams amino acid or protein by 4:

$$\text{Energy from amino acid or protein (kcal)} = (g \text{ amino acid or protein}) \times 4 \text{ kcal/g}$$

[0146] 2. Amino Acid Chemical Score: The profile of essential amino acids in a food is measured after conducting an amino acid analysis on the product; see AOAC Official Method 994.12, "Amino Acids in Feeds" (4.1.11, Chap. 4, pg. 4-12). Amino acid analysis is carried out on a Beckman Model 6300 ion-exchange instrument following a 16 hour hydrolysis at 115° C. in 6 N HCl, 0.2% phenol that also contains 2 mmol norleucine. The latter serves as an internal standard to correct for losses that may occur during sample transfer, drying, etc. After hydrolysis, the HCl is evaporated and the resulting amino acids dissolved in 100 µl Beckman sample buffer that contains 2 mmol homoserine with the latter acting as a second internal standard to independently monitor transfer of the sample onto the analyzer. The instrument is calibrated with a 2 mmol mixture of amino acids and it is operated via the manufacturer's programs and with the use of their buffers. Data analysis is carried out on an external computer using Perkin Elmer/Nelson data acquisition software.

[0147] During acid hydrolysis asparagine will be converted to aspartic acid and glutamine to glutamic acid. During the HPLC analysis that follows, cysteine co-elutes with proline; and methionine sulfonide, which is a common oxidation product found in peptides/proteins, co-elutes with aspartic acid. Hence, following normal acid hydrolysis, glutamine and asparagine are not individually quantified and it is possible that the methionine value will be low and that the aspartic acid and proline values will be somewhat high. Improved quantification of cysteine and methionine can be obtained by prior oxidation with performic acid, which converts both methionine and methionine sulfonide to methionine sulfones and cysteine and cystine to cysteic acid. Generally, however, performic acid oxidation destroys tyrosine. Best quantification of tryptophan is obtained by hydrolysis with methanesulfonic acid (MSA) instead of hydrochloric acid. The procedure used in this instance is to carry out the hydrolysis with MSA for 16 hours at 15° C. After hydrolysis, the sample is neutralized with 0.35 M NaOH and 100 µl (50% of the sample) is then analyzed on the Beckman 6300.

[0148] To calculate the amino acid chemical score of a dietary amino acid source, the measured essential amino acid pattern of the food is compared to an ideal reference protein. The reference protein used is the recommended profile of essential amino acids (mg/g reference protein) for preschool children ages 2-5, as specified by the World Health Organization (WHO, 1985, *Energy and Protein*

Requirements, WHO Technical Report Series 724, Geneva, 206 pp.). This ideal profile of essential amino acids is as follows:

	mg essential amino acid/ g reference protein
Histidine	19
Isoleucine	28
Leucine	66
Lysine	58
Methionine + Cystine	25
Phenylalanine + Tyrosine	63
Threonine	34
Tryptophan	11
Valine	35

[0149] The content of essential amino acids in a food (mg amino acid/g protein) is compared to the above ideal amino acid profile to identify the most limiting amino acid in the food; i.e., the amino acid in greatest deficit compared to the reference. The amino acid chemical score is then calculated based on the most limiting amino acid as follows:

$$\text{Amino Acid Chemical Score} = \left(\frac{\text{mg limiting amino acid/g protein in food}}{\text{mg amino acid/g reference protein}} \right)$$

[0150] The amino acid chemical score of the protein or amino acid source in the food may be as high as 1.0, which would indicate that the nutritional quality of the amino acid source is equal to the ideal reference protein.

[0151] 3. Digestible Fat and Digestible Saturated Fat:

The content of total digestible fat and digestible saturated fat in a food is measured according to the published AOAC peer-reviewed method for quantifying fat in olestra-containing snack foods (IAOAC, 81, 848-868, 1998, "Determination of fat in olestra-containing savory snack products by capillary gas chromatography", FVM 4:1995, AOAC International, Gaithersburg, Md.). The principle of this method involves extraction of the food product with chloroform-methanol solution, yielding a total lipid extract that contains the digestible fat and any non-digestible lipid. The lipid extract is hydrolyzed by sapon, yielding fatty acids from the digestible fat. The fatty acids are precipitated as calcium soaps and the isolated fatty acid soaps are converted back into fatty acids with hydrochloric acid and extracted into hexane. The isolated fatty acids are converted to methyl esters with boron trifluoride-methanol solution and quantified by capillary gas chromatography.

[0152] a.) The digestible fat and saturated fat content per a given mass of food is calculated as follows:

$$g \text{ digestible fat} = (\text{mass of food}) \times (\% \text{ digestible fat}/100)$$

[0153] $g \text{ digestible saturated fat} = (\text{mass of food}) \times (\% \text{ digestible saturated fat}/100)$

[0154] b.) Calories from digestible fat and saturated fat are calculated by multiplying by 9:

$$\text{Energy from fat (kcal)} = (g \text{ digestible fat}) \times 9 \text{ kcal/g}$$

[0155] $\text{Energy from saturated fat (kcal)} = (g \text{ digestible saturated fat}) \times 9 \text{ kcal/g}$

[0156] 4. Carbohydrate: The total carbohydrate content of a food product is calculated by difference as follows:

[0157] a.) $\% \text{ Carbohydrate} = 100 - (\% \text{ amino acid sources}) - (\% \text{ moisture}) - (\% \text{ total extractable lipid}) - (\% \text{ ash})$

[0158] b.) The carbohydrate content per a given mass of food is calculated as follows:

$$g \text{ carbohydrate} = (\text{mass of food}) \times (\% \text{ carbohydrate}/100)$$

[0159] c.) Calories from carbohydrate are calculated as follows:

$$\text{Energy from carbohydrate (kcal)} = (g \text{ carbohydrate}) \times \text{dietary fiber} \times 3.85 \text{ kcal/g}$$

[0160] 5. Moisture: The moisture content of a food is measured by the vacuum oven method known as AOAC Official Method 979.12, "Moisture (Loss on Drying) in Roasted Coffee" (30.1.20, Chp. 30, pg. 5).

[0161] 6. Ash: The ash content of a food is measured after ignition in a furnace at -550°C . This method is AOAC Official Method 923.03, "Ash in Flour" (32.1.05, Chp. 32, pg. 2).

[0162] 7. Dietary Fiber Combination of AOAC Method for Total Dietary Fiber With the Enzymatic-HPLC Determination of Indigestible Maltodextrin in Foods (Combined AOAC Prosky-HPLC method)

[0163] I. Principle:

[0164] This method to determine total dietary content in processed foods is a combination of the AOAC-Prosky method for total dietary fiber (AOAC 985.29) and a high performance liquid chromatography (HPLC) method for determining additional fiber from indigestible maltodextrin.

[0165] A sample is first analyzed for its total quantity of insoluble dietary fiber (IDF) and high molecular weight soluble dietary fiber (HMSPF) according to the AOAC method 985.29. A HPLC determination is conducted on the filtrate to obtain the quantity of low molecular weight soluble dietary fiber (LMSDF). The two values are combined to obtain the total dietary fiber value.

[0166] II. Scope:

[0167] The combined AOAC Prosky-HPLC method determines total dietary fiber value of processed foods containing low molecular weight soluble dietary fiber. This method defines dietary fiber (DF) as indigestible saccharides with a degree of polymerization of 3, and higher than 3, after enzymatic hydrolysis.

[0168] III. Additional Apparatus Beyond AOAC Method 985.29

[0169] A). Balance capable of weighing to 0.1 mg.

[0170] B). Rotary evaporator.

[0171] C). Glass or plastic columns to hold ion exchange resins (75 cm $\times$ 15 mm ID).

[0172] D). High-performance liquid chromatograph (HPLC) equipped with oven to maintain column temperature at 80°C and a 20 μL injection loop.

[0173] E). Guard column (or pre-column), TSK guard column FW_{XL} (size: 6.0 mm ID $\times$ 4 cm), TOSOH CORPORATION, distributed by TOSO-HAAS, Montgomeryville, Pa.

- [0174] F). HPLC column, TSK-GEL G2500PW_{XL} (size: 7.8 mm IDx90 cm), TOSOH CORPORATION, distributed by TOSHIOHAAS, Montgomeryville, Pa.
- [0175] G). Refractive Index (RI) detector maintained at 80° C.
- [0176] H). Integrator or computer for peak area measurement.
- [0177] I). Water aspirator or vacuum pump. Always use with a trap between vacuum source and sample.
- [0178] J). Round bottom flask, 1,000 mL (for volume reduction of initial filtrate volume).
- [0179] K). Round bottom flask, 250 mL (for volume reduction of ion-exchange column eluent).
- [0180] L). Filter for disposable syringe, 0.2 micron membrane, 13 mm.
- [0181] M). Filter for distilled-deionized (D D) water, 0.2 micron, 47 mm.
- [0182] N). Filter apparatus to hold 47 mm, 0.2 micron filter (to filter larger volumes of D-D water).
- [0183] O). Filter or vacuum flask, 500 mL, 1,000 mL.
- [0184] P). Glass rods with fire-polished ends, approximately 20 cm long.
- [0185] Q). Ten (10) mL plastic disposable syringes.
- [0186] R). Pasteur pipettes.
- [0187] S). Volumetric pipette, 10 mL.
- [0188] T). Volumetric flask, 1,000 mL, 250 mL, 50 mL and 10 mL.
- [0189] U). Graduated cylinders, 50 mL and 25 mL.
- [0190] V). Polyvinyl chloride (PVC) tubing, 2.79 mm I.D. (for ion-exchange columns).
- [0191] W). Funnel, general purpose.
- [0192] X). Teflon scraping rod. (can use in place of glass stirring rod to scrape precipitate in tall beaker).
- [0193] Y). Peristaltic pump.
- [0194] IV. Additional Reagents Beyond AOAC Method 985.29
- [0195] A). Distilled-Deionized (D-D) water.
- [0196] B). Mixed-bed ion exchange resin for each sample. Twenty (20) g of charged Amberlite IRA-67 (Sigma #A9960) and 20 g of charged Amberlite 200 (Sigma #200) are mixed and used per sample or per column. (Must be charged and adequately rinsed with D-D water.)
- [0197] It is advantageous to activate large amounts of both Amberlite IRA-67 and Amberlite 200 resins. Use large columns. The resins are mixed in a ratio of 1:1, 20 g each, for each column or sample just before use.
- [0198] 1). Amberlite IRA-67. Fill large column with resin and determine approximate resin volume based on column dimensions. Wash resin with two (2) volumes of D-D at the rate of 3 mL per min. Pass two (2) volumes of 3% sodium hydroxide (NaOH) through the resin at the rate of 3 mL per min. Remove NaOH with three (3) volumes of D-D water passed through the resin at the rate of 3 mL per min. The resin is further washed with D-D water at the rate of six (6) mL per min. Monitor pH of water eluent. The column is adequately washed of NaOH when a 7-8.8 pH value is obtained. (It takes approximately 6-8 hours to charge and rinse this resin.)
- [0199] 2). Amberlite 200. Fill large column with resin and determine approximate resin volume based on column dimensions. Wash resin with two (2) volumes of D-D at the rate of 3 mL per min. Pass two (2) volumes of 3% hydrochloric acid (HCl) through the resin at the rate of 3 mL per min. Remove HCl with three (3) volumes of D-D water passed through the resin at the rate of 3 mL per min. The resin is further washed with D-D water at the rate of six (6) mL per min. The column is adequately washed of HCl when a 4-7 pH value is obtained. (It takes 2-3 hrs to charge and rinse this resin.)
- [0200] C). Sodium hydroxide (0.275 N).
- [0201] D). Hydrochloric acid (0.325 N).
- [0202] E). Glycerol (≥99.5% purity). Glycerol stock solution: weigh 10 g glycerol into a small beaker. Quantitatively transfer to 1000 mL volumetric flask with repeated washes with D-D water. Make to volume with D-D water. It is important to measure or record the exact weight of the glycerol and again, taking care to weigh as close to 10 g as possible. Take purity and weight of glycerol into consideration when calculating final glycerol-standard concentration. (A glycerol standard solution having a concentration of 10 mg per mL is preferred.)
- [0203] F). Dextrose, HPLC grade, high purity >99.5%.
- [0204] V. Procedural Steps in Determining Total Dietary Fiber in Foods
- [0205] A. Sample enzymatic hydrolysis and filtration:
- [0206] Follow AOAC method 985.29.
- [0207] Each sample is prepared in duplicate. Two blank digestion determinations are also accomplished. These duplicate samples allow for corrections in subsequent residue weights for ash and protein.
- [0208] This residue weight, less protein, ash, and blank residue represents the weight of the dietary fiber by AOAC-Frsky method. The blank residue value used in the previous calculation must be corrected for its protein and ash content.
- [0209] B. Filtrate recovery and high performance liquid chromatograph analysis:

[0210] The filtrate from V(A) is quantitatively transferred to a 1,000 mL round bottom flask. The liquid contents of the round bottomed flask are evaporated with a rotary evaporator to obtain a near dryness residue. Redissolve the residue in the round bottomed flask with a minimum amount of distilled-deionized (D-D) water and transfer to a 50 mL volumetric flask. Add 10 mL of glycerol standard solution, 10 mg per mL, and make to volume with D-D water (see preparation of glycerol stock solution).

[0211] The contents of the 50 mL volumetric flask are quantitatively transferred to a column (75 cmx15 mm ID) containing 20 grams each, thoroughly mixed, of the charged ion-exchange resin, Amberlite IRA-67 (Sigma # A9960) and Amberlite 200 (Sigma #20072). The sample is washed through the column with 250 mL D-D water at the rate of 0.8 mL per min.

[0212] The 250 mL eluent collected from the ion-exchange column is quantitatively transferred into a 500 mL round bottom flask. The contents are evaporated to near dryness and quantitatively transferred to a 10 mL volumetric flask. Transfer the sample to a 10 mL disposable syringe and filter through a 0.2 micron filter.

[0213] Inject 20 μ L of the sample on the high performance liquid chromatograph. Perform the HPLC analysis on the filtrate using the following operating conditions.

[0214] Analytical Column: HPLC column, TSK-GEL G2500PWxL (size: 7.8 mm IDx30 cm),

[0215] TOSOH CORPORATION equipped with guard column (or pre-column),

[0216] TSK guard column PW_{XL} (size: 6.0 mm ID x 4 cm), TOSOH CORPORATION.

[0217] Column temperature: 80° C.

[0218] Mobile phase: Water (distilled-deionized and degassed)

[0219] Flow rate: 0.5 mL/min.

[0220] C. Determining the response factor for dextran; dextran is equivalent to soluble indigestible saccharides (i.e. Fiberol) in HPLC response.

[0221] 1). The objective of this portion of the experiment is to obtain the accurate measurement of soluble indigestible saccharides in the digestion filtrate by HPLC. Each chromatograph must be evaluated or standardized for the RI response of soluble indigestible saccharides. This is accomplished using dextran and glycerol.

[0222] 2). The peak area, representing concentration, obtained by HPLC analysis of equal amounts of soluble indigestible saccharides "i.e. Fiberol" and dextran are equivalent. Glycerol is used as the internal standard but its peak area compared to the peak area of an equal amount of dextran or Fiberol is not equivalent. A dextran-glycerol standard curve is prepared to obtain a "response

factor" to calculate the accurate amount of Fiberol or soluble indigestible saccharides in a chromatogram or sample.

[0223] 3). Three solutions (i.e., volumetric flasks) containing the same amount of glycerol and three levels of dextran are prepared. It is important to know and use the reported content (i.e., $\geq 99.5\%$ purity) of both glycerol and dextran standards. Ten (10) g high purity glycerol is accurately weighed into a small beaker. (We use molecular biology grade glycerol with $\geq 99.5\%$ purity.) The glycerol is quantitatively transferred to a 100 mL volumetric flask with D-D water and made to volume with D-D water. (Do not confuse this glycerol standard with that prepared and added to the sample before ion-exchange chromatography.) One-half (0.5), one (1) and (2) g of dextran is accurately weighed into three separate 100 mL volumetric flasks. To each flask is added 10 mL of the glycerol standard solution (100 mg per mL) previously prepared. Each flask is made to volume with D-D water. (These three flasks represent the standard solutions to calculate the "response factor" for dextran that is used to determine the amount of soluble indigestible saccharides found in the HPLC chromatogram.)

[0224] 4). Inject twenty (20) μ L of each standard glycerol-dextran solution. Obtain the values for the peak areas of dextran and glycerol from the same chromatograms. The reciprocal of the slope obtained comparing the ratio of peak area of dextran/peak area of glycerol (y-axis) to the ratio of the weight of dextran/weight of glycerol (x-axis) is the "response factor". Among laboratories, this "response factor" has been determined to be 0.83.

$$\text{Response factor} = \frac{1}{\frac{\text{PA-dex}}{\text{PA-gly}} \times \frac{\text{Wt-gly}}{\text{Wt-dex}}}$$

[0225] PA-dex=peak area dextran

[0226] PA-gly=peak area glycerol

[0227] Wt-dex=weight of dextran in standard

[0228] Wt-gly=weight of glycerol in standard

[0229] VI. Calculations

[0230] A). All values used in calculations are in mg, except for percent (%) values.

[0231] Each sample is assayed in duplicate resulting in two sample weights values, sample weight and sample weight' (prime) and two blanks, blank and blank' (prime).

[0232] B). Calculate Total Fiber from AOAC (TF-AOAC) as per AOAC method 985.29. This value is the average of the two determinations.

[0233] C). Calculate percent (%) LMSDF as follows:

[0234] Low molecular weight soluble dietary fiber (LMSDF) is soluble indigestible saccharides with a

degree of polymerization of ≥ 3 , after enzymatic hydrolysis.

Low molecular weight soluble dietary fiber =

$$\frac{\text{Peak area of LMSDF}}{\text{Peak area of glyceral}} \times \text{mg glyceral standard} \times \text{response factor} =$$

$$\text{mg low molecular weight soluble dietary fiber (LMSDF)}$$

[0235] mg low molecular weight soluble dietary fiber (LMSDF)

$$\text{Percent (\% LMSDF)} = \frac{\text{LMSDF}}{\text{Sample Weight}} \times 100$$

[0236] Repeat calculations for the duplicate samples' (prime), % LMSDF' using LMSDF' and Sample Weight'

[0237] D). % Average Low Molecular Weight Soluble Dietary Fiber

$$\% \text{ALMSDF} = \frac{\% \text{LMSDF} + \% \text{LMSDF}'}{2}$$

[0238] E). Percent (%) total dietary fiber

$$\% \text{TDF} = \% \text{IF-ACAC} + \% \text{ALMSDF}$$

[0239] 8. Soluble Dietary Fiber: The content of soluble dietary fiber in a food is calculated as follows:

$$\frac{(\% \text{soluble dietary fiber}) - (\% \text{dietary fiber}) - (\% \text{insoluble dietary fiber})}{100}$$

[0240] Percent Dietary Fiber is measured as described in method #7 above. The % insoluble dietary fiber content of a food is measured by the enzymatic-gravimetric method known as AOAC Official Method 991.42, "Insoluble Dietary Fiber in Food and Food Products" (32.1.16, Chp. 32, pg. 5-6).

[0241] The soluble dietary fiber content per a given mass of food is calculated as follows:

$$\frac{(\% \text{soluble dietary fiber}) - (\text{mass of food}) \times (\% \text{soluble dietary fiber}/100)}{100}$$

[0242] 9. Beta-Glucan Soluble Fiber: The content of beta-glucan soluble fiber in a food is measured by an enzymatic-spectrophotometric method according to AOAC Official Method 992.28, "(1 $\rightarrow$ 3) (1 $\rightarrow$ 4)-Beta-D-Glucans in Oat and Barley Fractions and Ready-to-Eat Cereals" (32.2.06, Chp. 32, pg. 28-29C).

[0243] The beta-glucan soluble fiber content per a given mass of food is calculated as follows:

$$\frac{(\% \text{beta-glucan soluble fiber}) - (\text{mass of food}) \times (\% \text{beta-glucan soluble fiber}/100)}{100}$$

[0244] 10. Extractable Lipid and Calculation of Non-Digestible Lipid: The total extractable lipid content of a food is measured by an extraction method known as AOAC Official Method 983.23, "Fat in Foods; Chloro-

reform-Methanol Extraction Method" (45.4.02, Chp. 45, pg. 64-65). Percent total non-digestible lipid is calculated as follows:

$$\frac{(\% \text{non-digestible lipid}) - (\% \text{extractable lipid}) - (\% \text{digestible fat})}{100}$$

[0245] The percent digestible fat value in the above equation is derived from method #3 of Applicants' Analytical Protocols.

[0246] The non-digestible lipid content per a given mass of food is calculated as follows:

$$\frac{(\% \text{non-digestible lipid}) - (\text{mass of food}) \times (\% \text{non-digestible lipid}/100)}{100}$$

[0247] 11. Water Activity: The water activity (A_w) of a food is measured using the following protocol and instruments:

[0248] Principle: The Rotronic Hygroskop relative humidity meter uses probes, each containing a humidity sensor and a temperature sensor, to measure the equilibrium relative humidity above a sample. A sample is introduced to the probe in an air tight chamber. After equilibrium has been reached, the relative humidity reading obtained from the instrument can be used to determine water activity (A_w).

[0249] Apparatus

[0250] a.) Rotronic Hygroskop model DT Relative Humidity Meter

[0251] b.) Model DMS100H Humidity Cells

[0252] c.) Rotronic Sample Dishes Part # PS-14

[0253] Reagents and Solutions

[0254] a.) 35% RH standard solution (EA-35) supplied by Rotronic Instrument Corp.

[0255] b.) 50% RH standard solution (EA-50) supplied by Rotronic Instrument Corp.

[0256] c.) 65% RH standard solution (EA-65) supplied by Rotronic Instrument Corp.

[0257] d.) 80% RH standard solution (EA-80) supplied by Rotronic Instrument Corp.

[0258] Procedure

[0259] a.) Instrument Operation and Calibration

[0260] (i) Prepare a standard curve of meter reading vs. %relative humidity (%RH) at 25° C. using the four RH standards listed in this method. The accuracy of the calibration curves should be checked periodically using the relative humidity standard solutions.

[0261] (ii) Carefully open a vial of RH standard solution and pour the contents into a plastic sample dish. Place the sample dish containing the standard solution into cell #1 of the instrument and seal tightly. Allow at least one hour for the meter reading to stabilize. Record the meter and temperature readings.

[0262] (iii) Repeat step 2 for the other humidity standards.

[0263] (iv) Prepare a standard curve by plotting the meter readings against the known RH of the standards.

[0264] (v) Prepare a standard curve for cell #2 in the same fashion.

[0265] b.) Sample Analysis

[0266] (i) Select a humidity cell to use for the analysis. Wipe clean the inner surfaces of the cell with a paper towel. This will remove anything left over from a previous sample.

[0267] (ii) Obtain a sample of food product. Samples must be at room temperature before the analysis can be run.

[0268] (iii) Place the sample into a plastic sample dish. The sample may need to be crushed or ground (eg. crackers) to fit into the dish. The dish should be filled as much as possible with the sample.

[0269] (iv) Place the sample dish into a cell and place the cell into the instrument. Keeping the cell level, seal the cell tightly to the instrument.

[0270] (v) Allow at least 1/4 hour for meter reading to stabilize. Turn lights on both the RH meter and temperature meter should not be lit when recording a reading. If either is lit at the end of 1/4 hour, wait until they go out before recording the meter readings.

[0271] (vi) Record the RH and temperature meter readings.

[0272] (iv) Convert the RH meter reading to the equilibrium %RH using the previously prepared standard curve for the cell used. Convert the equilibrium relative humidity to Aw.

[0273] c.) Water activity (Aw) Calculations:
 $Aw = \%RH/100$

[0274] All AOAC (Association of Official Analytical Chemists) published methods can be found in the following reference which is incorporated by reference in its entirety:

[0275] AOAC International, *Official Methods of Analysis*, P. Cunniff (ed.), 16th edition, 5th Revision, 1999, Gaithersburg, Md.

Process of Making Nutritious Compositions

[0276] Cracker Making

[0277] The following unit operations are unique to the production of crackers of this invention.

[0278] 1) Docking—holes are traditionally made in a cracker dough form before baking. While not to be bound by theory, it is believed docking bonds the dough layers together at discreet points to prevent excessive inflation (pillowing) of the cracker. Another function of docking is believed to be venting to allow the steam and gases generated during baking to escape the structure which aids in lowering the post-baked moisture, and reduces excessive inflation. The appearance of these docking holes has been found to detract from the beautiful image of the product. This may be because

consumers identify the product with traditional crackers, which are not seen as healthy foods. It has been learned that pressing bits, such as nut pieces (8-12 mesh) into the dough form prior to baking accomplishes the same effect on the structure as docking holes. The appearance of the final product is much more healthful to the consumer, possibly because of the nuts on the surface, and possibly because the product no longer looks like a traditional cracker.

[0279] 2) Water spray—is used on the dough forms immediately before they enter the oven to control color. It has been found that surface water spray of 0.02-0.22 g/sq.in. (0.003-0.034 g/sq. cm) immediately prior to baking (oven entry) can result in a very noticeable lightening of the baked cracker color. This is important because the lighter cracker color is consistent with the consumer's view of more healthy products. Surprisingly, this extra water spray was found to have very little impact on the final baked moisture of the cracker. This is important because low moisture (>about 5-6%) are necessary to achieve the desired crispness in eating quality.

[0280] 3) Water spray—when oven and oven band temperatures cannot be adjusted, water spray is used on the oven band immediately before the dough forms are transferred onto it from the feeder conveyor belt. This creates a damp band surface which facilitates the adherence of the dough form to the oven band. Without this help, rectangular dough forms are susceptible to shape deformation in the form of arching. This arching occurs such that the center of the shape is lifted off of the oven band surface. This deformation from a straight line from end to end can be as much or more than 1/4" (0.32 cm), which makes sandwiching two crackers very difficult.

[0281] 4) Oil spray—upon exit from the oven is normally done in a traditional cracker making operation in order to reduce the dryness impression during eating. The crackers of this invention are sprayed with Oleo. A forced air spray nozzle, made by Spraying Systems Co. of Palatine, Ill. is found to be useful in ensuring that uniformly controlled quantities of Oleo are sprayed onto the cracker surface.

[0282] Filling Making

[0283] Applicants' filling making processes include hot and cold processes. There are three major differences in Applicants' hot and cold processes:

[0284] 1.) In the cold process any vitamins are crystallized in about a 1:1 weight ratio with shortening before being added to any other filling ingredients, and said other filling ingredients should be below the crystallization temperature of said vitamin/shortening mix before being combined with said vitamin/shortening mix.

[0285] 2.) Also, in the cold process, any additional shortening is crystallized before being added to any other filling ingredients, and said other filling ingredients should be below the crystallization temperature of said additional shortening before being combined with said additional shortening.

[0286] 3.) All mixing is done at the lower of the shortening's crystallization temperature or 90° F. (32.2° C.). In addition to the processing differences list above, when Applicants' cold filling making process is used to make a filling, stabilizers may not be required and it may be possible to use lower levels of flavorings. In addition to the teachings listed above, Applicants' have provided numerous detailed examples teaching methods of making fillings.

Method of Use

[0287] Embodiments of Applicants' invention may be used as weight control products, as they are nutritionally balanced and low in fat. In addition, embodiments of Applicants' invention may be consumed as a protein or fiber supplement. Also, since embodiments of Applicants' invention contain heart healthy components that, in addition to other benefits, can impart a hypocholesterolemic capability to foods, said embodiments may be consumed by a subject to lower the subject's serum total and LDL-cholesterol. The following are specific examples of methods of using said embodiments to lower a subject's serum total and LDL-cholesterol. These examples are illustrative of the invention and are not to be construed to limit the invention in any way.

METHOD OF USE EXAMPLE A

[0288] The filled cracker of Example 7 is used as a fractional food composition to lower serum total and LDL-cholesterol. This product contains about 10 g of olestra (Olean brand), about 1.4 g of soy protein, and about 0.75 g of oat B-glucan soluble fiber per 40 g serving size. A group of at least 25 hypercholesterolemic subjects consume 3 servings/day of the filled crackers. The servings are spaced throughout the day, e.g., consumed with the breakfast, lunch, and dinner meals. Consumption continues for a period of 28 consecutive days. On day 1, a fasting blood sample is collected from each subject for measurement of the baseline blood lipid profile (total, LDL-, and HDL-cholesterol, and total lipids). On day 28, a second fasting blood sample is drawn from each subject and the blood lipid profile measured. For each subject, the blood lipid profile on day 28 is compared to the baseline profile measured on day 1. Following treatment, the total and/or LDL-cholesterol is reduced from the baseline level by an average of at least 10%.

METHOD OF USE EXAMPLE B

[0289] The filled cracker of Example 10 is used as a fractional food composition to lower serum total and LDL-cholesterol. This product contains about 9.6 g of olestra (Olean brand) and about 6.25 g of soy protein per 40 g serving size. A group of at least 25 hypercholesterolemic subjects consume 3 servings/day of the filled crackers. The servings are spaced throughout the day, e.g., consumed with the breakfast, lunch, and dinner meals. Consumption continues for a period of 28 consecutive days. On day 1, a fasting blood sample is collected from each subject for measurement of the baseline blood lipid profile (total, LDL-, and HDL-cholesterol, and total lipids). On day 28, a second fasting blood sample is drawn from each subject and the blood lipid profile measured. For each subject, the blood lipid profile on day 28 is compared to the baseline profile measured on day 1. Following treatment, the total and/or LDL-cholesterol is reduced from the baseline level by an average of at least 10%.

Product and Process Examples

[0290] The following processing teachings apply to the specific embodiments of Applicants' invention that are described later in this application. These processing teachings and examples are illustrative of the invention and are not to be construed to limit the invention in any way.

Making Procedures

[0291] Peanut Butter Filling Making Procedure PNB#1 (For Examples 1, 13 & 3)

[0292] Step #1—Preparation of De-fatted Peanut Flour

[0293] Peanuts are roasted to a 36-37 L' roast color and then ground in a Buser conventional grinder to produce a nut paste of pumpable consistency. The method for determining L' roast color values is disclosed in U.S. patent application Ser. No. 09/511,058 and in WO051449A1 both of which are incorporated by reference. The nut paste is defatted by using a mechanical press. The fat content of the defatted solids is 20%. The nut solids are then milled to a mono modal particle size distribution using a Lehmann mill (Model 4039).

[0294] Step #2—Pre-blending Ingredients

[0295] 1. The roll mill solids, peanut oil and 8.2% of the total Olean® are weighed together. Then the vitamins are added.

[0296] 2. Next, the ingredients from 1 above are blended, using a Hobart mixer (Model C-100) at speed setting #1 for 5 minutes, until all the ingredients are well blended.

[0297] Step #3—Heating and Finishing

[0298] 1. A jacketed Hobart (Model C-100-T) is pre-heated, 1 hour prior to using, to a temperature of about 150° F. (65.6° C.).

[0299] 2. The sucrose, malt, fiber, remaining Olean®, and vitamins are blended for 40 minutes in the heated Hobart at speed setting # 1.

[0300] 3. Then the rolled mill solids/peanut oil/Olean® mixture is added and blended in Hobart for 40 minutes.

[0301] 4. Next, the mixture is cooled through the temperature range of 130° F.-140° F. (54.4° C.-60.0° C.) in about 10 minutes to ensure the proper crystallizing structure. This can usually be accomplished by ambient cooling for lab batch sizes.

[0302] 5. The resulting filling is stored at room temperature until used.

[0303] Peanut Butter Filling Making Procedure PNB#2 (For Examples 3 & 16)

[0304] Step #1—Preparation of De-fatted Peanut Flour

[0305] Peanuts are roasted to a 36-37 L' roast color and then ground in a Buser conventional grinder to produce a nut paste of pumpable consistency. The method for determining L' roast color values is disclosed in U.S. patent application Ser. No. 09/511,058 and in WO051449A1 both of which are incorporated by reference. The nut paste is defatted by using a mechanical press. The fat content of the defatted solids is 20%. The nut solids are then milled to a mono modal particle size distribution using a Lehmann mill (Model 4039).

[0306] Step #2—Heating and Finishing

[0307] 1. A jacketed Hobart (Model C-100-T) is pre-heated, 1 hour prior to using, to a temperature of about 150° F. (65.6° C.).

[0308] 2. All the ingredients, wet and dry, including the vitamins are weighed, combined and then mixed in the heated Hobart at speed setting #1 for 1 hour.

[0309] 3. Next, the mixture is cooled through the temperature range of 130° F.-140° F. (54.4° C.-60.0° C.) in about 10 minutes to ensure the proper crystallizing structure. This can usually be accomplished by ambient cooling for lab batch sizes. 4. The remaining filling is stored at room temperature until used.

[0310] Peanut Butter Filling Making Procedure PNB#3 (For Example 12)**[0311] Step #1—Preparation of De-fatted Peanut Flour**

[0312] Peanuts are roasted to a 36-37 L' roast color and then ground in a Buser conventional grinder to produce a nut paste of pumpable consistency. The method for determining L' roast color values is disclosed in U.S. patent application Ser. No. 09/511,058 and in WO051449A1 both of which are incorporated by reference. The nut paste is defatted by using a mechanical press. The fat content of the defatted solids is 20%. The nut solids are then milled to a mono modal particle size distribution using a Lehmann mill (Model 4039).

[0313] Step #2—Pre-blending Ingredients

[0314] 1. The roll mill solids, peanut oil and 11.5% of the total Olean® are weighed together. Then the vitamins are added.

[0315] 2. Next, the ingredients from 1 above are blended, using a Hobart mixer (Model C-100) at speed setting #1 for 5 minutes, until all the ingredients are well blended.

[0316] Step #3—Heating and Finishing

[0317] 1. A jacketed Hobart (Model C-100-T) is pre-heated, 1 hour prior to using, to a temperature of about 150° F. (65.6° C.).

[0318] 2. The sucrose, salt, fiber, remaining Olean®, and vitamins are blended for 40 minutes in the heated Hobart at speed setting #1.

[0319] 3. Next, the constant behenic stabilizer (cbc) is placed in a separate container and then heated via a microwave to a temperature of 150° F. (65.6° C.) at which point cbc is a clear liquid.

[0320] 4. Then the rolled mill solids/peanut oil/Olean® mixture from Step #2 is added to the mixture from Step #3(2) above and then the melted cbc is added. The resulting mixture is blended in the heated Hobart for 1 hour at speed setting #1.

[0321] 5. Next, the mixture is cooled through the temperature range of 130° F.-140° F. (54.4° C.-60.0° C.) in about 10 minutes to ensure the proper crystallizing structure. This can usually be accomplished by ambient cooling for lab batch sizes.

[0322] 6. The resulting filling is stored at room temperature until used.

[0323] Peanut Butter Filling Making Procedure PNB #4 (For Example 19)**[0324] Step #1 Preparation of De-fatted Peanut Flour**

[0325] Peanuts are roasted to a 36-37 L' roast color and then ground in a Buser conventional grinder to produce a nut paste of pumpable consistency. The method for determining L' roast color values is disclosed in U.S. patent application Ser. No. 09/511,058 and in WO051449A1 both of which are incorporated by reference. The nut paste is defatted by using a mechanical press. The fat content of the defatted solids is 16.5%.

[0326] Step #2 Roll Milling of Peanut Solids

[0327] The nut solids are then combined with the fiber, soy protein isolate and 7.89% Olean®. The total oil content of the mix is 20%. The mix is passed through a 4 roll refining mill to reduce the particle size and to coat the solids with a film of oil and Olean®. The particle size of the mix has a D₅₀ and a D₉₀ of 7.6 and 22 microns, respectively.

[0328] Step #3 Refining of Peanut Mix Composition

[0329] The vitamin mix is combined with 14.4% of the Olean® and mixed for 3 minutes. The roll mix is then added. The mixing is done in a jacketed double arm mixer manufactured by Werner Lebara. The mixer is preheated to 200° F. (93.3° C.) prior to mixing. The mixing speed is set to medium and the mix temperature is about 150° F. (65.6° C.). The mixture is mixed for 10 minutes to convert the mix to a fluid paste.

[0330] Step #4 Sugar Slurry Mix

[0331] A sugar containing oil/Olean® suspension is prepared by mixing 12x sugar, salt, lecithin, and 26.73% Olean® in a jacketed double arm mixer manufactured by Werner Lebara. The mixer is preheated to 200° F. (93.3° C.) prior to mixing. The mixing speed is set to medium and the mix temperature is about 150° F. (65.6° C.). To achieve the desired viscosity, the materials are mixed for about 10 minutes.

[0332] Step #5 Blend Composition

[0333] Constant behenic stabilizer (cbc) is melted in a microwave able resistant container until its temperature reaches 150° F. (65.6° C.) and it becomes liquid. The peanut and sugar containing oil suspensions are then combined and mixed with the melted cbc in a jacketed double arm mixer manufactured by Werner Lebara. The mixer is preheated to 200° F. (93.3° C.) prior to mixing. The mixing speed is set to medium and the mix temperature is about 150° F. (65.6° C.). To achieve the desired viscosity, the materials are mixed for about 5 minutes.

[0334] Cold Peanut Butter Filling Making Procedure for PNB #4 (For Example 19) that does not Require Constant Behenic Stabilizer (cbc)**[0335] Step #1 Preparation of De-fatted Peanut Flour**

[0336] Peanuts are roasted to a 36-37 L' roast color and then ground in a Buser conventional grinder to produce a nut paste of pumpable consistency. The method for determining L' roast color values is disclosed in U.S. patent application Ser. No. 09/511,058 and in WO051449A1 both of which are

incorporated by reference. The nut paste is defatted by using a mechanical press. The fat content of the defatted solids is 16.5%.

[0337] Step #2 Roll Milling of Peanut Solids

[0338] The nut solids are then combined with the fiber, soy protein isolate and 7.89% Olean®. The total oil content of the mix is 20%. The mix is passed through a 4 roll refining mill to reduce the particle size and to coat the solids with a film of oil and Olean®. The particle size of the mix has a D₅₀ and a D90 of 7.6 and 22 microns, respectively.

[0339] Step #3 Vitamin Slurry

[0340] A vitamin containing oil/Olean® suspension is prepared by mixing the vitamin mix and Olean in a 1:1 ratio in a jacketed Hobart (Model C-100-T). The mixer is pre-heated to about 150° F. (65.6° C.) and a speed setting 2. To achieve good dispersion of the vitamins, the material are mixed for about 10 minutes. The mix is transferred to a second jacketed Hobart (Model C-100-T). The mixer is set to about 60° F. (15.5° C.) and a speed setting 2. The materials are mixed until the material temperature is below 80° F. (26.6° C.).

[0341] Step #4 Refining of Peanut Mix Composition

[0342] The roll mill mix is combined with the vitamin slurry and 14.4% Olean®. The mixing is done in a jacketed double arm mixer manufactured by Werner Lebara. The mixer is controlled at 70° F. (21.1° C.) prior to mixing. The mixing speed is set to medium and the mix temperature is about 70° F. (21.1° C.). The roll mill mix is slowly added to the Olean (5 minutes). The roll mill/Olean mixture is further mixed for 10 minutes to convert the mix to a fluid paste.

[0343] Step #5 Sugar Slurry Mix

[0344] A sugar containing oil/Olean® suspension is prepared by mixing 12x sugar, salt, lecithin, and 26.73% Olean® in a jacketed double arm mixer manufactured by Werner Lebara. The mixer is controlled at 70° F. (21.1° C.) prior to mixing. The mixing speed is set to medium and the mix temperature is about 70° F. (21.1° C.). To achieve the desired viscosity, the materials are mixed for about 10 minutes.

[0345] Step #6 Blend Composition

[0346] The peanut and sugar containing oil suspensions are combined and mixed in a jacketed double arm mixer manufactured by Werner Lebara. The mixer is controlled at 70° F. (21.1° C.) prior to mixing. The mixing speed is set to medium and the mix temperature is about 70° F. (21.1° C.). To achieve the desired viscosity, the materials are mixed for about 5 minutes.

[0347] Cheese Filling Making Procedure For Examples 2, 3, 6, 7, 8, 9, 10, 11 & 20

[0348] 1. The fiber is weighed in a separate bowl.

[0349] 2. Any cheese powder, soy protein, whey protein, corn syrup solids, sucrose, and cheese flavor are weighed together.

[0350] 3. Next, the Olean® and Karmel Flakes are weighed and then mixed together in a container.

[0351] 4. The Olean® and Karmel Flake mixture is melted by heating until the temperature reaches 150° F.

-160° F. (65.6° C.-71.1° C.). For lab scale, this is best accomplished by heating in a microwave oven at one-minute intervals, with stirring in between intervals, with power setting on high. After the desired temperature is reached, the vitamins are added.

[0352] 5. The melted fat blend is mixed with the fiber using a Kitchen Aid (Model KSM90 Ultra Power) mixer for 1 minute at speed setting #2. The rest of the dry ingredients are added and blended for 5 minutes at speed setting #5.

[0353] 6. Then the mixture is cooled through the temperature range of 130° F.-140° F. (54.4° C.-60.0° C.) in about 10 minutes to ensure the proper crystallizing structure. This can usually be accomplished by ambient cooling for lab batch sizes.

[0354] 7. The resulting filling is stored until used.

[0355] Bar Making Procedure (Examples 16, 17 & 18) Dough Making and Sheetting

[0356] 1. The shortening, salt, sugar, powdered milk, and powdered egg yolks are creamed together in a Hobart mixer for 2 minutes on speed #2 (medium).

[0357] 2. Next, the ammonium bicarbonate in cool water, corn syrup, and invert syrup are added and the resulting mixture is creamed for an additional 3 minutes at speed #2 (medium).

[0358] 3. Then, the remaining water followed by flour, sodium bicarbonate, and leavening salt(s) are added. The resulting mixture is mixed for 5 minutes in the Hobart mixer on speed #1 (low) to produce a dough.

[0359] 4. The dough from #3 above is rolled out with a hand rolling pin to approximately a 0.2-inch (0.5 cm) thickness.

[0360] 5. Next, the dough is run through a two-roll mill that is hand operated and which has 3-inch (7.6 cm) diameter rolls, to attain a final sheet thickness of 0.1 inches (0.25 centimeter).

[0361] Bar Filling Procedure

[0362] 1. A pizza cutter is used to cut out two 3.0x4.5 inch (7.6x11.4 cm) bar impressions from the dough sheet of Step #5 of the above Dough Making and Sheetting Procedure.

[0363] 2. Next, filling is placed on one side (one-half length wise) of the bar dough prepared in Step #1 above. The filling is spread uniformly with a spatula or syringe, while avoiding the outer edges by ¼ to ¼ of an inch (0.3 to 0.6 cm). In the case of dual fillings, the desired amount of each filling is placed side by side.

[0364] 3. Then, the side of the bar that is not covered with filling is folded over the side having the filling, to form an unfinished bar.

[0365] 4. The edges of the unfinished bar are then sealed, using a 1.5x4.5 inch (3.8x11.4 cm) bar-former die cutter.

[0366] 5. Next, several docking vents are cut on top of the bar using a small spatula having an approximately ¼ inch (0.64 cm) wide blade.

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[0367] 6. The bar is then transferred to an oven band or baking sheet and baked at 425° F. (218.3° C.) for 6½ minutes.

[0368] 7. After the baked bars are removed from the oven they are cooled ambiently to room temperature.

[0369] Cracker Making Procedure For Example 19

[0370] Dough Making

[0371] 1. Corn syrup, malt syrup, shortening, hot water at 160° F. (71.1° C.), and enzyme tablets dissolved in water are weighed into an APV 100# single blade horizontal mixer and then mixed for 30 seconds at 38 rpm.

[0372] 2. Next, sugar, salt, vitamin blend, and L-cysteine are weighed into the mixer and then mixed for 2 minutes at 38 rpm.

[0373] 3. Then, the remaining dry ingredients (flour, fibers, proteins, sodium bicarbonate, and non-ammonia leavening salts) are weighed into mixer and mixed for 3 minutes at 45 rpm.

[0374] 4. Then, ammonium bicarbonate, dissolved in cool water, is added and mixed for one minute at 60 rpm.

[0375] 5. The resulting dough is emptied into a stainless steel drum, covered with plastic sheet, and allowed to "rest" at room temperature for 30 minutes.

[0376] Dough Forming

[0377] 1. Dough is fed through a three-roll mill having two initial 16.5 inch (41.9 cm) corrugated rolls and one smooth 11.8-inch (30.0 cm) diameter roll and sheeted to 0.25 inches (0.64 cm). The take-off belt speed exiting the three-roll mill is 2.0 fpm (0.6 mpm), and is matched to the speed of the dough sheet as it exits the three-roll mill.

[0378] 2. The sheet is sent through a calendar roll #1 (an 11.8 inch or 30.0 cm diameter two-roll mill), and sheeted to approximately 0.10 inches (0.25 centimeters) in thickness. The take-off belt speed exiting the calendar roll #1 is 4.4 fpm (1.34 mpm), and is matched to the speed of the dough sheet as it exits the calendar roll #1.

[0379] 3. As the sheet comes through calendar roll #1, it is folded over eight times to a width of approximately 10 inches (25.4 cm) to form a bundle of laminated dough. The bundle is covered with plastic film to prevent dehydration and briefly set aside while additional bundles are collected.

[0380] 4. The laminated sheet of Step 3 above is sent through the two-roll mill #1 again to form a 0.10-inch (0.25 cm) thick sheet.

[0381] 5. Before the dough sheet reaches calendar roll #2 (an 11.8 inch or 30.0 cm diameter two-roll mill), a 90/10 mixture of almond pieces (Paramount Farms, Lost Hills, Calif.) about 8 to 12 mesh in size, and bran (Red Wheat Bran, Canadian Harvest, St. Thomas, Ontario Canada), are added at a level of about 1.0-1.5% of the total filled cracker weight by uniformly sprin-

kling the pieces across the dough sheet immediately before calendaring roll #2 such that they are pressed into the dough sheet.

[0382] 6. The sheet continues on calendar roll #2 to form a finished dough sheet approximately 0.08 inches (0.20 cm) thick. The take-off belt speed exiting the calendar roll #2 is 7.9 fpm (2.41 mpm), and is matched to the speed of the dough sheet as it exits the calendar roll #2.

[0383] 7. The dough sheet is then passed under a cutter die roll to form crackers of desired size/shape. The belt speed is 7.7 fpm (2.35 mpm). The 3.875-inch (9.842 cm) diameter cutter roll (obtained from Weidemiller Co. Itasca, Ill.) is designed to cut about a 1.1x3.4 inch (2.8x8.6 cm) rectangular bar shape. The cutter roll does not have docking pins inside the shape to be cut. The addition of the bits is thought to serve the function of the docking pins, as the dough layers are joined together and venting is created during baking.

[0384] 8. After separating the web (the portion of the sheet left over after the shapes are cut out), the crackers are salted using a roller-salter or equivalent. The web may be recycled back to the dough waiting to be introduced into the three-roll mill.

[0385] 9. The cracker dough items are then sprayed with a water mist (flow rate-65-212 g/min.) before baking. This helps attain a lighter color after baking.

[0386] Cracker Making Procedure For Examples 1-15

[0387] Dough Making

[0388] 1. Corn syrup, malt syrup, shortening, hot water at 160° F. (71.1° C.), and enzyme tablets dissolved in water are weighed into an APV 100# single blade horizontal mixer and then mixed for 30 seconds at 38 rpm.

[0389] 2. Next, sugar, salt, vitamin blend, and L-cysteine are weighed into the mixer and then mixed for 2 minutes at 38 rpm.

[0390] 3. Then the remaining dry ingredients (flour, fibers, proteins, sodium bicarbonate, and non-ammonia leavening salts) are weighed into mixer and mixed for 3 minutes at 45 rpm.

[0391] 4. Then ammonium bicarbonate, dissolved in cool water, is added and mixed for one minute at 60 rpm.

[0392] 5. The resulting dough is emptied into a stainless steel drum, covered with plastic sheet, and allowed to "rest" at room temperature for 30 minutes.

[0393] Dough Forming

[0394] 1. Dough is fed through a three-roll mill having two initial 16.5 inch (41.9 cm) corrugated rolls and one smooth 11.8-inch (30.0 cm) diameter roll and sheeted to 0.25 inches (0.64 cm). The take-off belt speed exiting the three-roll mill is 2.0 fpm (0.6 mpm), and is matched to the speed of the dough sheet as it exits the three-roll mill.

[0395] 2. The sheet is sent through a calendar roll #1 (an 11.8 inch or 30.0 cm diameter two-roll mill), and

sheeted to approximately 0.10 inches (0.25 centimeters) in thickness. The take-off belt speed exiting the calendar roll #1 is 4.4 fpm (1.34 mpm), and is matched to the speed of the dough sheet as it exits the calendar roll # 1.

[0396] 3. As the sheet comes through calendar roll # 1, it is folded over eight times to a width of approximately 10 inches (25.4 cm) to form a bundle of laminated dough. The bundle is covered with plastic film to prevent dehydration and briefly set aside while additional bundles are collected.

[0397] 4. The laminated sheet of Step 3 above is sent through the two-roll mill #1 again to form a 0.10-inch (0.25 cm) thick sheet.

[0398] 5. Before the dough sheet reaches calendar roll #2 (an 11.8 inch or 30.0 cm diameter two-roll mill), bits, such as, but not limited to, pieces of nuts, vegetables, grains, meats and candies, may optionally be added. These bits are uniformly sprinkled on the dough sheet immediately before calendar roll #2 such that they are pressed into the dough sheet. For example, in Examples 4, 6, 9 and 12 almond pieces (Paramount Farms, Lost Hills, Calif.), about 8 to 12 mesh in size, are added at a level of about 1.0-1.5% the total filled cracker weight by uniformly sprinkling the bits across the dough sheet immediately before calendaring roll #2 such that they are pressed into the dough sheet.

[0399] 6. The sheet continues on calendar roll #2 to form a finished dough sheet approximately 0.08 inches (0.20 cm) thick. The take-off belt speed exiting the calendar roll #2 is 7.9 fpm (2.41 mpm), and is matched to the speed of the dough sheet as it exits the calendar roll #2.

[0400] 7. The dough sheet is then passed under an embossing roller and under a cutter die roll to form crackers of desired size/shape. The belt speed is 7.7 fpm (2.35 mpm). The embossing roller is a 3.75-inch (9.52 cm) diameter roll with a uniform pattern of 0.061-inch (0.153 cm) diameter pins spaced 1/16 inches (0.794 centimeters) apart in both the axial and radial directions. The 3.875-inch (9.842 cm) diameter cutter roll (obtained from Weldonmiller Co. of Kansas, Ill.) can be designed to cut a variety of shapes. The shape used in these examples is a 1.4 inch (3.6) diameter round shape with docking holes. These docking pins serve the purpose of preventing the dough from inflating during baking. The function of the docking pins is thought to join the dough layers together and create venting during baking.

[0401] 8. After separating the web (the portion of the sheet left over after the shapes are cut out), the crackers are salted using a roller-salter or equivalent. The web may be recycled back to the dough waiting to be introduced into the three-roll mill.

[0402] 9. The cracker dough forms are then sprayed with a water mist (flow rate=65-212 g/min.) before baking. This helps attain a lighter color after baking.

[0403] Cracker Baking

[0404] 1. The cracker dough forms are transferred as a continuous feed from the dough-forming belt onto the

oven band such that their relative spacing is undisturbed (a slight speed differential is permissible if it is desired to place the cracker dough forms closer, or further apart on the oven band prior to baking). The oven band is made of metal of the open weave versus solid surface type. Solid surface metal oven bands may also be used for certain applications.

[0405] 2. The cracker dough forms are baked in an APV 45 foot long three-zone indirect-fired oven. Each zone has independent top and bottom heat applied. Dampers and temperatures in each zone are set at the following conditions:

1 st zone top:	465° F (240.6° C).	bottom:	500° F (260.0° C).	damper closed
2 nd zone top:	480° F (248.9° C).	bottom:	520° F (271.1° C).	damper 1/2
3 rd zone top:	355° F (179.4° C).	bottom:	425° F (218.3° C).	damper open
Oven band speed (fpm):				
Example				
	1, 2, 13 & 19	3, 5, 7, 10, 14 & 15	4, 6, 9 & 12	8 & 11
Oven Band	11.0 (3.0)	11.0 (3.0)	10.0 (3.0)	11.5 (3.5)
Speed:	fpm (mpm)			

[0406] Final moisture contents are about 0-4%.

[0407] Post Baking

[0408] 1. As the hot baked crackers exit the oven, they are sprayed with hot oil or Oleum® at approximately 160° F. (71.1° C.) to a level of about 10% their post baked weight. The crackers are passed under heat lamps for approximately 15 seconds to aid in absorption of oil.

[0409] 2. The crackers are then passed through a cooling tunnel at room temperature. Oleum® containing products must cool through the temperature range of 130° F.-140° F. (54.4° C.-60.0° C.) in about 10 minutes to ensure the proper crystalline structure.

[0410] Sandwiching Procedure for Crackers (Examples 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12 & 13)

[0411] 1. The filling is spread on a cracker.

[0412] 2. A second cracker is placed on top of the filling that is spread on the first cracker thereby forming a finished sandwich cracker.

[0413] Sandwiching Procedure For Cracker (Example 19)

[0414] The cracker is in the shape of an approximately 1.2x3.4 inch (3.0x8.6 cm) bar, and weighs about 4.5 g. The filling (about 6.0 g) is placed between two crackers to form a cracker bar. The filling and sandwiching method is as follows:

[0415] Filling Spreading Process

[0416] 1. Apply approximately 300 grams of filling at ambient temperature to an approximately 15x40-inch (38x102 cm) sheet of waxed paper.

- [0417] 2. Apply 2nd sheet of wax paper and press firmly to approximately 0.5-inch (1.27 cm) thickness.
- [0418] 3. Use gauge rolls to reduce sheet to approximately 0.20 inches (0.51 centimeters).
- [0419] 4. Adjust gauge rolls to approximately 0.12 inches (0.30 centimeters) and sheet a second time.
- [0420] 5. Adjust gauge rolls to desired thickness of 0.07 to 0.10 inches (0.18 to 0.25 centimeters) to deliver target piece weight of 6.0 g and sheet one at a time.
- [0421] 6. Place finished sheet in freezer at 0° F. to 10° F. (-17.8° C. to -12.2° C.) until firm.
- [0422] 7. Remove sheet to flat surface, remove top sheet, and cut strips 1.01×3.20 inches (2.57×8.13 centimeters) using cutter rolls.
- [0423] 8. Return sheet to freezer.
- [0424] Sandwiching
- [0425] 1. Place a 16×24 inch (41×61 centimeter) tray on top of another tray of same dimension filled with dry ice pellets.
- [0426] 2. Remove filling from freezer and place on top tray.
- [0427] 3. Remove top sheet of wax paper.
- [0428] 4. Separate filling pieces and place on cracker.
- [0429] 5. Apply top cracker and apply light pressure.
- [0430] 6. Place two sandwiches top to bottom on U-board.
- [0431] 7. Seal in cellophane wrapper.
- [0432] Making Procedure (Example 26)
- [0433] Peanut pieces are ground up and passed through #6 USA Std. Screen and held by a #14 screen, and are incorporated into the dough before baking.
- [0434] Dough Making
- [0435] 1. Mix in Kitchen Aid mixer (Model K45SS) with paddle.
- [0436] 2. The water and PGE are weighed in a Hobart mixer bowl and mixed for 1 minute on speed # 1.
- [0437] 3. Next, the molasses, and the PGE Hydrate and Panodan if used are added to the bowl and mixed for 1 minute on speed #1. The PGE Hydrate is prepared by mixing in a small bowl 1 part PGE with 9 parts water.
- [0438] 4. Sucrose is weighed into a tared bowl lined with a plastic bag. Add dry flavor, fiber, protein, soda, starch, salt, egg white solids, maltodextrin if used, and xanthan gum are added.
- [0439] 5. Ingredients are stirred with a fork and shaken in a bag to mix the ingredients.
- [0440] 6. The dry ingredients from # 5 are slowly added to the mix in the bowl from #3 above while the mixer is running on the lowest speed.
- [0441] 7. The mixture from #6 above is mixed for 30 seconds on low or speed 1, and then mixed 30 seconds on medium or speed 2.

- [0442] 8. The resulting dough from #7 above is allowed to rest for 15 minutes.
- [0443] 9. Then, the nuts are added to and mixed in the dough.
- [0444] Baking:
- [0445] 1. 2 gram pieces of dough are placed onto a lightly sprayed Teflon cookie sheet using Crisco® Cooking Spray. Care must be taken not to apply excessive cooking spray, so that the Product's final fat content is minimally effected.
- [0446] 2. The dough is then tamped into approximately 1.5-inch (3.8 cm) diameter circles and baked at 300° F. (148.9° C.) for 9 minutes.
- [0447] 3. The product is then depaned from tray within 30 seconds of removal from oven and placed in sealed containers when cool.

EXAMPLE 1

[0448]

Peanut butter filled crackers having a crumb to filling ratio by weight of 1.5:1		
Ingredient	Crumb Peanut weight percent	Filling Peanut weight percent
GLUC Corn Syrup (Quality Ingredients Corp., Chester, NJ)	0.62	
Oliver O (Proctor & Gamble Co., Cincinnati, OH)	0.12	15.30
Malt Syrup (Hendricks 200 Quality Ingredients Corp., Chester NJ)	1.24	
Peanut Oil (022000, Western Foods, Optimum, LA)		1.80
Sugar 22X (Amalgamated Sugar Co., Ogden, UT)		15.80
Granulated Sugar (Milly Sugar Co., Waco, TX)	5.60	
Infused Salt (Morton International, Inc., Chicago, IL)		1.10
Salt - TPC Pure (Morton International, Inc., Philadelphia, PA)	0.30	
L-Cysteine HCl Monohydrate (Quality Ingredients Corp., Chester NJ)	0.04	
Vitamin A, D, E, K, Inert (Western Foods Co., West Branch, CT)	0.06	0.04
Flour - soft wheat (Wheat Milling Co., Tuscarora, IL)	42.82	
Flour - hardwheat wheat (Vibrod® WF-600/30, I. Rottemund, Mannheim, Germany)	3.00	
Flour - whole (Flourant-2, Malvern Chem. Ind., Kent-city Hyogo, Japan)	3.90	12.00
Isolated Soy Protein (Nippon® 661, Protein Technologies Int'l., St. Louis, MO)	4.00	
Sodium Bicarbonate (Church & Dwight Co., Princeton, NJ)	0.95	
Calcium Phosphate Monobasic (Regent 12XX, Rhodia, Cranbury, NJ)	0.76	
Sodium Aluminum Phosphate (Levick, Rhodia, Cranbury, NJ)	0.76	
Ammonium Bicarbonate (Church & Dwight Co., Princeton, NJ)	2.40	
Functional De-fatted (20%) Peanut Flour from US#1 Medium Runny Peanuts (Orgill Peanut, Dawson GA)		33.96
Water	22.83	

[0449] 30 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 5.22 grams of an amino acid source; 1.38 grams of digestible fat, of which 0.27 grams are saturated fat; and 3.39 grams of dietary fiber.

EXAMPLE 2

[0450]

Cheesier cheese filled crackers having a crumb to filling ratio by weight of 1.5:1			
Ingredient	Crumb Formula weight percent	Filling Formula weight percent	
Corn Syrup (GHE Corn Syrup (Quality Ingredients Corp., Chester, NJ))	0.62		
Glaze @ (Purcell & Gamble Co., Cincinnati, OH)	9.12	31.00	
Milk Syrup (Hawthorne SUG, Quality Ingredients Corp., Chester NJ)	1.24		
Granulated Sugar (Billy Sugar Co., Waukegan, WI)	5.60		
Salt - TPC Food (Morton International, Inc., Philadelphia, PA)	0.30		
L-Cysteine HCl Monohydrate (Quality Ingredients Corp., Chester NJ)	0.04		
Vitamin A, D, E, K ₁ Malt (Watson Foods Co., West Haven, CT)	0.06	0.07	
Flour - soft wheat (Simmer Milling Co., Tazewell, IL)	41.78		
Fiber - insoluble wheat (Vital @ WF-600/30, I. Rottemacher, Elmengen, Germany)	3.00		
Fiber - soluble (Phoscol-2, Mitsubishi Chem. Ind., Bunkyo City Hyogo, Japan)	1.50	17.00	
Isolated Soy Protein (Soy @ 661, Protein Technologies Int., St. Louis, MO)	6.00	1.50	
Sodium Bicarbonate (Clasch & Dwight Co., Princeton, NJ)	0.95		
Calcium Phosphate Monobasic (Regent 120K, Riedel, Cambury, NJ)	0.76		
Sodium Aluminum Phosphate (Lovelis, Riedel, Cambury, NJ)	0.76		
Ammonium Monobasic (Regent 120K, Riedel, Cambury, NJ)	2.40		
Why Protein Isolate (DEPO, Davisco Food International, Inc., Le Sueur, MN)		11.00	
Water	22.97		
Corn Syrup Solids (GHE, Cargill Processing Corp., Minneapolis, IA)		6.50	
Cheese Powder (98100070346, Kraft Foods Ingredients, Memphis, TN)		23.93	
Cheese Flavor (91000WTF, Edlong Corporation, Elk Grove Village, IL)		2.00	
Kazumi Fiber (Lodex Crickens, Chesham, IL)		3.00	

[0451] 40 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 6.28 grams of an amino acid source; 2.04 grams of digestible fat, of which 1.08 grams are saturated fat; and 4.12 grams of dietary fiber.

EXAMPLE 3

[0452]

Peasant butter filled crackers having a crumb to filling ratio by weight of 1.5:1			
Ingredient	Crumb Formula weight percent	Filling Formula weight percent	
GHE Corn Syrup (Quality Ingredients Corp., Chester, NJ)	0.62		
Glaze @ (Purcell & Gamble Co., Cincinnati, OH)	9.12	15.30	
Milk Syrup (Hawthorne SUG, Quality Ingredients Corp., Chester, NJ)	1.24		
Peasant Oil (902000, Western Foods, Oskema, LA)		1.80	
Sugar 12X (Amalgamated Sugar Co., Ogden, UT)		15.80	
Granulated Sugar (Billy Sugar Co., Waukegan, WI)	5.00		
Salt - TPC Food (Morton International, Inc., Philadelphia, PA)	0.30		
Isolated Salt (Morton International, Inc., Chicago, IL)		1.30	
L-Cysteine HCl Monohydrate (Quality Ingredients Corp., Chester NJ)	0.04		
Vitamin A, D, E, K ₁ Malt (Watson Foods Co., West Haven, CT)	0.06	0.03	
Flour - soft wheat (Simmer Milling Co., Tazewell, IL)	37.88		
Fiber - insoluble wheat (Vital @ WF-600/30, I. Rottemacher, Elmengen, Germany)	2.75		
Fiber - soluble (Phoscol-2, Mitsubishi Chem. Ind., Bunkyo City Hyogo, Japan)	1.50	12.00	
Isolated Soy Protein (Soy @ 661, Protein Technologies Int., St. Louis, MO)	10.00		
Sodium Bicarbonate (Clasch & Dwight Co., Princeton, NJ)	0.95		
Calcium Phosphate Monobasic (Regent 120K, Riedel, Cambury, NJ)	0.76		
Sodium Aluminum Phosphate (Lovelis, Riedel, Cambury, NJ)	0.76		
Ammonium Monobasic (Clasch & Dwight Co., Princeton, NJ)	2.40		
Wheat Gluten (Glutal 21000, Cargill, Hammond, IN)	2.00		
Peasant De-Salt (200) Peasant Flour from UN91 Medium Roast Peasants (Cargill Peasant, Dawson GA)		53.97	
Water	22.91		

[0453] 30 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 6.39 grams of an amino acid source; 1.38 grams of digestible fat, of which 0.27 grams are saturated fat; and 3.43 grams of dietary fiber.

EXAMPLE 4

[0454]

Powder better filled cracker comprising sweet corns and having a crush to filling ratio by weight of 1.5:1 and, on a 40-grain basis, containing at least 5 grams of protein having a quality of 1.0			
Ingredient	Crush Protein weight percent	Filling Protein weight percent	
620K Corn Syrup (Quality Ingredients Corp., Chester, N.J.)	0.60		
Glaze @ (Pinech & Gamble Co., Cincinnati, OH)	8.81	20.00	
Milk Syrup (Hawthys 500 Quality Ingredients Corp., Chester N.J.)	1.20		
Protein Oil (502000, Western Foods, Olatoma, LA.)		0.80	
Granulated Sugar (Gilly Sugar Co., Waukegan, WI)	5.40		
Sugar 12K (Amalgamated Sugar Co., Ogden, UT)		13.80	
Salt - TFC Purex (Morton International, Inc., Philadelphia, PA.)	0.29		
Iodized Salt (Morton International, Inc., Chicago, IL.)		1.10	
L-Cystine HCl Monohydrate (Quality Ingredients Corp., Chester N.J.)	0.04		
Vitamin A, D ₂ , K ₁ blend (Western Foods Co., West Haven, CT)	0.04	0.05	
Whole Grain Flour (Mann, Cincinnati, OH)	0.10		
Flour - soft wheat (Homer Milling Co., Indianapolis, IL.)	41.00		
Fiber - inulin wheat (Vital @ WF-600/30, I. Rottemauer, Ellwangen/J, Germany)	2.80		
Fiber - soluble (Pharmel-2, Mitsubishi Chem. Ind., Bant-city Hyogo, Japan)	1.25	9.00	
Isolated Soy Protein (Soy @ 601, Protein Technologies Int., St. Louis, MO.)		3.80	
Sodium Bicarbonate (Church & Dwight Co., Princeton, NJ)	0.92		
Calcium Phosphate Monobasic (Regent 120K, Rhodia, Cumbury, NJ.)	0.73		
Sodium Aluminum Phosphate (Lewic, Rhodia, Cumbury, NJ.)	0.73		
Ammonium Bicarbonate (Church & Dwight Co., Princeton, NJ)	2.32		
Wheat Gluten (Glutal 21000, Cornier, Hammond, IN)	1.93		
Rumex Crusts (Main Street Ingredients, LeClerc, WI)	9.85		
Processed De-fatted (20%) Peanut Flour from URSI Medium Roast Peanuts (Cargill Peanut, Dawson GA.)		51.45	
Water	22.08		

[0455] 30 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 6.39 grams of an amino acid source; 1.50 grams of digestible fat, of which 0.26 grams are saturated fat; and 2.78 grams of dietary fiber.

EXAMPLE 5

[0456]

Cracker cheese filled cracker having a crush to filling ratio by weight of 1.5:1			
Ingredient	Crush Protein weight percent	Filling Protein weight percent	
620K Corn Syrup (Quality Ingredients Corp., Chester, N.J.)	0.60		
Corn Syrup Solids (620K, Corn Processing Corp., Muscatine, IA.)		8.50	
Glaze @ (Pinech & Gamble Co., Cincinnati, OH)	9.13	31.00	
Milk Syrup (Hawthys 500, Quality Ingredients Corp., Chester N.J.)	1.24		
Expanded Flakes (Lodges Cracker, Channahon, IL.)		1.00	
Granulated Sugar (Gilly Sugar Co., Waukegan, WI)	5.00		
Salt - TFC Purex (Morton International, Inc., Philadelphia, PA.)	0.30		
L-Cystine HCl Monohydrate (Quality Ingredients Corp., Chester N.J.)	0.04		
Vitamin A, D ₂ , K ₁ blend (Western Foods Co., West Haven, CT)	0.04	0.07	
Flour - soft wheat (Homer Milling Co., Indianapolis, IL.)	37.88		
Fiber - inulin wheat (Vital @ WF-600/30, I. Rottemauer, Ellwangen/J, Germany)	2.75		
Fiber - soluble (Pharmel-2, Mitsubishi Chem. Ind., Bant-city Hyogo, Japan)	1.20	17.00	
Isolated Soy Protein (Soy @ 601, Protein Technologies Int., St. Louis, MO.)		3.50	
Sodium Bicarbonate (Church & Dwight Co., Princeton, NJ)	0.95		
Calcium Phosphate Monobasic (Regent 120K, Rhodia, Cumbury, NJ.)	0.76		
Sodium Aluminum Phosphate (Lewic, Rhodia, Cumbury, NJ.)	0.76		
Ammonium Bicarbonate (Church & Dwight Co., Princeton, NJ)	1.40		
Wheat Gluten (Glutal 21000, Cornier, Hammond, IN)	2.00		
Whey Protein Isolate (WPRO, Davisco Food International, Inc., Le Sueur, MN.)		11.00	
Water	22.91		
Cheese Powder (501600/8346, Kraft Foods Ingredients, Memphis, TN)		23.93	
Cheese Flvwr (F0010WYF, Edlong Corporation, Elk Grove Village, IL.)		2.00	

[0457] 30 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 5.79 grams of an amino acid source; 1.26 grams of digestible fat, of which 0.66 grams are saturated fat; and 3.21 grams of dietary fiber.

EXAMPLE 6

[0438]

Cheddar cheese filled crackers comprising ruminant protein and having a crumb to filling ratio by weight of 1.5:1 and, on a 30-gram basis, containing at least 5 grams of protein having a quality of 1.0			
Ingredient	Crumb Formula weight percent	Filling Formula weight percent	
62DE Corn Syrup (Quality Ingredients Corp., Chester, N.J.)	0.60		
Glenn ® (Foster & Gamble Co., Cincinnati, OH)	8.81	30.00	
Malt Syrup (Marskys 5900, Quality Ingredients Corp., Chester N.J.)	1.20		
Kosmos Protein (Lodum Crutcher, Channahon, IL)		2.20	
Granulated Sugar (Billy Sugar Co., Wickard, WY)	1.40		
Salt - TPC Purex (Morton International, Inc., Philadelphia, PA)	0.29		
L-Cystine HCl Monohydrate (Quality Ingredients Corp., Chester N.J.)	0.04		
Vitamin A, D, E, blend (Vitamin Foods Co., West Haven, CT)	0.06	0.07	
Whole Grain Flour (Morton, Cincinnati, OH)	0.01		
Flour - soft wheat (Morton Milling Co., Tinianopolis, IL)	41.00		
Fiber - insoluble wheat (Vitamin ® WF-600/30, I. Rotenberger, Elmengen, Germany)	2.89		
Fiber - soluble (Fibromax-2, Matutinal Chem. Ind., Ibad-city Hyogo, Japan)	1.25	16.00	
Sodium Bicarbonate (Church & Dwight Co., Princeton, NJ)	0.92		
Calcium Phosphate Monobasic (Regent 220K, Rhodia, Cranbury, NJ)	0.73		
Sodium Aluminum Phosphate (Lovelis, Rhodia, Cranbury, NJ)	0.73		
Ascorbic Acid Monobasic (Church & Dwight Co., Princeton, NJ)	2.33		
Wheat Gluten (Unifed 21000, Osmotex, Hammond, IN)	1.83		
Whey Protein Isolate (NIPRO, Davisco Food International, Inc., Le Sueur, MN)		17.30	
Ruminant Protein (Main Street Ingredients, LeCrown, WI)	9.65		
Water	21.17		
Corn Syrup Solids (M200, Gula Processing Corp., Muncie, IA)		8.50	
Cheese Powder (#2100078346, Kraft Foods Ingredients, Memphis, TN)		21.83	
Cheese Flavor (#1030WYR, Hilary Corporation, Elk Grove Village, IL)		2.00	

[0439] 30 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 6.03 grams of an amino acid source; 1.50 grams of digestible fat, of which 0.66 grams are saturated fat; and 2.86 grams of dietary fiber.

EXAMPLE 7

[0440]

Cheddar cheese filled crackers having a crumb to filling ratio by weight of 1.5:1 and at least 0.75 beta-glucan soluble fiber per 40-gram serving			
Ingredient	Crumb Formula weight percent	Filling Formula weight percent	
62DE Corn Syrup (Quality Ingredients Corp., Chester, N.J.)	0.62		
Glenn ® (Foster & Gamble Co., Cincinnati, OH)	9.13	32.00	
Malt Syrup (Marskys 5900, Quality Ingredients Corp., Chester N.J.)	1.24		
Granulated Sugar (Billy Sugar Co., Wickard, WY)	5.60		
Salt - TPC Purex (Morton International, Inc., Philadelphia, PA)	0.30		
L-Cystine HCl Monohydrate (Quality Ingredients Corp., Chester N.J.)	0.04		
Vitamin A, D, E, blend (Vitamin Foods Co., West Haven, CT)	0.06	0.07	
Flour - soft wheat (Morton Milling Co., Tinianopolis, IL)	39.99		
Fiber - soluble (Fibromax-2, Matutinal Chem. Ind., Ibad-city Hyogo, Japan)		8.00	
Isolated Soy Protein (Nippro ® 661, Protein Technologies Ind., St. Louis, MO)	4.40	2.50	
Sodium Bicarbonate (Church & Dwight Co., Princeton, NJ)	0.95		
Calcium Phosphate Monobasic (Regent 220K, Rhodia, Cranbury, NJ)	0.76		
Sodium Aluminum Phosphate (Lovelis, Rhodia, Cranbury, NJ)	0.76		
Ascorbic Acid Monobasic (Church & Dwight Co., Princeton, NJ)	2.40		
Whey Protein Isolate (NIPRO, Davisco Food International, Inc., Le Sueur, MN)		10.00	
Oat Bran Chanc. (Chanc., Quaker Oats Co., Chicago, IL)	16.89	11.50	
Water	22.86		
Corn Syrup Solids (M200, Gula Processing Corp., Muncie, IA)		10.00	
Cheese Powder (#2100078346, Kraft Foods Ingredients, Memphis, TN)		21.93	
Cheese Flavor (#1030WYR, Hilary Corporation, Elk Grove Village, IL)		2.00	

[0441] 40 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 5.36 grams of an amino acid source; 1.72 grams of digestible fat, of which 0.84 grams are digestible saturated fat; and 2.95 grams of dietary fiber.

EXAMPLE 8

[0462]

Chocolate cheese filled cookies containing Fibersid® and having a crumb to filling ratio by weight of 1.5:1			
Ingredient	Crumb Formula weight percent	Filling Formula weight percent	
GDH Cream Syrup (Quality Ingredients Corp., Chester, N.J.)	0.62		
Glaze® (Procter & Gamble Co., Cincinnati, OH)	9.13	31.00	
Milk Syrup (Borden's 5900, Quality Ingredients Corp., Chester, N.J.)	1.24		
Excessed Fats (Lorden Crystals, Channahon, IL)		3.00	
Granulated Sugar (Hilly Sugar Co., Wheelock, WY)	5.60		
Salt - TFC Pure (Morton International, Inc., Philadelphia, PA)	0.30		
L-Cysteine HCl Monohydrate (Quality Ingredients Corp., Chester, N.J.)	0.04		
Vitamin A, D, E, K, Malt (Vitamin Foods Co., West Haven, CT)	0.06	0.07	
Flour - soft wheat (Homer Milling Co., Tuscarora, IL)	42.73		
Flour - hardwheat wheat (Vitamin® WF-6020, J.E. Heston & Co., Elmhurst, Germany)	3.00		
Instant Soy Protein (Soypro® 861, Protein Technologies Int., St. Louis, MO)	6.00	3.50	
Sodium Bicarbonate (Clarks & Dwight Co., Princeton, NJ)	0.93		
Calcium Phosphate Monobasic (Regent 120K, Riedel, Cumbury, N.J.)	0.76		
Sodium Aluminum Phosphate (Lovelis, Riedel, Cumbury, N.J.)	0.76		
Ascorbic Acid Monobasic (Clarks & Dwight Co., Princeton, NJ)	2.40		
Whey Protein Isolate (WPI® 90, Davisco Food International, Inc., Le Sueur, MN)		11.00	
Fibersid® (Lanx Corp., White Bear Lake, MN)	3.50	17.00	
Water	22.91		
Cream Syrup Solids (GDH, Gail Processing Corp., Morton, IL)		8.50	
Glaze Powder (#2100378346, Kraft Foods Ingredients, Memphis, TN)		23.93	
Glaze Flavor (#2100378346, Kraft Foods Ingredients, Memphis, TN)		2.00	

[0463] 40 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 6.16 grams of an amino acid source; 1.52 grams of digestible fat, of which 0.76 grams are digestible saturated fat; and 4.68 grams of dietary fiber.

EXAMPLE 9

[0464]

Chocolate cheese filled cookies containing pea fiber and having a crumb to filling ratio by weight of 1.5:1			
Ingredient	Crumb Formula weight percent	Filling Formula weight percent	
GDH Cream Syrup (Quality Ingredients Corp., Chester, N.J.)	0.64		
Glaze® (Procter & Gamble Co., Cincinnati, OH)	9.37	31.00	
Milk Syrup (Borden's 5900, Quality Ingredients Corp., Chester, N.J.)	1.27		
Excessed Fats (Lorden Crystals, Channahon, IL)		3.00	
Granulated Sugar (Hilly Sugar Co., Wheelock, WY)	5.75		
Salt - TFC Pure (Morton International, Inc., Philadelphia, PA)	0.31		
L-Cysteine HCl Monohydrate (Quality Ingredients Corp., Chester, N.J.)	0.04		
Vitamin A, D, E, K, Malt (Vitamin Foods Co., West Haven, CT)	0.07	0.07	
Flour - soft wheat (Homer Milling Co., Tuscarora, IL)	43.80		
Instant Soy Protein (Soypro® 861, Protein Technologies Int., St. Louis, MO)	6.16	3.50	
Sodium Bicarbonate (Clarks & Dwight Co., Princeton, NJ)	0.97		
Calcium Phosphate Monobasic (Regent 120K, Riedel, Cumbury, N.J.)	0.78		
Sodium Aluminum Phosphate (Lovelis, Riedel, Cumbury, N.J.)	0.78		
Ascorbic Acid Monobasic (Clarks & Dwight Co., Princeton, NJ)	2.46		
Wheat Gluten (Gluten® 21000, Cargill, Hammond, IN)	2.85		
Whey Protein Isolate (WPI® 90, Davisco Food International, Inc., Le Sueur, MN)		11.00	
Pea Fiber (Cargill Inc., Peabody, MA)	4.10	17.00	
Water	21.45		
Cream Syrup Solids (GDH, Gail Processing Corp., Morton, IL)		8.50	
Glaze Powder (#2100378346, Kraft Foods Ingredients, Memphis, TN)		23.93	
Glaze Flavor (#2100378346, Kraft Foods Ingredients, Memphis, TN)		2.00	

[0465] 40 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 6.28 grams of an amino acid source; 1.48 grams of digestible fat, of which 0.76 grams are digestible saturated fat; and 4.40 grams of dietary fiber.

EXAMPLE 10

[0466]

Cheddar cheese filled crackers containing at least 6.25 grams of any protein per 40 gram serving and having a crumb to filling ratio by weight of 1.5:1		
Ingredient	Crumb Formula weight percent	Filling Formula weight percent
GDH Corn Syrup (Quality Ingredients Corp., Chester, N.J.)	0.58	
Glens ® (Procter & Gamble Co., Cincinnati, OH)	8.47	30.00
Malt Syrup (Hawkeye SSG, Quality Ingredients Corp., Chester, N.J.)	1.15	
Kernal Fibra (Lodan Crutcher, Channahon, IL)		2.50
Granulated Sugar (Holly Sugar Co., Wadestown, WY)	4.33	
Salt - TFC Power (Morton International, Inc., Philadelphia, PA)	0.28	
L-Cysteine HCl Monohydrate (Quality Ingredients Corp., Chester, N.J.)	0.04	
Vitamin A, D, E, K, Mand (Viterra Foods Co., West Haven, CT)	0.08	0.07
Flour - soft wheat (Simmer Milling Co., Tiptonville, IL)	31.65	
Fiber - soluble (Fibersol-2, Matsutani Chem. Ind., Iwano-city Hyogo, Japan)	5.75	72.00
Isolated Soy Protein (Soyas ® 661, Protein Technologies Int., St. Louis, MO)	14.83	18.00
Sodium Bicarbonate (Church & Dwight Co., Princeton, NJ)	0.88	
Calcium Phosphate Monobasic (Regent 120K, Rhode, Cranbury, NJ)	0.70	
Sodium Aluminum Phosphate (Lovelis, Rhode, Cranbury, NJ)	0.70	
Ammonium Bicarbonate (Church & Dwight Co., Princeton, NJ)	2.22	
Wheat Gluten (Marvial 21000, Cramer, Shrewsbury, IN)	1.55	
Water	26.79	
Corn Syrup Solids (M280, Gula Processing Corp., Mazonia, IA)		11.50
Cheese Powder (#21000783-4, Kraft Foods Ingredients, Memphis, TN)		23.93
Cheese Flavor (#1030WY7, Edlong Corporation, Elk Grove Village, IL)		2.00

[0467] 30 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 6.81 grams of an amino acid source; 1.20 grams of digestible fat, of which 0.63 grams are digestible saturated fat; and 2.52 grams of dietary fiber.

EXAMPLE 11

[0468]

Cheddar cheese filled crackers containing whey protein isolate and having a crumb to filling ratio by weight of 1.5:1		
Ingredient	Crumb Formula weight percent	Filling Formula weight percent
GDH Corn Syrup (Quality Ingredients Corp., Chester, N.J.)	0.63	
Glens ® (Procter & Gamble Co., Cincinnati, OH)	9.23	30.00
Malt Syrup (Hawkeye SSG, Quality Ingredients Corp., Chester, N.J.)	1.25	
Kernal Fibra (Lodan Crutcher, Channahon, IL)		2.50
Granulated Sugar (Holly Sugar Co., Wadestown, WY)	5.66	
Salt - TFC Power (Morton International, Inc., Philadelphia, PA)	0.30	
L-Cysteine HCl Monohydrate (Quality Ingredients Corp., Chester, N.J.)	0.04	
Vitamin A, D, E, K, Mand (Viterra Foods Co., West Haven, CT)	0.06	0.07
Flour - soft wheat (Simmer Milling Co., Tiptonville, IL)	49.00	
Fiber - insoluble wheat (Vital ® WF-62000, I. Rottemund, Ellwangen, Germany)	1.03	
Fiber - soluble (Fibersol-2, Matsutani Chem. Ind., Iwano-city Hyogo, Japan)	1.01	12.00
Sodium Bicarbonate (Church & Dwight Co., Princeton, NJ)	0.96	
Calcium Phosphate Monobasic (Regent 120K, Rhode, Cranbury, NJ)	0.77	
Sodium Aluminum Phosphate (Lovelis, Rhode, Cranbury, NJ)	0.77	
Ammonium Bicarbonate (Church & Dwight Co., Princeton, NJ)	2.43	
Whey Protein Isolate (90F80, Davisco Food International, Inc., Le Sueur, MN)	3.74	18.00
Water	21.12	
Corn Syrup Solids (M280, Gula Processing Corp., Mazonia, IA)		11.50
Cheese Powder (#21000783-4, Kraft Foods Ingredients, Memphis, TN)		23.93
Cheese Flavor (#1030WY7, Edlong Corporation, Elk Grove Village, IL)		2.00

[0469] 40 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 6.40 grams of an amino acid source; 1.92 grams of digestible fat, of which 0.80 grams are digestible saturated fat; and 3.15 grams of dietary fiber.

EXAMPLE 14

[0474]

Un-filled cookies	
Ingredient	Cream Formula weight percent
GGDS Cream Syrup (Quality Ingredients Corp., Chester, N.J.)	0.62
Glens ® (Fracor & Gaudin Co., Cincinnati, OH)	9.13
Milk Syrup (Hawley 5000, Quality Ingredients Corp., Chester N.J.)	1.24
Granulated Sugar (Rally Sugar Co., Warkent, WI)	1.00
Salt - TFC Pure (Morton International, Inc., Philadelphia, PA)	0.30
L-Cysteine HCl Monohydrate (Quality Ingredients Corp., Chester N.J.)	0.04
Vitamin A, D ₂ , E, blend (Watson Foods Co., West Haven, CT)	0.06
Flour - soft wheat (Brunner Milling Co., Tazewell, IL)	37.88
Fiber - insoluble wheat (Vibrad ® WF-600/30, J. Rothemann, Elmhagen, Germany)	2.75
Fiber - soluble (Pharmul-2, Metabond Chem. Ind., Bannockburn, IL)	3.20
Isolated Soy Protein (Hypo ® 601, Protein Technologies Int., St. Louis, MO)	12.80
Sodium Bicarbonate (Church & Dwight Co., Princeton, NJ)	0.95
Calcium Phosphate Monobasic (Regent 1200X, Rhodia, Cranbury, NJ)	0.76
Sodium Aluminum Phosphate (Lovelis, Rhodia, Cranbury, NJ)	0.76
Ammonium Bicarbonate (Church & Dwight Co., Princeton, NJ)	1.40
Wheat Gluten (Glutal 21000, Cramer, Hammond, IN)	1.00
Water	22.91

[0475] 30 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 5.76 grams of an amino acid source; 0.21 grams of digestible fat, of which 0.05 grams are digestible saturated fat; and 2.85 grams of dietary fiber.

EXAMPLE 15

[0476]

Un-filled cookies containing at least 6.25 grams of soy protein per 42-gram serving	
Ingredient	Cream Formula weight percent
GGDS Cream Syrup (Quality Ingredients Corp., Chester, N.J.)	0.58
Glens ® (Fracor & Gaudin Co., Cincinnati, OH)	8.47
Milk Syrup (Hawley 5000 Quality Ingredients Corp., Chester N.J.)	1.15
Granulated Sugar (Rally Sugar Co., Warkent, WI)	4.33
Salt - TFC Pure (Morton International, Inc., Philadelphia, PA)	0.28
L-Cysteine HCl Monohydrate (Quality Ingredients Corp., Chester N.J.)	0.04

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Un-filled cookies containing at least 6.25 grams of soy protein per 42-gram serving	
Ingredient	Cream Formula weight percent
Vitamin A, D ₂ , E, blend (Watson Foods Co., West Haven, CT)	0.08
Flour - soft wheat (Brunner Milling Co., Tazewell, IL)	31.65
Fiber - soluble (Pharmul-2, Metabond Chem. Ind., Bannockburn, IL)	5.75
Isolated Soy Protein (Hypo ® 601, Protein Technologies Int., St. Louis, MO)	14.80
Sodium Bicarbonate (Church & Dwight Co., Princeton, NJ)	0.88
Calcium Phosphate Monobasic (Regent 1200X, Rhodia, Cranbury, NJ)	0.70
Sodium Aluminum Phosphate (Lovelis, Rhodia, Cranbury, NJ)	0.70
Ammonium Bicarbonate (Church & Dwight Co., Princeton, NJ)	2.22
Wheat Gluten (Glutal 21000, Cramer, Hammond, IN)	1.55
Water	26.79

[0477] 40 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 9.65 grams of an amino acid source; 0.27 grams of digestible fat, of which 0.07 grams are digestible saturated fat; and 2.88 grams of dietary fiber.

EXAMPLE 16

[0478]

Peanut butter filled bars having a cream to filling ratio by weight of 1.5:1		
Ingredient	Cream Formula weight percent	Filling Formula weight percent
GGDS Cream Syrup (Quali Food Inc., Elmhurst, IL)	0.62	
Glens ® (Fracor & Gaudin Co., Cincinnati, OH)	8.10	30.00
Milk Syrup (Hawley 5000 Quality Ingredients Corp., Chester N.J.)	1.24	
Peanut Oil (8022000, Watson Foods, Ocala, FL)		1.35
Sugar - White Softs (Amalgamated Sugar Co., Ogden, UT)	6.98	
Salt - Fine-Flo Fine Flats (Cargill Inc., St. Clair, MI)	0.30	0.82
L-Cysteine HCl (Quali Food Inc., Dallas, TX)	0.04	
Vitamin A, D ₂ , E, blend (Watson Foods Co., West Haven, CT)	0.06	0.07
Whole Grain Flour (899-6700, Moss, Wayne, MI)	0.10	
Flour - soft wheat (Brunner Milling Co., Tazewell, IL)	47.74	
Fiber - insoluble wheat (Vibrad ® WF-600/30, J. Rothemann, Elmhagen, Germany)	1.90	
Fiber - soluble (Pharmul-2, Metabond Chem. Ind., Bannockburn, IL)	2.50	11.83

-continued		
Powdered butter filled base having a cream to filling ratio by weight of 1.5:1		
Ingredient	Cream Formulas weight percent	Filling Formulas weight percent
Isolated Soy Protein (Soyas 661, Protein Technologies Int., St. Louis, MO)	6.00	
Sodium Bicarbonate (Church & Dwight Co., Princeton, NJ)	0.48	
Calcium Phosphate Monobasic (Regent 120K, Riedel, Cramery, NJ)	0.30	
Sodium Aluminum Phosphate (Lowe's, Riedel, Cramery, NJ)	0.35	
Ammonium Monobasic (Church & Dwight Co., Princeton, NJ)	1.20	
Whey Protein Isolate (BIFRO, Davisco Food International, Inc., Le Sueur, MN)		6.00
Water	21.30	
Processed De-fatted (20%) Peanut Flour from USP1 Medium Swallow Peanuts (Chagall Peanut, Dawson GA.)		49.93

[0479] 40 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 7.12 grams of an amino acid source; 2.12 grams of digestible fat, of which 0.48 grams are digestible saturated fat; and 3.93 grams of dietary fiber.

EXAMPLE 17

[0480]

Fruit filled base having a cream to filling ratio by weight of 1.5:1		
Ingredient	Cream Formulas weight percent	Filling Formulas weight percent
GGDI Corn Syrup (Good Food Inc., Honey Brook, PA.)	3.40	
Milk Syrup (Hawthorne 500 Quality Ingredients Corp., Chester NJ)	4.00	
Shortening (Cotton O, Procter & Gamble, Cincinnati, OH)	8.40	
Sugar - White Table (Amalgamated Sugar Co., Ogden, UT)	8.99	
Salt - Iodine-Free Fine Flakes (Chagall Inc., St. Clair, MI)	0.52	
Whole Grain Flour (#954270, Mase, Wayne, NJ)	0.10	
Flour - soft wheat (Glenn Milling Co., Toledo, IL)	34.15	
Fiber - Insoluble wheat (Vincel @ WF-600/20, I. Rottemund, Elvington, Germany)	4.10	
Fiber - soluble (Fibersol-2, Minnesota Chem. Int., Bond-city Rygo, Japan)	4.00	2.35
Isolated Soy Protein (Soyas 661, Protein Technologies Int., St. Louis, MO)	10.40	
Sodium Bicarbonate (Church & Dwight Co., Princeton, NJ)	0.30	

-continued		
Fruit filled base having a cream to filling ratio by weight of 1.5:1		
Ingredient	Cream Formulas weight percent	Filling Formulas weight percent
Calcium Phosphate Monobasic (Regent 120K, Riedel, Cramery, NJ)	0.30	
Ammonium Monobasic (Church & Dwight Co., Princeton, NJ)	0.30	
Wheat Gluten (Glutal 21000, Cramery, Hammond, IL)	2.50	
Whey Protein Isolate (BIFRO, Davisco Food International, Inc., Le Sueur, MN)		6.00
Non-Fat Dry Milk (Kemper Co., Cincinnati, OH)	1.10	
Eggwhite Solids (Chalabon Food Products, Inc., Oskaloosa, IA)	0.50	
Water	16.96	
Glycerin - Special (Procter & Gamble, New Milford, CT)		9.65
Fruit Paste (Low Ave, Fruit Fillings, Inc., Fresno, CA)		60.00

Additional Making Procedures

[0481] Fruit Filling Making

[0482] 1. The soluble fiber (Fibersol-2), whey protein isolate (BIFRO), glycerine, and fruit puree are weighed and blended, using a Kitchen Aid (Model KSM450 Ultra Power) mixer set on speed setting #2, for 5 minutes.

[0483] 2. The resulting fruit filling is stored until used.

[0484] 40 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 5.60 grams of an amino acid source; 2.64 grams of digestible fat, of which 0.60 grams are digestible saturated fat; and 2.74 grams of dietary fiber.

EXAMPLE 18

[0485]

50/50 fruit/powdered butter filled base having a cream to filling ratio by weight of 1.5:1		
Ingredient	Cream Formulas weight percent	Filling Formulas weight percent
GGDI Corn Syrup (Quality Ingredients Corp., Chester, NJ)	0.61	
Cotton O (Procter & Gamble Co., Cincinnati, OH)	8.03	15.00
Milk Syrup (Hawthorne 500 Quality Ingredients Corp., Chester NJ)	1.22	
Peanut Oil (#02200, Western Foods, Oskaloosa, IA)		0.60
Sugar-White Table (Amalgamated Sugar Co., Ogden, UT)	6.91	
Salt-Iodine-Free Fine Flakes (Chagall Inc., St. Clair, MI)	0.30	0.41

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50/50 fruit/peanut butter filling mass having a crumb to filling ratio by weight of 1.5:1		
Ingredient	Crumb Formula weight percent	Filling Formula weight percent
L-Cysteine HCl Monohydrate (Quality Ingredients Corp., Chester N.J.)	0.04	
Vitamin A, D ₂ , E ₁ blend (Watson Foods Co., West Haven, CT)	0.06	0.03
White Gum Flavor (WFD-GTR, Miss, Weyan, NJ)	0.10	
Flour-soft wheat (Stinner Milling Co., Tappanville, IL)	48.50	
Fiber-insoluble wheat (Vitamin @ WF-600/30, J.B.Hausman, Elmhurst, IL, Germany)	2.48	
Fiber-soluble (Fibersol-2, Motuland Chem. Ind., East-city Hyogo, Japan)	2.48	7.10
Isolated Soy Protein (Soyas @ 661, Protein Technologies Int'l., St. Louis, MO.)	5.85	
Sodium Hexametate (Church & Dwight Co., Princeton, NJ)	0.47	
Calcium Phosphate Monohydrate (Regent 223K, Rhodia, Cambridge, NJ.)	0.38	
Sodium Aluminum Phosphate (Lovelock, Rhodia, Cambridge, NJ.)	0.38	
Ammonium Hexametate (Church & Dwight Co., Princeton, NJ)	1.19	
Whey Protein Isolate (BSPRO, Davisco Food International, Inc., Le Sueur, MN)		7.00
Processed De-fatted (20%) Peanut Flour from URSI Medium Roaster Peanuts (Cargill Peanut, Dawson GA.)		24.78
Water	21.20	
Glycerol-Depend (Procter & Gamble, New Milford, CT)		5.00
Fruit Puree (Low Ac, Fruit Fillings, Inc., Fresno, CA.)		40.00

Additional Making Procedures

[0486] Fruit Filling Making

- [0487] 1. All of the soluble fiber (Fibersol-2), whey protein isolate (BSPRO), glycerin, and fruit puree are weighed and blended, using a Kitchen Aid (Model KSM90 Ultra Power) mixer set on speed setting #2, for 5 minutes.
- [0488] 2. The resulting fruit filling is stored until used.
- [0489] 40 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 5.52 grams of an amino acid source; 1.56 grams of digestible fat, of which 0.26 grams are digestible saturated fat; and 2.88 grams of dietary fiber.

EXAMPLE 19

[0490]

Open filled peanut butter cracker mass containing 3 protein sources and having a crumb to filling ratio by weight of 1.5:1		
Ingredient	Crumb Formula weight percent	Filling Formula weight percent
50/50 Crm Syrup (Quality Ingredients Corp., Chester, NJ)	0.61	
Crumb @ Procter & Gamble Co., Cincinnati, OH.)	8.95	23.00
Malt Syrup (Bluebird 5000 Quality Ingredients Corp., Chester N.J.)	1.21	
Midwest Butter Flavor (Flavors of North America, Inc., Carol Stream, IL)	1.47	
Processed De-fatted (20%) Peanut Flour from URSI Medium Roaster Peanuts (Cargill Peanut, Dawson GA.)		40.00
Sugar 1XX (Amalgamated Sugar Co., Ogden, UT)		13.80
Granulated Sugar (Bally Sugar Co., Wickham, WY)	5.49	
Sub-TFC Powder (Morton International, Inc., Philadelphia, PA.)	0.29	
Isolated Salt (Morton International, Inc., Chicago, IL)		1.10
L-Cysteine HCl Monohydrate (Quality Ingredients Corp., Chester N.J.)	0.04	
Leucine-Cysteine ER (Oxenal Soy Co., Inc., Port Weyan, NJ)		0.20
Flour-soft wheat (Stinner Milling Co., Tappanville, IL)	43.48	
Fiber-insoluble wheat (Vitamin @ WF-600/30, J.B.Hausman, Elmhurst, IL, Germany)	2.94	
Fibersol @ (Lumex Corp., White Bear Lake, MN)	1.47	9.00
Isolated Soy Protein (Soyas @ 661, Protein Technologies Int'l., St. Louis, MO.)	6.27	3.50
Sodium Hexametate (Church & Dwight Co., Princeton, NJ)	0.74	
Calcium Phosphate Monohydrate (Regent 223K, Rhodia, Cambridge, NJ.)	0.39	
Sodium Aluminum Phosphate (Lovelock, Rhodia, Cambridge, NJ.)	0.39	
Ammonium Hexametate (Church & Dwight Co., Princeton, NJ)	1.86	
Whey Protein Isolate (BSPRO, Davisco Food International, Inc., Le Sueur, MN)		2.80
Water		19.40
Wheat Gluten (Graham 223K, Corcoran, Hammond, IN)		1.96
Calcium Citrate (USP AlphaCell, Specialty Minerals, Inc., Bethlehem, PA.)		1.96
Egg White Solids (Hanselgen Foods, Omaha, NE)	0.98	
Quintet Soluble Stabilizer (ADM, Macon, GA.)		0.40
Vitamin mix added to 100 grams of filling (Components & percentages of each component per 100 grams of vitamin mix listed below)		0.80
Vitamin A, D ₂ , E ₁ blend (Watson Foods Co., West Haven, CT)		20.15
Vit E alpha-tocopherol acetate 50% type CWS/F (Rocke Vitamin, Parsippany, NJ)		19.81
(Vit B ₁) Thiamine Hydrochloride (Rocke Vitamin, Parsippany, NJ)		0.75
(Vit B ₂) Riboflavin (Rocke Vitamin, Parsippany, NJ)		0.82
(Vit B ₃) Nicotin USP FCC (Rocke Vitamin, Parsippany, NJ)		7.19
(Vit B ₆) Pyridoxine Hydrochloride (Rocke Vitamin, Parsippany, NJ)		0.96
(Vit B ₁₂) 2% Titration of Vitamin B ₁₂ (Rocke Vitamin, Parsippany, NJ)		0.25

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Open filled peanut butter cracker bars containing 3 protein sources and having a crumb to filling ratio by weight of 1.5:1

Ingredient	Crumb Percent weight	Filling Percent weight
Vitamin C ultra fine powder (Roche Vitamins, Parsippany, NJ)		21.55
Zinc Chloride Trihydrate (Rohm & Lysle, Decatur, IL)		6.88
Iron (reduced) (100%) (Roche Vitamins, Parsippany, NJ)		2.64

[0491] 30 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 5.20 grams of an amino acid source; 1.40 grams of digestible fat, of which 0.15 grams are digestible saturated fat; and 2.60 grams of dietary fiber.

EXAMPLE 20

[0492]

Dietary enriched cheese filled snack product having a crumb to filling ratio by weight of 1.5:1

Ingredient	Crumb Percent weight	Filling Percent weight
Cheese @ (Fracor & Gamble Co., Cincinnati, OH)		31.60
Enamel Flakes, Lardon Crystals, Cholesterol, IL)		1.50
Super 22K (Amalgamated Sugar Co., Ogden, UT)	2.80	
Salt-Water Salt (Cargill Inc., St. Clair, MI)	1.40	
Instant Clearjel Starch (National Starch & Chemical, Bridgewater, NJ)	18.09	
Maltin M100 (Garden of Eatin' Corp., Mountain, IA)	4.05	
Bahn Plus (National Starch & Chemical, Bridgewater, NJ)	4.86	
Onion Powder (Hain Vegetable Products, Inc., Solon, CA)	0.74	
Fiber-cellulose (Pharmat-S, Metrolab Chem. Ind., Brent-ley Hyogo, Japan)		23.15
Isolated Soy Protein (Soypro 601, Protein Technology Int'l., St. Louis, MO)	15.00	3.50
Sodium Bicarbonate (Church & Dwight Co., Princeton, NJ)	0.55	
Whey Protein Isolates (MFPB, Davisco Food International, Inc., Le Sueur, MN)		14.25
Yellow Mon (Lambert-Guth Co., Danville, IL)	33.31	0.03
Vitamin A, D ₂ , E ₁ blend (Vitaco Foods Co., West Haven, CT)		
Cheese Powder (#210078344, Kraft Foods Ingredients, Memphis, TN)		22.97
Cheese Flavor (#1030WVF, Edlong Corporation, Elk Grove Village, IL)		1.00

Making Procedures

[0493] Dough Making:

[0494] 1. Each ingredient is weighed and then combined in a 150 lb (68.2 kg) horizontal ribbon blender.

[0495] 2. Next, the mixture of ingredients is blended for 15 minutes to form a dry dough mix and then transferred into a food grade container for temporary storage.

[0496] Extrusion Process:

[0497] 1. The dry dough mix is added to the feeder bin (hopper) of a K-Tron loss in weight feeder, which is calibrated to 378 g/min (± 5 g). The feeder transfers the dry mix to the pre-mixer of a Pavan single screw extruder (Model F70 Extruder Former).

[0498] 2. In the pre-mixer, water is added at a rate of 0.57 lb/min. (0.17 kg/min.) while at ambient temperature.

[0499] 3. The emulsifier, Emuldan SD K (Danisco, Copenhagen, Denmark), is then added to the pre-mixer at a rate and temperature of 5 g/min. and 150° F. (65.6° C.).

[0500] 4. The dough is then mechanically fed by the pre-mixer into the main mixer where it is further mixed, cooled and moved toward the extrusion screw.

[0501] 5. At this point the single screw extruder pulls the dough into the screw chamber where the dough is forced through a die housing to give it shape. The dough is then cut via rotating blades to produce individually sized pieces.

[0502] Frying:

[0503] 1. The extruded product (extrudate) of Step #5 above is placed in a frying basket that is then placed into a 50 lb (22.7 kg) fryer containing 100% Olean® at 350° F. (176.7° C.). The extrudate is free fried (surface) for 30 seconds and then submerged and fried for an additional 60 seconds.

[0504] 2. The extrudate is then transferred from the fryer to a paper towel where it is allowed to cool. The extruded product has approximately a 20.3% Olean® content after frying.

[0505] Filling the Snack:

[0506] 1. After frying, random snack pieces are weighed to obtain an average weight, which is about 1.1 g per snack piece.

[0507] 2. A snack to filling ratio of about 1.5:1 is required to obtain the desired nutritional profile, which requires about 0.73 g filling per snack piece.

[0508] 3. The filling is added to the snack pieces using a spatula to force the filling into the void spaces in the snack.

[0509] 4. The filled snack pieces are seasoned with Nacho Seas seasoning (Kerry Ingredients, Beloit Wis.) by placing about 100 g of snack pieces in a plastic bag containing excess seasoning, and shaking until the snack pieces are fully covered.

[0510] 40 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 5.20 grams of an amino

acid source; 1.70 grams of digestible fat, of which 0.73 grams are digestible saturated fat; and 2.80 grams of dietary fiber.

EXAMPLE 21

[0511]

Potato crisp	
Ingredient	Crisp Formula weight percent
* Emulsifier Blend	6.60
Wheat Starch Alter (ADM Co., Omaha, NE)	6.30
Fiber-enriched (Fibersol-2, Minnesota Chem. Ind.,	6.30
Brenton City Hyogo, Japan)	
Isolated Soy Protein (Soypro 6641, Protein	17.50
Technology Int'l., St. Louis, MO)	
Potato Flour (Barto American Foods, Blackford,	33.70
Id.)	
Corn Flour (Lankoff Grain Co., Danville, IL)	6.30
Water	28.80
* Emulsifier is a blend of 85% olefin (Carna based, The Procter & Gamble Co., Cincinnati, OH), 12.75% Dimethyl O distillate monoglyceride (Danisco Ingredients, Inc., New Century, KS), and 2.25% DEHSA polyglycerol ester (Lanza, Williamsport, PA).	

Making Procedures

[0512] Dough Making:

- [0513] 1. The potato flakes, soy protein, Fibersol, wheat starch and corn flour are weighed, combined and put into a food processor (Waring commercial) and mixed for 1 minute.
- [0514] 2. Water is heated to approximately 180° F. (82.2° C.) and combined with emulsifier, using a high shear mixer for 15 seconds. During this mixing process the temperature of the blend is dropped therefore, the temperature is adjusted to 160° F.+5° F. (71.1° C.+2.9° C.) by heating using a microwave oven.
- [0515] 3. While the food processor is on, the liquid mixture of Step #2 above is combined with the dry ingredients of Step #1 above and the resulting mixture is mixed for 30 seconds.
- [0516] 4. Next the processor is stopped and its sides are scraped with a spatula to loosen any adhered material. The processor is then restarted and the mixture is mixed for another 30 seconds to form a dough.
- [0517] 5. The dough of Step #4 above is then transferred into a seal able plastic bag to minimize moisture loss.
- [0518] 6. Next, the dough is transferred into a 12-inch (30.48 cm) diameter two-roll mill and roll milled to a thickness of 0.023-0.026 inches (5.84-6.60 mm).
- [0519] 7. Then, approximately 2 inch by 2.75 inch (5.08 cm by 6.98 cm) elliptical shapes are manually cut from the dough sheet.

[0520] Frying:

- [0521] 1. The dough forms from Step #7 above are then fried in a 50 lb (22.7 kg) oil capacity food service fryer (Frymaster) filled with 100% Oleon® (The Procter & Gamble Co.) that is maintained at 375° F. (190.6° C.).

[0522] 2. A stainless steel carrier is used to hold 6 elliptical shaped dough pieces in a saddle form during the frying in the oil for 9 seconds.

[0523] 3. The resulting fried crisps are removed from the carrier and allowed to cool on a paper towel. The crisps have approximately a 23.5% Oleon® content after frying.

[0524] Salting:

[0525] 1. The crisps of #3 above are placed on a shallow pan/tray that is then placed in an oven at 200° F. (93.3° C.) for 2 min.

[0526] 2. The heated crisps are immediately transferred to a tared tray on a two-place balance.

[0527] 3. After being removed from the oven, salt is uniformly added over the crisp's surface at a level of 0.8% by weight of the crisps. The salt mixture comprises 60% fine flake salt and 40% flour salt (Cargill Inc., St. Clair, Mich.).

[0528] Seasoning:

[0529] The crisps are then seasoned as follows:

[0530] 1. A forced air oven is preheated to 200° F. (93.3° C.).

[0531] 2. The crisps are placed on a shallow pan/tray that is placed in the oven for 2 min.

[0532] 3. After being removed from the oven, the crisps are immediately transferred to a tared tray on a two-place balance and seasoning is uniformly added to the crisps' surface at a level of 5.553% of the weight of the crisps. The seasoning used is 99.037% sour cream & onion seasoning (Baltimore Spice, Baltimore, Md.) and 0.963% vitamin pack containing vitamins A, D₃, E₁ (Watson Foods Co., West Haven, Conn.).

[0533] 30 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 6.30 grams of an amino acid source; 0.21 grams of digestible fat, of which 0.09 grams are digestible saturated fat; and 2.50 grams of dietary fiber.

EXAMPLE 22

[0534]

Sweet butter spread	
Ingredient	Filling Formula weight percent
Cocoa @ (Procter & Gamble Co., Cincinnati, OH)	31.04
Sugar 22X (Amalgamated Sugar Co., Ogden, UT)	14.00
Salt (Morton International, Inc., Chicago, IL)	1.10
Fiber-enriched (Fibersol-2, Minnesota Chem. Ind.,	5.36
Brenton City Hyogo, Japan)	
Processed De-fatted (20%) Peanut Flour from	34.43
US91 Medium Roaster Peanuts (Cargill Peanut,	
Darien GA.)	
Vitamin A, D ₃ , E ₁ blend (Watson Foods Co., West	0.07
Haven, CT)	

-continued	
Peanut butter spread	
Ingredient	Filling Formula weight percent
Corn Syrup Solids (MCCO, Gula Processing Corp., Macon, GA)	10.00

Making Procedure

- [0535] Preparation of Roll Milled Peanut Solids (Defatted Peanut Flour)
- [0536] Peanuts are roasted to a 36-37 L' roast color and then ground in a Buser conventional grinder to produce a nut paste of pump able consistency. The method for determining L' roast color values is disclosed in allowed U.S. patent application Ser. No. 09/511,058 and in WO051449A1 both of which are incorporated by reference. The nut paste is defatted by using a mechanical press. The fat content of the defatted solids is 20%. The nut solids are then milled to a mono modal particle size distribution using a Lehmann mill (Model 4039).
- [0537] Heating and Finishing
- [0538] 1. A jacketed Hobart (Model C-100-T) is pre-heated, 1 hour prior using, to a temperature of about 150° F. (65.6° C.).
- [0539] 2. All the ingredients, wet and dry, including the vitamins are weighed, combined and then mixed in the heated Hobart at speed setting #1 for 1 hour.
- [0540] Next, the mixture is cooled through the temperature range of 130° F.-140° F. (54.4° C.-60.0° C.) in about 10 minutes to ensure the proper crystallizing structure. This can usually be accomplished by ambient cooling for lab batch sizes.
- [0541] 40 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 6.60 grams of an amino acid source; 2.40 grams of digestible fat, of which 0.44 grams are digestible saturated fat; and 3.37 grams of dietary fiber.

EXAMPLE 23

[0542]

-continued	
Cheese spread	
Ingredient	Filling Formula weight percent
Oleum (Procter & Gamble Co., Cincinnati, OH)	40.00
Fiberizable (Fibersol-2, Minnesota Chem. Ind., Bond City, Mo., USA)	9.00
Whey Protein Isolate (WPI, Davisco Food International, Inc., Le Sueur, MN)	9.25
Corn Syrup Solids (MCCO, Gula Processing Corp., Macon, GA)	19.00
Vitamin A, D, E, K, Blend (Vitamax Food Co., West Haven, CT)	0.09

-continued	
Cheese spread	
Ingredient	Filling Formula weight percent
Cheese Powder (#2100078346, Kraft Foods Ingredients, Memphis, TN)	11.00
Cheese Flavor (#13378778, Edlong Corporation, Elk Grove Village, IL)	11.66

Making Procedure

- [0543] 1. The fiber is weighed in a separate bowl.
- [0544] 2. The cheese powder, soy protein, whey protein, corn syrup solids, sucrose, and cheese flavor are weighed and combined.
- [0545] 3. Next, the Oleum® and Kasmel Flakes are weighed and then combined in a container.
- [0546] 4. Then the Oleum® and Kasmel Flakes mixture is melted by heating the mixture to a temperature of 150° F.-160° F. (65.6° C.-71° C.)
- [0547] 5. After the desired temperature is reached, the vitamins are added to the Oleum® and Kasmel Flakes mixture.
- [0548] 6. The melted fat blend and fiber are combined and mixed using a Kitchen Aid (Model KSM90 Ultra Power) mixer for 1 minute at speed setting #2. After the ingredients are mixed, they are blended for 5 minutes at speed setting #5.
- [0549] 7. Then the mixture is cooled through the temperature range of 130° F.-140° F. (54.4° C.-60.0° C.) in about 10 minutes to ensure the proper crystallizing structure. This can usually be accomplished by ambient cooling for lab batch sizes.
- [0550] 40 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 5.48 grams of an amino acid source; 2.24 grams of digestible fat, of which 1.36 grams are digestible saturated fat; and 2.64 grams of dietary fiber.

EXAMPLE 24

[0551]

Peanut butter filled sandwich cookies having a crumb to filling ratio by weight of 2.0:1			
Ingredient	Crumb Formula weight percent	Filling Formula weight percent	
Oleum (Procter & Gamble Co., Cincinnati, OH)	20.07	20.00	
Whole Egg	9.61		
Peanut Oil (#022000, Ventron Foods, Opakawa, LA)		0.87	

150
150

-continued-

Peanut butter filled sandwich cookies having a crumb to filling ratio by weight of 3.0:1		
Ingredient	Crumb Peanut weight percent	Filling Peanut weight percent
Instant Salt (Morton International, Inc., Chicago, IL)		1.10
Salt (Kings, Cincinnati, OH)	0.41	
Sugar XXI (Amalgamated Sugar Co., Ogden, UT)		13.70
Light Brown Sugar (Domino Sugar Corp., New York, NY)	25.52	
Proline Flavour (McCormick, Hunt Valley, MD)	0.10	
All Purpose Flour-with wheat (Glaxo Milling Co., Westport, IL)	23.26	
Fiber-oxide (Fibersol-2, Minnesota Chem. Ind., Burnsville, MN)	2.25	9.00
Instant Soy Protein (Soypro 661, Protein Technologies Int., St. Louis, MO)	4.57	1.20
Sodium Bicarbonate (Chest & Dwight Co., Princeton, NJ)	0.41	
Whey Protein Isolate (Borden, Davison Food International, Inc., Le Sueur, MN)	2.00	
Processed De-Gassed (DVG) Peanut Flour from USDA Medium Roasted Peanuts (Cargill Peanut, Dawson GA)		51.50
Vanilla A, D, K, Blend (Watson Foods Co., West Haven, CT)		0.12
Vanilla Flavour, Midam-Manny Vanilla, Inc., Westport, IL	2.00	

Making Procedure

[0552] Dough Making:

- [0553] 1. The flour, soy protein isolate, salt, baking soda, Fibersol, and proline powder are weighed, combined in a medium bowl and then stirred until they are well mixed.
- [0554] 2. The Oleo® and brown sugar are weighed, placed in the bowl of a Sunbeam Mixer electric stationary mixer (Cat. No. 01401) and then blended at speed #6 until creamy.
- [0555] 3. The eggs and vanilla are then added to the mixture of Step #2 above and the resulting mix is beaten at speed #6 until it is well blended.
- [0556] 4. Next, the dry ingredients of Step #1 above are gradually added to mixture of Step #3 above and blended at speed #1, until well blended, thus forming a dough.

[0557] Baking:

- [0558] 1. 2.5-3.0 gram dough balls are dropped onto a non-stick, 12.5 inch x 16.5 inch (31.7 cmx41.9 cm) Wilton Performance Baking Sheet and flattened out to about 1.5 inch (3.8 cm) diameter circles. A cookie weight of about 2.5 g and a diameter of about 1.5 inches after baking is the target.
- [0559] 2. The dropped cookies are baked in a pre-heated oven at 375° F. (190.6° C.) for about 4 minutes—the cookies should be golden brown overall with brown edges.
- [0560] 3. The cookies are removed from the baking sheet after about 10 minutes, and placed on a cooling rack to cool.

[0561] 40 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 6.48 grams of an amino acid source; 1.48 grams of digestible fat, of which 0.31 grams are digestible saturated fat; and 2.71 grams of dietary fiber.

EXAMPLE 25

[0562]

Chocolate chip drop cookies having a crumb to chocolate chip ratio by weight of 4.93:1		
Ingredient	Crumb Peanut weight percent	
Oleo® (Procter & Gamble Co., Cincinnati, OH)	24.28	
Whole Eggs	7.50	
Chocolate Chips (Nestle USA, Glendale, CA)	14.50	
Light Brown Sugar (Domino Sugar Corp., New York, NY)	13.84	
Salt (Kings, Cincinnati, OH)	0.34	
Proline Flavour (McCormick, Hunt Valley, MD)	0.09	
All Purpose Flour-with wheat (Glaxo Milling Co., Westport, IL)	18.71	
Fiber-oxide (Fibersol-2, Minnesota Chem. Ind., Burnsville, MN)	7.11	
Instant Soy Protein (Soypro 661, Protein Technologies Int., St. Louis, MO)	11.70	
Sodium Bicarbonate (Chest & Dwight Co., Princeton, NJ)	0.34	
Vanilla Flavour, Midam-Manny Vanilla, Inc., Westport, IL	1.20	

Making Procedures

[0563] Dough Making:

- [0564] 1. The flour, soy protein isolate, salt, baking soda, Fibersol, and proline powder are weighed, combined in a medium bowl and then stirred until they are well mixed.
- [0565] 2. The Oleo® and brown sugar are weighed, placed in the bowl of a Sunbeam Mixer electric stationary mixer (Cat. No. 01401) and then blended at speed #6 until creamy.
- [0566] 3. The eggs and vanilla are then added to the mixture of Step #2 above and the resulting mix is beaten at speed #6 until it is well blended.
- [0567] 4. Next, the dry ingredients of Step #1 above are gradually added to mixture of Step #3 above and blended at speed #1, until well blended, thus forming a dough.
- [0568] 5. Chocolate chips are then added and mixed by manually stirring the dough.

[0569] Baking

- [0570] 1. 20 g±0.5 g dough balls are dropped, using a #70 scoop, onto a parchment lined, 12.5x16.5-inch (31.7 cmx41.9 cm) Wilton Performance Baking Sheet. Each dough ball is flattened to until it is about 2.5 inches (6.3 centimeters) diameter circle that is about ¼

inch (0.3 cm) thick. The dough balls are then transferred from the parchment sheet onto a baking sheet.

[0571] 2. Next, the dough balls are baked in a preheated oven at 350° F. (176.7° C.) for about 7-8 minutes—the resulting cookies should be golden brown overall with brown edges, and light brown on the bottom.

[0572] 3. The cookies are removed from the baking sheet after about 10 minutes, and placed on a cooling rack to cool.

[0573] 40 grams of the resulting product is analyzed according to the protocols disclosed in the “Analytical Protocols” Section of this application and the test results indicate that the product comprises: 6.20 grams of an amino acid source; 1.72 grams of digestible fat, of which 0.96 grams are digestible saturated fat; and 3.05 grams of dietary fiber.

EXAMPLE 26

[0574]

SNACK CRISP	
Ingredient	Cooked Formula g/100 g
Salt (Kroger, Cincinnati, OH)	0.88
Granulated Sugar (Domino Sugar Corp., New York, N.Y.)	45.80
Mellinex-Granola's (Mellin's USA, Div. Of Calumet Beverages Inc., Hammond, IN)	1.28
Vanilla Flavor (McCormick, Hunt Valley, MD)	8.10
Water	25.86
Wheat Starch Adm (ADM Co., Clinton, IL)	1.28
Isolated Soy Protein (Soypro 661, Protein Technologies Int'l., St. Louis, MO)	8.16
Sodium Bicarbonate (Clarks & Dwight Co., Princeton, NJ)	1.04
Egg White Solids Deb-d Foods Corp., Elmwood, NJ	0.88
Xanthan Gum (Kelco Nutritional, Div. Of Monsanto, St. Louis, MO)	1.00
Sugar Beet Fiber-Fiber (Mellin American Food Sales Ltd., Northbrook, IL)	6.10
Phosaid 6 (Lanx Corp., White Bear Lake, MN)	2.86
Whey Protein Isolate (MILPRO, Davisco Food International, Inc., Le Sueur, MN)	4.76
Total	100.00
Percent Protein-GRM1 Medium Roast Peanuts (Cargill Peanut, Danvers, GA)	18.50
Grand Total	118.50

[0575] 30 grams of the resulting product is analyzed according to the protocols disclosed in the “Analytical Protocols” Section of this application and the test results indicate that the product comprises: 5.30 grams of an amino acid source; 1.70 grams of digestible fat, of which 0.49 grams are digestible saturated fat; and 2.70 grams of dietary fiber.

EXAMPLE 27

[0576]

COOKIE MIX		
Ingredient	Dry Mix Formula (total grams)	Short- ening Formula (total grams)
Light Brown Sugar (Domino Sugar Corp., New York, N.Y.)	82.50	
All Purpose Flour-w/it wheat (Glaxo Milling Co., Indianapolis, IN)	110.00	
Isolated Soy Protein (Soypro 661, Protein Technologies Int'l., St. Louis, MO)	77.50	
Sub-TVC Fecul (Morton International, Inc., Philadelphia, PA)	2.10	
Vanilla Flavor (Fratelli Foods, Kent, WA)	0.10	
Flavor Flavor (McCormick, Hunt Valley, MD)	8.50	
Sodium Bicarbonate (Clarks & Dwight Co., Princeton, NJ)	2.10	
Phosaid 6 (Lanx Corp., White Bear Lake, MN)	44.50	
Chocolate Chips (Nestle USA, Glendale, CA)	120.50	
Glans 6 (Fischer & Gerdin Co., Cincinnati, OH)		150.00
Vanilla A, D, E, K, Island (Wahon Foods Co., West Haven, CT)	1.05	

[0577] The resulting cookie mix system is analyzed according to the protocols disclosed in the “Analytical Protocols” Section of this application and the Dry Mix Formula is found to contain 18.50% by weight of an amino acid source, 9.25% by weight digestible fat, 5.55% by weight digestible saturated fat and 10.00% by weight dietary fiber. The ratio of shortening to dry mix formula is found to be 0.34:1; and the ratio of digestible fat to non-digestible fat for the cookie mix system is found to be 1:2.47.

Making Procedures

[0578] Mix Pouch Preparation Process:

- [0579] 1. Weigh out and blend all dry ingredients together, except for chocolate chips.
- [0580] 2. Stir in chocolate chips.
- [0581] 3. Seal in air tight moisture controlled pouch.
- [0582] 4. Weigh out the shortening.
- [0583] 5. Seal into an air tight pouch.
- [0584] 6. Place both pouches in a carton.

[0585] Cookie Preparation:

- [0586] 1. Open pouch containing dry ingredients and empty contents into a bowl.
- [0587] 2. Open pouch containing shortening ingredient and empty contents into the bowl.
- [0588] 3. Blend well with a fork.
- [0589] 4. Add 1 egg.
- [0590] 5. Add 2½ tablespoons water.
- [0591] 6. Beat until well mixed with a fork.

- [0592] 7. Spoon dough balls (approximately 20 g) onto a non-stick baking sheet (12 per sheet).
- [0593] 8. Bake for 8-12 minutes at 350° F. (176.7° C.), or until golden brown overall with brown edges and light brown on the bottom.
- [0594] 9. Remove cookies from the baking sheet after about 10 minutes and place on a cooling rack.
- [0595] 40 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 5.40 grams of an amino acid source; 2.30 grams of digestible fat, of which 0.52 grams are digestible saturated fat; and 2.80 grams of dietary fiber.

EXAMPLE 28

[0596]

BROWNIE MIX			
Ingredient	Dry Mix Formula (total grams)	Shortening Formula (total grams)	
Granulated Sugar (Dandies Sugar Corp., New York, N.Y.)	227.70		
All Purpose Flour - soft wheat (Huntar Milling Co., Eastonville, IL.)	135.20		
Isolated Soy Protein (Soypro 661, Protein Technologies Int., St. Louis, MO.)	74.40		
Salt - TFC Purex (Morton International, Inc., Philadelphia, PA.)	5.30		
Vanilla Flavor (McCormick, West Valley, MD.)	1.95		
Sodium Bicarbonate (Clayton & Dwight Co., Princeton, NJ.)	0.11		
Phosaid® (Lear Corp., White Bear Lake, MN.)	52.70		
Crums (Huntar's Food Inc., Huntar, PA.)	51.10		
Wheat Starch Axit (ADM Co., Clinton, IL.)	15.50		
Wheat Gluten (Klebsol 2100, Cargill, Hammond, IN.)	6.20		
Whey Protein Isolate (NIDCO, Davisco Food International, Inc., Le Sueur, MN.)	21.00		
Dextrose (ADM Corn Processing, Decatur, IL.)	6.20		
Cargill Corn TIC Gum, Bolcamp, MD.)	0.65		
Shortening (Crisco®, Procter & Gamble, Cincinnati, OH.)		34.60	
Gluten®		99.80	
Vitamin A, D, E, K, Blend (Waters Foods Co., West Haven, CT.)		0.70	

[0597] The resulting brownie mix system is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the Dry Mix Formula is found to contain 19.50% by weight of an amino acid source, 1.50% by weight digestible fat, 0.90% by weight digestible saturated fat and 8.75% by weight dietary fiber. The ratio of shortening to dry mix formula is found to be 0.23:1; the ratio of digestible fat to non-digestible fat contained in the brownie mix system's shortening packet is found to be 1:2.73 and the ratio of digestible fat to non-digestible fat for the brownie mix system is found to be 1:2.39.

Making Procedures

[0598] Mix Pouch Preparation Process:

- [0599] 1. Weigh out and blend all dry ingredients together.
- [0600] 2. Seal in air tight moisture controlled pouch.
- [0601] 3. Weigh out the shortening and Olean®.
- [0602] 4. Seal into an air tight pouch.
- [0603] 5. Place both pouches in a carton.

[0604] Brownie Preparation:

- [0605] 1. Open pouch containing dry ingredients and empty contents into a bowl.
- [0606] 2. Open pouch containing shortening ingredients and empty contents into the bowl.
- [0607] 3. Stir in 2 eggs, ¼ cup water and ¼ cup oil.
- [0608] 4. Mix with spoon until well blended (about 50 strokes).
- [0609] 5. Spread into greased pan.
- [0610] 6. Bake for 24-27 minutes in a 9x13-inch (23 cmx33 cm) pan at 350° F. (176.7° C.).
- [0611] 7. Cool completely before cutting.

[0612] 40 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 5.40 grams of an amino acid source; 2.30 grams of digestible fat, of which 0 grams are digestible saturated fat; and 2.70 grams of dietary fiber.

EXAMPLE 29

[0613]

Asch Cinnamon Bar	
Ingredient	Formula g/100 g
Salt (Kings, Cincinnati, OH.)	0.55
Granulated Sugar (Dandies Sugar Corp., New York, N.Y.)	8.22
Molasses - Grandma's (Mist's USA, Div. Of Cadbury Beverages Inc., Stamford CT)	0.55
Corn Syrup - Inverest 100 (A. H. Staley Mfg. Co., Decatur, IL.)	10.28
Extended Apple Flavors (Mitsubishi Food Co., Inc., San Jose, CA.)	35.60
Glycerin - Spawel (Procter & Gamble Co., Cincinnati, OH.)	2.74
Soybean Soy Nuggets (Protein Technologies Int., St. Louis, MO.)	13.71
Isolated Soy Protein (Soypro 661, Protein Technologies Int., St. Louis, MO.)	1.19
Sodium Bicarbonate (Clayton & Dwight Co., Princeton, NJ.)	0.82
Egg White Solids (Huntington Foods, Inc., Omaha, NE.)	0.55
Protein Gum (Klebsol 2100, Cargill, Hammond, IN.)	0.82
Emulsifier - Penodon EOE (Dandies A/E, Oronotopos, Denmark)	0.55
Phosaid® (Lear Corp., White Bear Lake, MN.)	7.41
Vanilla Flavor 8928754 (Huntar Fragrances-Flavors, Leifer Bar Loop, France)	0.38
Cinnamon (McCormick, West Valley, MD.)	1.02
Water	13.71

Making Procedure

[0614] Dough Making

- [0615] 1. The water, molasses, glycerine, cane syrup, and Panodan are weighed in a Hobart mixer bowl and mixed, using a Kitchen Aid mixer (Model K45SS) with paddle, for 1 minute on speed #1.
- [0616] 2. Sucrose, dry flavor, fiber, protein, soda, starch, salt, egg white solids, cinnamon, and xanthan gum are weighed into a tared bowl lined with a plastic bag.
- [0617] 3. Ingredients are shaken in the bag to mix the ingredients.
- [0618] 4. The dry ingredients from # 3 are slowly added to the mix in the bowl from #1 above while the mixer is running on the lowest speed (3-5 minutes depending on amount).
- [0619] 5. The Supro Soy Nuggets and extruded apple pieces are weighed, added to the mixture from #4 above and the resulting mixture is mixed for 30 seconds at speed #2.
- [0620] 6. The resulting dough from #5 above is covered and allowed to rest for 15 minutes.

[0621] Baking:

- [0622] 1. The dough from Step #6 above is rolled between two pieces of aluminum foil to a 0.5 inch (1.27 cm) thickness.
- [0623] 2. The sheets are then frozen at minus 40° F. (minus 40° C.) for 10 minutes after which the top foil sheet is immediately peeled off.
- [0624] 3. The sheet is then placed on a baking sheet and baked at 300° F. (148.9° C.) for 12 minutes followed by baking at 250° F. (121° C.) for 22 minutes. The foil is removed from the product within 30 seconds of removing the product from the oven and the product is placed in sealed containers when cool.

[0625] 40 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 5.50 grams of an amino acid source; 0.50 grams of digestible fat, of which 0 grams are digestible saturated fat; and 4.70 grams of dietary fiber.

EXAMPLE 30

[0626]

Caneola white bar with chocolate chips	
Ingredient	Percent g/100 g
Salt (Kroger, Cincinnati, OH)	0.44
Granulated Sugar (Domino Sugar Corp., New York, N.Y.)	6.62
Molasses - Grandma's (Malt's USA, Div. Of Oatway Beverages Inc., Stamford CT)	0.44
Cane Syrup - Inawest 100 (A. E. Staley Mfg. Co., Decatur, IL.)	4.00
Cane Syrup - 42DE (A. E. Staley Mfg. Co., Decatur, IL.)	4.38

-continued-

Caneola white bar with chocolate chips	
Ingredient	Percent g/100 g
Semi-sweet Chocolate Chips (Berry Calumet, St-Alban, VT)	15.13
Glycerine - Supro (Procter & Gamble Co., Cincinnati, OH)	2.21
Supro Soy Nuggets (Protein Technologies Int'l., St. Louis, MO.)	11.04
Oats - 1 Minute (Quaker Oats Co., Chicago, IL.)	0.84
Rollins - Airport Select Thompson Seedless (Black Packing Co. Inc., Del Rio, CA.)	16.43
Heavy Granule - Fisher (John B. Snodgrass & Son, Inc., Elk Grove Village, IL.)	12.23
Instant Soy Protein (Supro © 661, Protein Technologies Int'l., St. Louis, MO.)	5.59
Sodium Bicarbonate (Clumch & Dwight Co., Princeton, NJ)	0.66
Egg White Solids (Hessolagum Foods, Inc., Omaha, NE.)	0.44
Wheat Starch, Atlas (ADM Co., Decatur, IL.)	0.88
Xanthan Gum (Kalsei Nutrasweet, Div. Of Minnesota, St. Louis, MO.)	0.66
Emulsifier - Panodan BDK (Danco ARI, Opaussagen, Denmark)	0.44
Flavorid © (Lunar Corp., White Bear Lake, MN)	1.59
Vanilla Flavor, Nielsen-Menary Vanilla, Inc., Washington, IL.	0.22
Cinnamon (McCormick, Hunt Valley, MD.)	0.82
Water	11.04

Making Procedure

- [0627] The making procedure is the same as that of Example 29, except chocolate chips, granules, and raisins are substituted for apple pieces in Step #5 and oats are applied to surface after baking.
- [0628] 40 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 5.50 grams of an amino acid source; 2.90 grams of digestible fat, of which 1.81 grams are digestible saturated fat; and 2.80 grams of dietary fiber.

EXAMPLE 31

[0629]

Caneola white bar with chocolate chips	
Ingredient	Percent g/100 g
Salt (Kroger, Cincinnati, OH)	0.48
Granulated Sugar (Domino Sugar Corp., New York, N.Y.)	7.24
Molasses - Grandma's (Malt's USA, Div. Of Oatway Beverages Inc., Stamford CT)	0.48
Cane Syrup - Inawest 100 (A. E. Staley Mfg. Co., Decatur, IL.)	3.61
Cane Syrup - 42DE (A. E. Staley Mfg. Co., Decatur, IL.)	4.38
Glycerine - Supro (Procter & Gamble Co., Cincinnati, OH)	2.41
Supro Soy Nuggets (Protein Technologies Int'l., St. Louis, MO.)	12.26
Rollins - Airport Select Thompson Seedless (Black Packing Co. Inc., Del Rio, CA.)	18.20
Heavy Granule - Fisher (John B. Snodgrass & Son, Inc., Elk Grove Village, IL.)	13.96
Instant Soy Protein (Supro © 661, Protein Technologies Int'l., St. Louis, MO.)	6.13
Sodium Bicarbonate (Clumch & Dwight Co., Princeton, NJ)	0.72
Yogurt Coating (Hessolagum Foods, Inc., New Caney, TX)	10.00

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Sample Recipe For Protein Treated Yogurt System	
Ingredient	Amount g/100 g
Xanthan Gum (Kalsei Nutrasweet, Div. Of Minnesota, St. Louis, MO.)	0.56
Emulsifier - Puritan 80K (Danisco A/S, Copenhagen, Denmark)	0.48
Fibersol® (Lanx Corp., White Bear Lake, MN.)	6.13
Vanilla Flavor, Nielsen-Massey Vanilla, Inc., Washington, IL.	0.24
Cinnamon (McCormick, Hunt Valley, MD.)	0.82
Water	12.2

Making Procedure

[0630] The making procedure is the same as that of Example 29, except chocolate chips, granola, and raisins are substituted for apple pieces in Step #5 and yogurt coating is applied to surface after baking.

[0631] 40 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 5.60 grams of an amino acid source; 2.90 grams of digestible fat, of which 0 grams are digestible saturated fat; and 2.80 grams of dietary fiber.

EXAMPLE 32

[0632]

Recipe	
Ingredient	Amount g/100 g
Salt (Kings, Cincinnati, OH.)	0.51
Granulated Sugar (Domino Sugar Corp., New York, N.Y.)	7.53
Milkmaid - Canadian's (Milk's) USA, Div. Of Cadbury Beverages Inc., Stamford CT)	0.51
Corn Syrup - Inherent 100 (A. H. Bailey Mfg. Co., Dundas, IL.)	9.5
Semi-sweet Chocolate Chips (Bury Chocolate, St-Albans, VT.)	14.93
Glycerin - Suprad (Procter & Gamble Co., Cincinnati, OH.)	2.54
Supro Soy Nuggets (Protein Technologies Int'l., St. Louis, MO.)	21.26
Cocoa - Hershey's (Hershey Foods Corp., Hershey, PA.)	8.47
Chocolate Flavor 462977 (Givaudan Flavors Corp., Cincinnati, OH.)	0.64
Isolated Soy Protein (Supro® 661, Protein Technologies Int'l., St. Louis, MO.)	1.88
Sodium Hexametate (Church & Dwight Co., Princeton, NJ.)	0.76
Egg White Stabilizer (Hewitt-Packard Foods, Inc., Omaha, NE.)	0.75
Xanthan Gum (Kalsei Nutrasweet, Div. Of Minnesota, St. Louis, MO.)	0.75
Emulsifier - Puritan 80K (Danisco A/S, Copenhagen, Denmark)	0.51
Fibersol® (Lanx Corp., White Bear Lake, MN.)	7.71
Vanilla Flavor, Nielsen-Massey Vanilla, Inc., Washington, IL.	0.45
Vanilla Flavouring - Betty Crocker (General Mills Sales, Inc., Minneapolis, MN.)	4.60
Water	12.7

Making Procedure

[0633] The making procedure is the same as that of Example 29, except chocolate chips are substituted for apple pieces in Step #5, the Supro Soy Nuggets are ground to a powder before addition, and cocoa is added to dry ingredients in Step #2.

[0634] 40 grams of the resulting product is analyzed according to the protocols disclosed in the "Analytical Protocols" Section of this application and the test results indicate that the product comprises: 6.20 grams of an amino acid source; 2.60 grams of digestible fat, of which 1.27 grams are digestible saturated fat; and 3.00 grams of dietary fiber.

What is claimed:

1. A nutritionally balanced, traditional snack food having a water activity of less than 0.90; and comprising, on a 30 gram basis:

- a.) at least 5 grams of an amino acid source;
- b.) less than 3 grams of a digestible fat; and
- c.) a carbohydrate that provides at least about 2.5 grams of dietary fiber.

2. The traditional snack food of claim 1 having a water activity of less than 0.85 and comprising an adjunct ingredient.

3. The traditional snack food of claim 1 comprising from 5 grams to 10 grams of an amino acid source and from about 2.5 grams to about 5.0 grams of dietary fiber.

4. The traditional snack food of claim 1 wherein said amino acid and fiber sources are at least 75% active; and said fiber is selected from the group consisting of soluble fiber having a viscosity of from 1 to 2 centipoise for a 10% solution at 25° C., insoluble fiber having a particle size of less than 150 microns and a water absorption of less than 7.0 grams per gram of fiber, and mixtures thereof.

5. The traditional snack food of claim 1 having an amino acid score from 0.60 to 1.00.

6. The traditional snack food of claim 1 comprising less than 2 grams of digestible saturated fat.

7. The traditional snack food of claim 6 comprising less than ½ of a gram of digestible saturated fat.

8. The traditional snack food of claim 1 further comprising a material selected from the group consisting of non-digestible lipids, partially digestible lipids, and mixtures thereof.

9. The traditional snack food of claim 1 wherein said food is a filled cracker, cracker, snack crisp, or potato crisp.

10. The traditional snack food of claim 1 comprising a material selected from the group consisting of arabinoxylan fiber, beta-glucan soluble fiber, and mixtures thereof.

11. The traditional snack food of claim 1 comprising fluorine; sodium; potassium; and from about 10% to about 100% of the U.S. RDI of the vitamins A, D, E, K, C, thiamin, riboflavin, niacin, vitamin B₆, folate, vitamin B₁₂, biotin, and pantothenic acid and from about 10% to about 100% of the U.S. RDI of the minerals calcium, phosphorus, magnesium, iron, zinc, iodine, selenium, copper, manganese, chromium, molybdenum, and chloride.

12. A nutritionally balanced, traditional snack food having a water activity of less than 0.90; and comprising, on a 40 gram basis:

- a.) at least 5 grams of an amino acid source;
- b.) less than 3 grams of a digestible fat; and
- c.) a carbohydrate that provides at least about 2.5 grams of dietary fiber.

13. The traditional snack food of claim 12 having a water activity of less than 0.85 and comprising an adjunct ingredient.

14. The traditional snack food of claim 12 comprising from 5 grams to 13 grams of an amino acid source and from about 2.5 grams to about 6.5 grams of dietary fiber.
15. The traditional snack food of claim 12 wherein said amino acid and fiber sources are at least 75% active; and said fiber is selected from the group consisting of soluble fiber having a viscosity of from 1 to 2 centipoise for a 10% solution at 25° C., insoluble fiber having a particle size of less than 150 microns and a water absorption of less than 7.0 grams per gram of fiber, and mixtures thereof.
16. The traditional snack food of claim 12 having an amino acid score from 0.60 to 1.00.
17. The traditional snack food of claim 12 comprising less than 2 grams of digestible saturated fat.
18. The traditional snack food of claim 17 comprising less than ½ of a gram of digestible saturated fat.
19. The traditional snack food of claim 12 comprising a non-digestible or partially digestible lipid.
20. The traditional snack food of claim 12 wherein said food is a filled cracker, cracker, spread, cookie, snack crisp, brownie or potato crisp.
21. The traditional snack food of claim 12 comprising a material selected from the group consisting of arabinogalactan fiber, beta-glucan soluble fiber, and mixtures thereof.
22. The traditional snack food of claim 12 comprising fluoride; sodium; potassium; and, on a 30 gram basis, from about 10% to about 100% of the U.S. RDI of the vitamins A, D, E, K, C, thiamin, riboflavin, niacin, vitamin B₆, folate, vitamin B₁₂, biotin, and pantothenic acid and from about 10% to about 100% of the U.S. RDI of the minerals calcium, phosphorus, magnesium, iron, zinc, iodine, selenium, copper, manganese, chromium, molybdenum, and chloride.
23. A mix system for producing the nutritionally balanced, traditional snack food of claim 12 said mix system comprising a mix that comprises:
- a.) at least about 18.5% amino acid source;
 - b.) no more than about 5.5% digestible fat; and
 - c.) a carbohydrate that provides at least about 8.7% dietary fiber.

24. The mix system of claim 23 wherein said amino acid and fiber sources of said mix are at least 75% active; and said fiber is selected from the group consisting of soluble fiber having a viscosity of from 1 to 2 centipoise for a 10% solution at 25° C., insoluble fiber having a particle size of less than 150 microns and a water absorption of less than 7.0 grams per gram of fiber, and mixtures thereof.
25. The mix system of claim 23 wherein said mix comprises no more than about 5.5% digestible saturated fat.
26. The mix system of claim 25 wherein said mix comprises no more than about 0.9% digestible saturated fat.
27. The mix system of claim 23 wherein said mix comprises a material selected from the group consisting of non-digestible lipids, partially digestible lipids, and mixtures thereof.
28. The mix system of claim 23 wherein said mix comprises a material selected from the group consisting of arabinogalactan fiber, beta-glucan soluble fiber, and mixtures thereof.
29. The mix system of claim 23 wherein said mix comprises fluoride; sodium; potassium; and a sufficient amount of vitamins and minerals to provide the finished traditional snack food with, on a 30 gram basis, from about 10% to about 100% of the U.S. RDI of the vitamins A, D, E, K, C, thiamin, riboflavin, niacin, vitamin B₆, folate, vitamin B₁₂, biotin, and pantothenic acid and from about 10% to about 100% of the U.S. RDI of the minerals calcium, phosphorus, magnesium, iron, zinc, iodine, selenium, copper, manganese, chromium, molybdenum, and chloride.
30. The mix system of claim 23 comprising a separately packaged shortening that comprises a material selected from the group consisting of non-digestible lipids, partially digestible lipids, and mixtures thereof; and said mix system having a ratio of separately packaged shortening to mix of less than about 0.34:1.
31. The mix system of claim 30 having a ratio of digestible fat to total non-digestible lipids, partially digestible lipids, and mixtures thereof; of no more than about 1:2.5.

* * * * *



US006210720B1

(12) **United States Patent**
Leusner et al.

(10) Patent No.: **US 6,210,720 B1**
(45) Date of Patent: **Apr. 3, 2001**

(54) **CALCIUM FORTIFIED CEREAL PRODUCT AND METHOD OF PREPARATION**

(75) Inventor: **Steven J Leusner, Orono; Dawn W Creighton, Brooklyn Park, both of MN (US)**

(73) Assignee: **General Mills, Inc., Minneapolis, MN (US)**

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/401,287**

(22) Filed: **Sep. 22, 1999**

(51) Int. Cl.⁷ **A23L 1/304**

(52) U.S. Cl. **426/74; 426/271; 426/619; 426/620; 426/621**

(58) Field of Search **426/74, 619, 620, 426/621, 271**

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Primary Examiner—Helen Pratt

(74) *Attorney, Agent, or Firm*—John A. O'Toole; Douglas J. Taylor; Everett G. Diederichs

(57) **ABSTRACT**

Lightly cooked cereal dough products are provided that are fortified with at least a 0.3% calcium at least a portion of which is supplied by CaCO₃, exhibiting reduced discoloration such as RTE cereals and grain based snacks. The dried cereal finished products are fabricated from cooked cereal doughs that can comprise rice and/or corn and minor levels of other conventional cereal ingredients and calcium carbonate. The cooked cereal doughs additionally contain effective amounts of calcium sequestrants. Methods for preparing such calcium fortified cooked cereal compositions and dried cereal finished food products are: A. providing a lightly colored calcium fortified cooked cereal dough or mass containing at least 0.3% calcium (dry weight basis) at least a portion of which is supplied by calcium carbonate and sequestrants; B. forming the lightly colored calcium fortified cereal dough into pieces; and, C. drying the pieces to form the present rice based finished food products fortified with high levels of calcium.

38 Claims, No Drawings

CALCIUM FORTIFIED CEREAL PRODUCT AND METHOD OF PREPARATION

FIELD OF THE INVENTION

The present invention is directed generally to food products and to their methods of preparation. In particular, the present invention is directed to improved Ready-To-Eat cereal products fortified with a nutritionally fortifying ingredient such as calcium and to processes for making such improved fortified cereal products.

BACKGROUND

Ready-To-Eat ("RTE") breakfast cereals have long been fortified with various vitamins and minerals. Health and nutrition interests have recently focused upon increasing the calcium content of foods and in RTE cereals in particular. The present invention provides improvement in the mineral fortification of cooked cereal products such as Ready-To-Eat cereals. More specifically, the present invention provides improvements in providing lightly colored RTE cereals fortified such as rice and/or corn based with high levels of calcium that are not discolored.

For adults, recent medical studies have indicated that a diet containing the U.S. recommended daily allowance (RDA) of calcium might be effective in preventing or mitigating osteoporosis, and also possibly high blood pressure and colon cancer. Calcium is also of particular nutritional value in growing children to support bone growth. There is therefore great public interest in the consumption of food products that will supply the recommended daily allowance of calcium.

In view of the desire for introducing more calcium into diets, especially children's diets, it would be desirable if such RTE cereal products were fortified with supplemental calcium to provide a significantly nutritionally enhanced product. By significantly nutritionally enhanced is meant a product having at least 10% of the current recommended daily allowance ("RDA") or at least 100 mg of calcium per serving (typically 25 to 35 g of product) of RTE cereal.

Calcium can be added in limited amounts to RTE cereal products. However, at higher levels of calcium fortification, the presence of such high amounts of calcium can adversely interfere with other desired characteristics. For example, high levels of added calcium materials could negatively affect the taste, texture and density of the RTE cereal products. More importantly, for lightly colored cereals such as those that are rice and/or corn (maize) based, calcium fortification can result in development of off-colors.

RTE cereal products fabricated from rice and/or corn based cooked cereal doughs such as Rice ChexTM, Corn ChexTM, or Honey Nut ChexTM, (a rice and corn based RTE cereal) are very popular. Such rice and/or corn base products are popular in part due to their light coloration and light airy texture. The combination of their rice and/or corn flavor as well as their light color and texture are particularly pleasing. A good description of techniques for forming such RTE cereal products is given in U.S. Pat. No. 2,600,532 entitled "Method for Manufacture of Cereal Food Products" (issued Jun. 17, 1952 to D. Hale et al.) and U.S. Pat. No. 2,743,685 entitled "Apparatus for Manufacturing a Cereal Food Product" (issued May 1, 1956 to D. Hale et al.) each of which is incorporated herein by reference.

In view of the current interest in providing RTE cereals having high levels of calcium fortification, it would thus be desirable to provide RTE cereal products fabricated from

rice and/or corn based cooked cereal doughs fortified with supplemental calcium to provide a significantly nutritionally enhanced product. Calcium carbonate at 40% dry weight calcium is potentially a good ingredient to employ to provide desired calcium fortification. Unfortunately, however, RTE cereal products fabricated from lightly colored cereal doughs such as but not limited to rice and/or corn based cooked cereal doughs fortified with high levels of calcium supplied by calcium carbonate can develop an undesirable green or grey discoloration.

One technique for addressing this discoloration is to add coloring agents or other colored ingredients to mask or darken the cereal. However, it would be desirable to provide RTE cereal products that exhibit the familiar and desirable light color which nonetheless possess high levels of calcium fortification. Another technique to provide RTE cereal products that are naturally darker such as those that are wheat based. The dark brown color of the wheat-based products naturally masks any discoloration that can occur.

It would thus be desirable to be able to calcium fortify RTE cereal products fabricated from lightly colored cooked cereal doughs to provide high levels of calcium fortification while minimizing discoloration and maintaining a light coloration.

The present invention is directed towards the provision of improved R-T-E cereal products fortified with high calcium levels of superior appearance and reduced discoloration. The present invention resides in part in the additionally including particular levels of sequestrants into a lightly colored cooked cereal dough formulation, cooking the calcium and sequestrant containing cereal ingredients to form cooked cereal doughs of reduced discoloration and forming such cooked cereal doughs into finished RTE cereal products.

The present invention further resides in part in the selection of calcium material of particular type and size to provide the desired calcium fortification.

SUMMARY OF THE INVENTION

In its product aspect, the present invention provides light cooked cereal compositions such as cooked cereal doughs fortified with at least a 0.3% calcium at least a portion of which is supplied by CaCO_3 that exhibit reduced discoloration and further provides dried finished cereal food products fabricated therefrom such as RTE cereals and grain based snacks.

The dried cereal finished products are fabricated from lightly colored cooked cereal doughs that can comprise rice and/or corn and minor levels of other conventional cereal ingredients and at least 0.3% calcium (dry weight basis) cereal supplied in part by calcium carbonate. The cooked cereal doughs additionally essentially comprise effective amounts of calcium sequestrants. Notwithstanding high concentrations of the calcium, the finished fortified cereal products are not only organoleptically desirable but also almost indistinguishable from their unfortified counterparts especially in terms of color appearance.

In its method aspect, the present invention resides in methods for preparing such calcium fortified cooked cereal compositions and dried cereal finished food products.

In the preferred embodiment, the methods of providing finished products essentially comprise the steps of:

- A. Providing a lightly colored calcium fortified cooked cereal dough or mass containing at least 0.3% calcium (dry weight basis) at least a portion of which is supplied by calcium carbonate and sequestrants;

- B. Forming the lightly colored calcium fortified cereal dough into pieces; and,
- C. Drying the pieces to form the present rice based finished food products fortified with high levels of calcium.

DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to cooked cereal doughs containing defined levels calcium at least partially provided by calcium carbonate, to finished dried cooked cereal dough based products prepared therefrom such as RTE cereals, and to methods for the preparation of the doughs and finished products. Each of these product constituents, as well as methods for their preparation and use are described in detail below.

Throughout the specification and claims, percentages are by weight and temperatures in degrees Fahrenheit, unless otherwise indicated.

The present invention is particularly suitable for providing calcium fortified lightly colored cooked cereal dough of equivalent color to doughs not fortified with the levels of calcium herein. Cooked cereal doughs can be simply characterized as "light" or "dark" on the familiar Hunter color scale wherein pure white has a value of 100 and pure black has a value of zero. A rice-based RTE cereal typically will have a color value of between about 55 to 63 depending in part upon the degree of toasting. A corn-based cereal can have a Hunter color value ranging from about 55 to 60. A 50:50 rice and corn blend RTE cereal can have an intermediate value. By "lightly colored" cooked cereal dough or finished product herein is meant a product having a color value ranging above 51, or more practically, about 60 to 90 on the Hunter color scale. In contrast, a darker cooked cereal dough such as prepared from whole red wheat can have a Hunter color value of about 40 to 50.

Useful herein to measure the color of an cereal product is a spectrophotometer such as a LabScan XE spectrophotometer manufactured by HunterLab, 11491 Sunset Hills Road, Reston, Va. U.S.A. 22090. The spectrophotometer measures color on an L, a, and b axis. The L axis measures the light to dark on a scale of 0-100, 0 being the darkest and 100 the lightest. The a and b axes measure the color hue. The measurement procedure is the manufacturer's recommended procedure.

In one preferred embodiment of providing lightly colored cooked cereal doughs and finished products therefrom, the principle essential component of the present cereal compositions is rice and/or corn. The rice component can be provided from whole grain rice or brown rice, or, preferably from white or polished rice. The rice component can be provided by whole rice pieces such as whole white rice, cut rice grain pieces, rice flour or other rice ingredients, e.g., blends of variously sized rice components. The rice component can also include blends of white rice, e.g., rice flour, and rice bran, if desired. The corn (maize) component can be similarly provided by whole grain, corn, corn grits, corn cobs, corn flours, and mixtures thereof. When corn is the sole or principal grain ingredient, masa corn (i.e. alkaline treated) can be selected to provide its distinctive flavor. In preferred embodiments, the rice and/or corn ingredient(s) comprise about 40 to 97% (dry weight basis) of the cooked cereal dough. In more preferred embodiments, the rice and/or corn ingredients comprise about 75 to 95% (dry weight basis) of the cooked cereal dough. For best results the rice and/or corn ingredients comprise about 80 to 95% of the present cereal products.

In still other variations, the present lightly colored cooked cereal doughs can comprise white wheat, especially those white hard wheat varieties that have recently become more widely available such as, but not limited to, from the species *Triticum aestivum*. In such wheat containing products preferably the wheat content ranges from about 1 to 30 with the balance of the cereal ingredients being supplied by the lightly colored rice and/or corn.

In still other variations, the lightly colored cooked cereal dough can comprise those bleached wheat grains and grain products such as whole flours that are described in copending commonly assigned U.S. Ser. No. 09/392,699 filed Sep. 9, 1999 by Lloyd Metzger entitled "Bleached Grain and Grain Products and Methods of Preparation" which is incorporated herein by reference. In that application, cereal grains such as whole grain wheat kernels (whether hard or soft, red or white and especially hard white) are bleached with hydrogen peroxide to bleach or whiten the bran layer. Bleached whole grain kernels and milled grain products such as whole flours are provided having the white color and bland flavor of conventional white or patent flour.

In other less preferred embodiments, the principal rice and/or corn ingredient is partially substituted or blended with other or supplemental starchy cereal components. The supplemental starchy cereal component can optionally further comprise any conventionally employed starchy cereal or, synonymously, farinaceous material, for use in a ready-to-eat cereal. Exemplary suitable starchy cereals include cereal grains, cut grains, grits or flours from wheat, corn, oats, barley, rye, triticale or other cereal grains and mixtures thereof. The flours can be whole flours or, preferably flour fractions such as with the germ fraction or bran fraction removed. Of course, the R-T-E cereal art is well developed and the skilled artisan will have no difficulty selecting suitable farinaceous materials for use herein.

Care however, must be taken to insure that the selection of type and amount of cereal components is made so as to provide a lightly colored cooked cereal dough. In certain embodiments, the rice and/or corn ingredient comprises at least 50% of the cooked cereal dough (dry weight basis). In less preferred embodiments having higher levels of supplemental cereal ingredients, the rice ingredient is present in the cooked cereal dough at levels ranging from about 10% to less than 50% (dry weight basis).

Calcium The present cooked cereal doughs and finished food products fabricated therefrom further essentially comprise a calcium ingredient to provide the desired calcium enrichment wherein at least a portion of the calcium is supplied by calcium carbonate $CaCO_3$.

Good results are obtained when the products comprise sufficient amounts of calcium ingredients to provide the total calcium content (including both native calcium associated with ingredients, with water, and added calcium) of the composition to provide at least 10% of the current recommended daily requirement of calcium per serving. Generally, the cooked cereal dough compositions comprise at least about 100 mg per 33 g serving (dry basis) (i.e., about 0.3% by weight, dry basis) of calcium, preferably about 0.30% to 1% (by weight, dry basis), and more preferably about 0.5% to 1% calcium.

Higher calcium concentrations in the cooked cereal dough are desired when sugar coated RTE cereal pieces are provided. Sugar coating generally comprises about 20% to 35% of the finished product. Thus, to provide the desired levels of calcium (e.g., 0.3%) in the finished product, e.g., a sugar coated RTE cereal, the concentration of calcium in the base piece, must be higher to compensate for the sugar coating.

At least a portion of the calcium level is essentially supplied by calcium carbonate CaCO_3 . Calcium carbonate comprises about 40% calcium. While expensive, food grade calcium carbonate obtained by chemical reaction processes is desirable due to low levels of impurities, a good, inexpensive source of calcium carbonate from natural sources is ground limestone. Care should be exercised in selecting sources of ground limestone that are low in trace metals, especially such heavy metals such as lead. In particular, it is desirable that the ground limestone has trace metal concentrations of less than 10 PPM. Useful levels of calcium carbonate range from about 0.75% to 15% in the finished product. Such calcium material levels insure that the calcium content in the finished product ranges from about 100 mg per serving.

If desired, the cooked cereal doughs and finished products prepared therefrom can further comprise supplemental calcium fortification from other less desirable insoluble calcium ingredients. Useful herein to supply the supplemental calcium levels are calcium ingredients that provide at least 20% of their weight of calcium. Useful herein to provide the supplemental calcium fortifications above that provided by CaCO_3 are insoluble mineral calcium salts, particularly calcium phosphate salts. Such calcium phosphate salts provide high levels of calcium and are relatively inexpensive. Moreover, such calcium phosphate salts can be used to provide calcium at high fortification levels with an acceptable taste. Calcium phosphate is generally available as a monobasic ($\text{CaH}_2(\text{PO}_4)_2 \cdot \text{H}_2\text{O}$), dibasic ($\text{CaHPO}_4 \cdot 2\text{H}_2\text{O}$) or tribasic ($\text{Ca}_3(\text{PO}_4)_2$) salts. Preferred for use herein is tricalcium phosphate, $\text{Ca}_3(\text{PO}_4)_2$ ("TCP") because of its high weight percentage of calcium (about 38%).

A useful tricalcium phosphate starting material is also known as tribasic calcium phosphate or tricalcium orthophosphate and is available in food chemicals codex grade from Monsanto or Rhone Poulenc, having the general formula $3\text{Ca}_3(\text{PO}_4)_2 \cdot \text{Ca}(\text{OH})_2$. This product provides assayed calcium content of from 34 to 40% by weight. Less preferred but nonetheless useful herein is anhydrous dicalcium phosphate, also known as anhydrous dibasic calcium phosphate, having a formula of CaHPO_4 . An anhydrous dicalcium phosphate material is also available from Stauffer in food chemical codex grade, providing an assay calcium content from about 30 to about 31.7% calcium by weight. Other calcium phosphate hydrates also can be useful, including, but not limited to, calcium pyrophosphate, calcium hexametaphosphate and monobasic calcium phosphate.

The skilled artisan will appreciate that while CaCO_3 and these calcium phosphate salts are characterized herein as insoluble, of course, some small percentage will dissolve in water depending in part upon the temperature and pH.

Soluble calcium salts typically are expensive and contain low weight percentages of calcium. While calcium chloride is an exception to this generalization, addition of significant calcium levels supplied by calcium chloride imparts an unacceptable bitter flavor to cooked cereal dough. In addition, by adding sufficient amounts of many of these soluble calcium salts to achieve the desired fortification level, the finished product may exhibit an undesirably dry texture and gritty mouth feel. Thus, in highly preferred embodiments, the present food products are essentially free (i.e., less than 0.1%) of added soluble calcium salts.

The insoluble calcium ingredient regardless of source or type is further preferably characterized by a particularly fine particle size. Such a fine or flour form of the calcium

ingredient provides a particle size such that the average particle size is less than 25 μm . Selection of such a fine particle size allows for inclusion of the particulate material without imparting an undesirable gritty mouthfeel.

Even more preferred for use herein are calcium ingredients having a mean particle of less than 15 μm and for best results less than 10 μm . A good material, for example, is ground limestone of high purity having an average particle size of 3.8 μm available from Finco-Stauffer (California), Inc. (Lucerne Valley, Calif.).

Sequestrant

It has been unfortunately found that fortification of lightly colored cooked cereal doughs with calcium carbonate at the levels of calcium fortification herein can undesirably result in the development of an off color in the cooked cereal dough. Depending in part upon the particular grain ingredients the off color can be green or grey in color. While not wishing to be bound by the proposed theory, it is speculated herein that the calcium carbonate partially dissolves in the hydrated cereal ingredients during the cooking step. It is further speculated that upon dissolution, divalent calcium ions react with a phytic acid constituent in grains leading to development of the off color.

The present cooked cereal doughs and finished food products fabricated therefrom further essentially comprise effective amounts of a calcium sequestrant to prevent discoloration of the lightly colored cooked cereal doughs. Addition of the sequestrant herein binds up the dissolved calcium ions preventing reaction with the phytic acid.

Suitable materials for use herein as the calcium sequestrants useful herein include phosphate salts such as sodium hexametaphosphate ("SHMP"), trisodium phosphate, disodium phosphate, tetrasodium pyrophosphate, polyphosphates; edible organic acids such as ascorbate, citric, maleic, malic, tartaric, succinic, oxalic, cistic, fumaric; ethylenediaminetetraacetate ("EDTA"), and mixtures thereof.

SHMP is the preferred calcium sequestrant primarily because SHMP can bind up to six Ca^{++} ions and thus is much more effective on a weight basis than the useful organic acid sequestrants. Thus, in preferred form at least a portion of the sequestrant is supplied by SHMP. Especially preferred for use as the sequestrant is a mixture of sodium ascorbate and sodium hexametaphosphate ("SHMP") in a 1 to 5:1 weight ratio.

The organic acids can be added in pure form or, preferably as their water-soluble salts, e.g. sodium citrate.

Good results are obtained when the sequestrant(s) ranges for example, about 0.005% to 0.05%, preferably about 0.025% to 0.05% (dry weight basis).

The problem of discoloration is evident when CaCO_3 is used to provide calcium mineral fortification, but surprisingly, not with the calcium phosphate salts described above. Again while not wishing to be bound by the proposed theory, it is speculated that these materials have enough ionic phosphorous when partially dissolved to complex with any divalent calcium ions sufficiently to prevent significant discoloration in the grain based cooked cereal dough. Thus, in a less preferred embodiment wherein the lightly colored calcium fortified cooked cereal doughs are free of CaCO_3 , sequestrant addition can also be and preferably is avoided.

Moisture

The present cooked cereal dough food products herein range in moisture broadly from about 1 to 35% moisture. The amount of moisture depends, in part, upon the particular cereal ingredients, dished intermediates or finished products, cooking equipment and drying techniques employed.

The cooked cereal dough products generally has a moisture content of about 22% to 35% moisture, preferably about 26% to 29%. Cereal pellets and/or half products generally range in moisture from about 10% to 18% moisture. Half products that are shipped to separate locations for further processing into finished products such as fried snacks preferably range from about 10% to 14% moisture to provide shelf stable products. Pellets used in RTE cereal plants that are typically further processed in short order and thus that do not require shelf stability can range from about 10% to 18% moisture. Finished dried RTE cereals can have moisture contents of about 2% to 5% while fried snack products can be 1% to 3% moisture.

Within this broad moisture range, particular preferred moisture ranges can be selected in important part upon the particular cooking technique and equipment selected. For extruder cookers, e.g., twin screw extruders, the preferred moisture content ranges from about 22 to 28%. When batch pressure cookers are employed such as is described in the '532 and/or '685 patents the moisture content is generally higher and ranged from about 26 to 30%, and most preferably about 26-28%.

Supplemental Ingredients

In more preferred embodiments, if desired, the present cereal dough composition can additionally include a variety of materials designed to improve the aesthetic, organoleptic or nutritional qualities of the cereal. These adjunct materials can include vitamin and/or mineral fortification, colors, flavors, high potency sweetener(s), and mixtures thereof. The precise ingredient concentration in the present cereal composition will vary in known manner. Generally, however, such materials can each comprise about 0.01% to about 2% dry weight of the cereal composition.

One especially useful material is common salt. Desirably, the salt comprises about 0.1 to 4%, preferably about 0.5 to 3.0% of the cereal composition.

The present cooked cereal dough products can optionally additionally comprise minor amounts such as 1% to 30%, preferably about 1% to 12%, of one or more supplemental starchy cereal components. The starchy cereal component can comprise any conventionally employed starchy cereal or, synonymously, farinaceous material, for use in a ready-to-eat cereal. Exemplary suitable starchy cereals include cereal grains, cut grains, grits or flours from wheat, rice, corn, oats, barley, rye, triticale or other cereal grains and mixtures thereof. The flours can be whole flours or flour fractions such as with the germ fraction or bran fraction removed or, alternatively, brans. For those embodiments to be fabricated into puffed cereal pieces the supplemental ingredient can for example comprise pure starches or pure modified starches to assist in providing desired puff volumes. Of course, the R-T-E cereal art is well developed and the skilled artisan will have no difficulty selecting suitable farinaceous and/or starchy materials (e.g., potato starch) for use herein.

If desired, the present cooked cereal dough food products can additionally comprise about 0.1% to about 20% (dry weight), preferably about 1% to 10%, and most preferably about 5% to 10% by weight sugar(s) or, synonymously herein, nutritive carbohydrate sweetening agents. Such materials are also well known in the R-T-E cereal art. Useful herein as the sugar component is sucrose. However, the sugar(s) component can additionally comprise conventional fructose, maltose, dextrose, honey, fruit juice solids, brown sugar, and the like. In addition to providing desirable sweetness, the sugar component additionally beneficially

affects the cereal color and texture. Better results are obtained, especially for R-T-E cereal products, when the sugar(s) component comprises from about 1% to about 10% by weight of the composition.

In a preferred embodiment for ready-to-eat cereals, the present cereal compositions are further essentially defined in part by low fat levels, i.e., the present cereals do not comprise added or absorbed fat. Thus, the total fat or lipid component is quite low. The fat content results from the native fat associated with the starchy cereal component(s). Permissible low fat additions can also result from adding emulsifiers and from vitamin or flavor addition. However, the total fat content of the cereal compositions should be less than about 3%, preferably less than about 2%. Preferably, the R-T-E cereal is substantially free of any fat or oil incorporated into the cooked cereal dough. Such "added fat" is to be distinguished from "absorbed fat" that is picked up during deep fat frying used to prepare finished snack products herein.

It is also desirable to vitamin fortify the present R-T-E cereals, especially selected B vitamins, e.g., riboflavin. Conventional methods and techniques of vitamin fortification can be used herein. Due in part to their heat sensitivity, vitamin fortification is typically practiced by topical application to the R-T-E cereal and such a technique is preferred herein. More heat tolerant vitamins can be added to the other cereal ingredients that form the cooked cereal dough.

Method of Preparation

In the preferred embodiment, the present methods essentially comprise a first step of providing a light colored cooked cereal composition such as a cereal dough or cereal mass containing calcium and sequestrant each within the herein their respective specified ranges.

Cooked cereal dough can be prepared by blending various dry cereal ingredients together with water and cooking to gelatinize the starchy components and to develop a cooked flavor. Preferably, a preblend of wet ingredients is made and combined with a preblend of the dry ingredients. The cooked cereal material or mass can also be mechanically worked to form cooked cereal dough. The cooking and mechanical work can occur simultaneously or sequentially. The dry ingredients can also include various cooked cereal dough additives such as sugar(s), salt and mineral salts, and starches. In addition to water, various liquid ingredients such as corn (maize) or malt syrups can be added. A cooked cereal mass is quite similar to cooked cereal dough except that larger sized particles such as whole grains or cut grains are cooked rather than cereal flour ingredients.

The calcium carbonate and the sequestrant(s) can be added in whole or in part to either the dry or wet blend. Surprisingly, in a preferred variation add calcium carbonate and sequestrant at each added at least in part, and preferably entirely to the wet ingredients to insure that the sequestrant is more intimately admixed with the calcium.

Moreover, while the invention finds particular suitability for use in connection with the provision of R-T-E cereals fabricated from calcium fortified cooked cereal doughs, the skilled artisan will appreciate that the present calcium fortified cooked cereal doughs can find applicability for use in connection with other grain based food products such as grain based snack products. For example, the calcium fortified cooked cereal doughs can be formed into suitably sized, shaped and partially dried pellets or half products. These half products are useful intermediate products. Finished grain based snack products are usually provided by the deep fat frying or other puffing of the pellets (e.g., hot air or

microwave heating) of partially dried half products fabricated from cooked cereal doughs. An advantage of half products is that they can be produced in bulk in one location and thereafter fried in one or more finish operations to form the finished snack products. Not only are shipping costs reduced due to the reduced volume of the half products compared to the finished products but also breakage of the finished product is reduced. Also, the present invention can be used to provide pretzel snack products fortified with calcium.

The cereal dough cooking step can be practiced using a batch, atmospheric cooker and a low pressure extruder cooker especially those equipped with a conditioner precooler, or a twin screw extruder. The cereal is cooked with steam and sufficient amounts of added water for times and at temperatures sufficient to gelatinize the cereal starch and to develop desired levels of cooked cereal flavor.

Forming into Desirably Shaped and Sized Pieces

The present methods further essentially comprise the step of forming the cooked cereal dough or mass into individual pieces of desirable shape and size. Conventional techniques and equipment can be employed to practice this step and the skilled artisan will have no difficulty in selecting those suitable for use herein.

For example, the dough having a moisture content of about 25% to 30% is first partially dried to a partially dried dough having a moisture content of about 12% to 20%. The partially dried dough can then be fed to piece forming apparatus that form the partially dried dough into individually shaped and sized pieces.

The present cereal compositions can be fabricated into any of a variety of common R-T-E cereal or snack forms including, shreds, biscuits, flakes, rings, or any common R-T-E cereal or cereal based snack product form, shape or size. The present cereal compositions can also be formulated and fabricated so as to provide puffed cereals of various shapes and sizes such as "biscuits". Especially desirable for use herein are biscuits, especially toasted biscuits. Especially for flakes, the forming step can first involve a substep of shaping the dough into pellets and then a final substep of shaping the pellets into a final desired shape such as flakes.

For example, the cooked cereal dough can be fed to a pellet former to form pellets. In the preparation of R-T-E cereals in flake form, the pellets can be sized to have a pellet count of about 35 to 50 per 10 g and a moisture content of 16 to 20%. In the preparation of a flaked R-T-E cereal, the pellets can be partially dried to moisture contents of about 18 to 20%. The pellets can then be formed into "wet" flakes having a thickness of about 380 to 635 μm (0.015 to 0.025 inch), preferably while warm 76.6 to 87.8° C. (170 to 190° F.) to form desirably shaped and sized wet flakes.

In still another variation, the dough can be sheeted to form sheets of dough (e.g., 25 to 800 microns in thickness) and the individual pieces formed by cutting the sheet into individual pieces or by stamping out shaped pieces from the dough sheet.

In still another variation, the cooked cereal dough can be extruded through a die imparting a desired peripheral shape to form an extrudate cooked cereal dough rope. The dough rope can be cut to form individual shaped pieces.

In still another variation, the cooked cereal dough can be fed to a biscuit forming device (see, for example, U.S. Pat. No. 5,342,188, entitled "Device For Crimping and Cutting Dough Ropes," issued Aug. 30, 1994 to C. E. Zimmermann, which is incorporated herein by reference) which forms the dough into block shaped individual pieces.

In another preferred variation, the cooked cereal dough is formed into individual "O" shaped pieces or rings, biscuits, shreds, figurines, letters, spheres or flakes or other geometric shapes, nuggets, or even irregular shapes.

Drying To Form Finished Pieces

The present methods further comprise the step of drying the shaped and sized individual pieces to form finished cereal products fortified with calcium.

The skilled artisan will appreciate that the drying step depends importantly in part upon the desired end product. For example, for end products in the form of puffable half products or pellets for snack production, the drying step can be practiced to provide a "finish" moisture content of about 10 to 15%. However, when the desired end product is an R-T-E cereal, drying the pellets to these moisture contents may only be an intermediate or substep prior to, for example, flaking the dried pellets to form "wet" flakes. These "wet" flakes can then be subjected to a finish or final drying step wherein the pieces are dried to final dried moisture contents of 1 to 4% such as by toasting.

In still another variation, the dough can be extruded under conditions of temperature and pressure so as to puff and expand (the "direct expansion" technique) and sectioned or cut into individual pieces to form individual expansions puffed R-T-E cereal or snack pieces.

In certain embodiments, the cooked cereal dough can be puffable such as by deep fat frying, microwave heating, gun puffing, jet zone heating, etc.

In another variation, the drying step can involve heating the pieces under conditions that not only dry the piece but also cause the piece to expand to form dried and puffed or flaked finished pieces. For example, pellets can be gun puffed to form dried puffed R-T-E cereal products. The wet flakes can be toasted to dry, expand and tenderize to form finished R-T-E cereal flakes.

In still another variation, the pieces or pellets can be deep fat fried to form dried puffed fried finished cereal products fortified with calcium. Such dried puffed fried finished cereal pieces are especially desirable as calcium fortified snack products. Such products can absorb about 5 to 35% of frying fat during the drying and puffing step.

The dried cereal pieces, however realized, can optionally be provided with a topical sugar coating and subsequently dried to remove the moisture added by the sugar coating solution to form presweetened R-T-E flaked cereal pieces. In other variations, an oil topical coating optionally with salt and/or flavors, is applied to form finished dried snack products. Both conventional sugar coatings and coatings employing high potency sweeteners, especially aspartame and potassium acesulfame, are known and can be used to provide presweetened cereals for use herein.

If employed, the topical sweetening is applied in sufficient amounts such that after drying to remove added moisture associated with the sugar coating solution, the sugar coating is present in a weight ratio of sugar coating to cereal base of about 1:100 to about 50:100, preferably 10:100 to about 40:100 and for best results about 25:100 to about 35:100. Typically, the sugar coating solution will have a blend of sugars and will comprise about 4 to 20% moisture. When higher amounts of the sugar coating solution, particularly for those solutions employing higher moisture levels, the slurry coated cereal pieces may be subjected to a final drying step to remove the added moisture from the sugar coating to provide finished dried products having a moisture content of about 1 to 5%.

The R-T-E cereal pieces so prepared can then be conventionally packaged for distribution and sale.

In still other variations, the present finished dried food products are admixed with other dry snack ingredients (e.g., peanuts, pretzels, and other cereal pieces) to form a mixed aggregate snack product.

The finished dried R-T-E cereal and cereal based snack products fabricated from the calcium fortified cooked cereal doughs herein are useful as nutrient fortified food products. Surprisingly, the finished R-T-E cereal and cereal-based snack products provided herein are remarkably similar to their unfortified counterparts, even though containing the added calcium ingredient. Good flavor, good texture and other favorable organoleptic attributes characterize the products. Notwithstanding their highly acceptable taste, appearance and texture attributes, the products are nonetheless characterized as having high levels of calcium. The present finished products are remarkably free of the undesirable discoloration heretofore associated with finished light colored dried cereal products high in calcium content. The cooked cereal doughs and finished products prepared therefrom can each further be characterized by a Hunter value of greater than 60. If desired, the finished products can also be subjected to a toasting step.

The products can be packaged and distributed in conventional form.

Thus, since the invention disclosed herein may be embodied in other specific forms without departing from the spirit or general characteristics thereof, some of which forms have been indicated, the embodiments described herein are to be considered in all respects illustrative and not restrictive. The scope of the invention is to be indicated by the appended claims, rather than by the foregoing description, and all changes, which come within the meaning and range of equivalency of the claims, are intended to be embraced therein.

What is claimed is:

1. Calcium fortified cooked cereal food product comprising:

- A. a lightly colored cooked cereal dough product having a moisture content of about 1% to 30%;
- B. sufficient amounts of calcium carbonate to provide a total calcium content of at least 0.3% (dry weight basis);
- C. about 0.005% to 0.05% of the cooked cereal dough product of a calcium sequestrant, wherein at least a portion of the calcium sequestrant is sodium hexametaphosphate.

2. The food product of claim 1 wherein the calcium sequestrant includes an additional portion selected from the group consisting of phosphate salts, edible organic salts, EDTA and mixtures thereof.

3. The food product of claim 2 wherein the calcium sequestrant is a mixture of the additional portion and the sodium hexametaphosphate in a 1 to 5:1 ratio.

4. The food product of claim 3 wherein at least a portion of the calcium carbonate is supplied by ground limestone.

5. The food product of claim 4 wherein the ground limestone has a metal concentration of 10 PPM or less.

6. The food product of claim 2 wherein the food product is in the form of a dough having a moisture content of about 25% to 30%.

7. The food product of claim 2 wherein the food product is in the form of cooked cereal dough pellets or half products having a moisture content of about 10% to 18%.

8. The food product of claim 2 wherein the food product is in the form of cooked cereal dough RTE cereals having a moisture content of about 3% to 5%.

9. The food product of claim 8 additionally comprising a sugar coating.

10. The food product of claim 2 wherein at least a portion of the calcium sequestrant is an edible organic acid.

11. The food product of claim 10, wherein at least a portion of the edible organic acid is provided in the form of a water-soluble salt.

12. The food product of claim 1 wherein at least a portion of the calcium carbonate is supplied by ground limestone.

13. The food product of claim 12 additionally comprising supplemental insoluble calcium material in a quantity sufficient to bring the total calcium content of the food product composition to from about 0.6% to 20% by weight (dry basis).

14. The food product of claim 12 wherein the calcium carbonate has an average particle size of no larger than 25 microns.

15. The food product of claim 1 wherein the lightly cooked cereal dough comprises about 40% to 97% rice, corn (maize) and mixtures thereof.

16. The food product of claim 15 wherein the lightly cooked cereal dough comprises about 40% to 97% rice.

17. The food product of claim 16 in the form of biscuits.

18. The food product of claim 15 wherein the lightly cooked cereal dough comprises about 40% to 97% corn.

19. The food product of claim 1 wherein the light cooked cereal dough product has a Hunter L color value of about 60.

20. A method of providing calcium fortified cooked cereal dough products, comprising the steps of:

- A. providing a lightly colored calcium fortified cooked cereal dough or mass containing at least 0.3% calcium (dry weight basis) at least a portion of which is supplied by calcium carbonate and about 0.005% to 0.005% of calcium sequestrant, wherein at least a portion of the calcium sequestrant is constituted by sodium hexametaphosphate;
- B. forming the lightly colored calcium fortified cereal dough into pieces; and, C. drying the pieces to form finished food products fortified with high levels of calcium.

21. The method of claim 20 wherein the calcium sequestrant includes an additional portion selected from the group consisting of phosphate salts, edible organic acids, EDTA and mixtures thereof.

22. The method of claim 21 wherein at least a portion of the calcium sequestrant is an edible organic acid.

23. The method of claim 21 wherein at least a portion of the calcium carbonate is supplied by ground limestone.

24. The method of claim 23 wherein the calcium carbonate has an average particle size of no larger than 25 microns.

25. The method of claim 21 wherein the calcium sequestrant is a mixture of the additional portion and the sodium hexametaphosphate in a 1 to 5:1 ratio.

26. The method of claim 20 wherein the food product is in the form of cooked cereal dough pellets or half products having a moisture content of about 10% to 18%.

27. The method of claim 20 wherein the food product is in the form of cooked cereal dough RTE cereals having a moisture content of about 3% to 5%.

28. The method of claim 20 wherein the light cooked cereal dough comprises about 40% to 97% rice, corn (maize) and mixtures thereof.

29. The method of claim 28 wherein the light cooked cereal dough comprises about 40% to 97% rice.

30. The method of claim 28 drying the cooked cereal dough to a moisture content of 10% to 20% prior to forming into pieces.

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31. The method of claim 20 wherein at least a portion of the edible organic acid is provided in the form of a water soluble salt.

32. The method of claim 20 additionally comprising supplemental insoluble calcium material in a quantity sufficient to bring the total calcium content of the food product composition to from about 0.6% to 20% by weight (dry basis).

33. The method of claim 20 wherein the dough comprises about 5% to 10% sugar.

34. The method of claim 20 additionally comprising the step of toasting.

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35. The method of claim 20 additionally comprising the step of applying a sugar topical coating.

36. The method of claim 20 wherein at least a portion of the sequestrant is provided by sodium ascorbate.

37. The method of claim 20 wherein calcium carbonate comprises about 0.5% to 1% (dry weight basis) of the cooked cereal dough.

38. The method of claim 20 wherein in step B, the cereal pieces are formed into the biscuits.

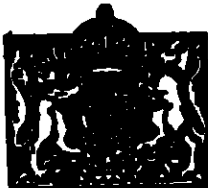
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PATENT SPECIFICATION

335,214

Application Date: June 19, 1929. No. 18,885/29.

Complete Accepted: Sept. 18, 1930.



COMPLETE SPECIFICATION.

Improvements in or relating to Flour and Dough.

I, JOSEF DAFER, of Marshallstrasse 3a, Düsseldorf, Germany, a German citizen, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

It has previously been found by experiments that the baking property or capacity of flour or dough can be increased by incorporating with it small quantities of a mixture of persulphates and bromates, for instance potassium bromate and ammonium persulphate, for example during or after the grinding or during the stirring into paste or in the further course of the dough preparation. It is possible in such cases to use different proportions of the constituents according to the nature of the dough or flour to be treated; for instance it has been found advantageous in many cases to use about 1 molecule of ammonium persulphate to 1-2 molecules potassium bromate.

During his experiments with this process the applicant found the drawback that the bromate is partly decomposed with separation of bromine, by the leavening of the dough. This phenomenon is undesirable as the effect of the additions which are intended to exercise an improving action on the baking process, is reduced thereby. The inventor has found in further experiments that the above drawback can be eliminated. This is done according to the invention by adding to the mixture of the additional substances, or, jointly with the additional substances, to the flour or dough, besides the above mentioned combination of persulphates and bromates, an acid-neutralising constituent, for example magnesium carbonate or calcium carbonate or a mixture of both these substances. These acid neutralising substances have the property of preventing interaction between the persulphate and the bromate both in the mixture ready for sale and when used in flour or dough. The result of this is that the separation of bromine is held back, so that the bromate acts as such by giving off oxygen and so that it will be finally present in the form of

[Price 1/-]

bromide. The inventor has found that a combination of potassium persulphate and potassium bromate with magnesium carbonate is particularly suitable for the purpose in question, and that it is preferable to use a quantity of magnesium carbonate relatively large in comparison with the quantity of the other additions, for instance a quantity one to eight times as great. Thus for instance a mixture of 3 parts of potassium bromate, 5 parts of potassium persulphate and 50 parts of magnesium carbonate may be used with excellent results. The treatment quantity per 100 kg. of flour is preferably made to correspond to the parts indicated in grams, that is to say for each 100 kg. of flour, in the example mentioned 58 grams can be used of the mixture constituted by 3 gr. potassium bromate, 5 gr. potassium persulphate and 50 gr. magnesium carbonate. The proportions specified are of course given merely by way of example and may be modified to a very great extent without departing from the invention.

When using such combinations which have moreover the advantage of being perfectly durable as finished mixture of addition, any reduction of the effect is avoided that might be caused by decomposition during the leavening of the dough.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A process for the treatment of flour or dough with a mixture of persulphates and bromates for the purpose of increasing the baking property, characterised by incorporating with the mixture of the additional substances, or jointly with them with the flour or dough, an acid-neutralising constituent, for instance magnesium carbonate and/or calcium carbonate, preferably in a quantity exceeding that of the additions.

2. Flour and dough when treated by the process claimed in claim 1.

Dated this 19th day of June, 1929.

2 335,214

JOSEF HÄFFNER,

For Boulton, Wade and Tennant,
111 & 112, Hatton Garden,
London, E.C. 1,
Chartered Patent Agents.

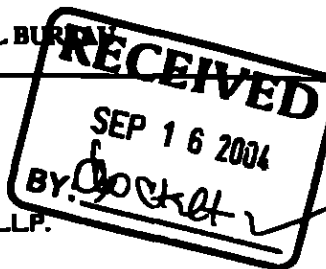
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Date of mailing (day/month/year) 10 September 2004 (10.09.2004)		
Applicant's or agent's file reference CFLAY.00179P		IMPORTANT NOTICE
International application No. PCT/US2004/003448	International filing date (day/month/year) 06 February 2004 (06.02.2004)	Priority date (day/month/year) 21 February 2003 (21.02.2003)
Applicant FRITO-LAY NORTH AMERICA, INC. formerly known as RECOT, INC. et al		

The International Bureau transmits herewith the following documents:

- ☒ copy of the international application as published by the International Bureau on 10 September 2004 (10.09.2004) under No. WO 2004/075657
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(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
10 September 2004 (10.09.2004)

PCT

(10) International Publication Number
WO 2004/075657 A2

(51) International Patent Classification⁷: A23L

PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM,
TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM,
ZW.

(21) International Application Number:
PCT/US2004/003448

(22) International Filing Date: 6 February 2004 (06.02.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10/372,154 21 February 2003 (21.02.2003) US

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),
Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), Euro-
pean (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR,
GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— as to applicant's entitlement to apply for and be granted
a patent (Rule 4.17(ii)) for the following designations AE,
AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ,
CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE,
EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS,
JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA,
MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM,
PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ,
TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM,
ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, SD,
SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY,
KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG,
CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT,
LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ,
CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD,
TG)

— of inventorship (Rule 4.17(iv)) for US only

Published:

— without international search report and to be republished
upon receipt of that report

For two-letter codes and other abbreviations, refer to the "Guid-
ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.

(71) Applicant (for all designated States except US):
FRITO-LAY NORTH AMERICA, INC. formerly
known as RECOT, INC. [US/US]; 7701 Legacy Drive,
Plano, TX 75266 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): ELDER, Vincent,
Allen [US/US]; 2903 Panorama Drive, Carrollton, TX
75007 (US). FULCHER, John, Gregory [US/US]; 9930
Ontario Lane, Dallas, TX 75220 (US). LEUNG, Henry,
Kin-Hang [US/US]; 3704 Ellington Drive, Plano, TX
75093 (US). TOPOR, Michael, Grant [US/US]; 2312
Evergreen, Carrollton, TX 75006 (US).

(74) Agent: CAHOON, Collin, P.; Carstens Yee & Cahoon,
L.L.P., P.O. Box 802334, Dallas, TX 75380 (US).

(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN,
CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI,
GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE,
KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD,
MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG,



WO 2004/075657 A2

(54) Title: METHOD FOR REDUCING ACRYLAMIDE FORMATION IN THERMALLY PROCESSED FOODS

(57) Abstract: In fabricated, thermally processed foods, the addition of one of a select group of divalent or trivalent cations to the recipe for the food inhibits the formation of acrylamide during the thermal processing. The cation can come from the group including calcium, magnesium, copper, aluminum, copper, and iron salts.

METHOD FOR REDUCING ACRYLAMIDE FORMATION IN THERMALLY PROCESSED FOODS

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BACKGROUND OF THE INVENTION

Cross-Reference to Related Applications

This application is a continuation-in-part of co-pending U.S. Patent Application 10/247,504, filed September 19, 2002.

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Technical Field

The present invention relates to a method for reducing the amount of acrylamide in thermally processed foods. This invention permits the production of foods having significantly reduced levels of acrylamide. The method relies on the addition of a divalent or trivalent cation, such as are found in the salts of calcium, magnesium, copper, iron, zinc, or
15 aluminum to the dough formulation of a food.

Description of Related Art

The chemical acrylamide has long been used in its polymer form in industrial applications for water treatment, enhanced oil recovery, papermaking, flocculants, thickeners, ore processing and permanent press fabrics. Acrylamide participates as a white crystalline
20 solid, is odorless, and is highly soluble in water (2155 g/L at 30°C). Synonyms for acrylamide include 2-propenamide, ethylene carboxamide, acrylic acid amide, vinyl amide, and propenoic acid amide. Acrylamide has a molecular mass of 71.08, a melting point of 84.5°C, and a boiling point of 125°C at 25 mmHg.

In very recent times, a wide variety of foods have tested positive for the presence of
25 acrylamide monomer. Acrylamide has especially been found primarily in carbohydrate food products that have been heated or processed at high temperatures. Examples of foods that have tested positive for acrylamide include coffee, cereals, cookies, potato chips, crackers,

french-fried potatoes, breads and rolls, and fried breaded meats. In general, relatively low contents of acrylamide have been found in heated protein-rich foods, while relatively high contents of acrylamide have been found in carbohydrate-rich foods, compared to non-detectable levels in unheated and boiled foods. Reported levels of acrylamide found in various similarly processed foods include a range of 330 - 2,300 ($\mu\text{g}/\text{kg}$) in potato chips, a range of 300 - 1100 ($\mu\text{g}/\text{kg}$) in french fries, a range 120 - 180 ($\mu\text{g}/\text{kg}$) in corn chips, and levels ranging from not detectable up to 1400 ($\mu\text{g}/\text{kg}$) in various breakfast cereals.

It is presently believed that acrylamide is formed from the presence of amino acids and reducing sugars. For example, it is believed that a reaction between free asparagine, an amino acid commonly found in raw vegetables, and free reducing sugars accounts for the majority of acrylamide found in fried food products. Asparagine accounts for approximately 40% of the total free amino acids found in raw potatoes, approximately 18% of the total free amino acids found in high protein rye, and approximately 14% of the total free amino acids found in wheat.

The formation of acrylamide from amino acids other than asparagine is possible, but it has not yet been confirmed to any degree of certainty. For example, some acrylamide formation has been reported from testing glutamine, methionine, cysteine, and aspartic acid as precursors. These findings are difficult to confirm, however, due to potential asparagine impurities in stock amino acids. Nonetheless, asparagine has been identified as the amino acid precursor most responsible for the formation of acrylamide.

Since acrylamide in foods is a recently discovered phenomenon, its exact mechanism of formation has not been confirmed. However, it is now believed that the most likely route for acrylamide formation involves a Maillard reaction. The Maillard reaction has long been recognized in food chemistry as one of the most important chemical reactions in food processing and can affect flavor, color, and the nutritional value of the food. The Maillard

reaction requires heat, moisture, reducing sugars, and amino acids.

The Maillard reaction involves a series of complex reactions with numerous intermediates, but can be generally described as involving three steps. The first step of the Maillard reaction involves the combination of a free amino group (from free amino acids and/or proteins) with a reducing sugar (such as glucose) to form Amadori or Heyns rearrangement products. The second step involves degradation of the Amadori or Heyns rearrangement products via different alternative routes involving deoxyosones, fission, or Strecker degradation. A complex series of reactions - including dehydration, elimination, cyclization, fission, and fragmentation - results in a pool of flavor intermediates and flavor compounds. The third step of the Maillard reaction is characterized by the formation of brown nitrogenous polymers and co-polymers. Using the Maillard reaction as the likely route for the formation of acrylamide, Figure 1 illustrates a simplification of suspected pathways for the formation of acrylamide starting with asparagine and glucose.

Acrylamide has not been determined to be detrimental to humans, but its presence in food products, especially at elevated levels, is undesirable. As noted previously, relatively higher concentrations of acrylamide are found in food products that have been heated or thermally processed. The reduction of acrylamide in such food products could be accomplished by reducing or eliminating the precursor compounds that form acrylamide, inhibiting the formation of acrylamide during the processing of the food, breaking down or reacting the acrylamide monomer once formed in the food, or removing acrylamide from the product prior to consumption. Understandably, each food product presents unique challenges for accomplishing any of the above options. For example, foods that are sliced and cooked as coherent pieces may not be readily mixed with various additives without physically destroying the cell structures that give the food products their unique characteristics upon cooking. Other processing requirements for specific food products may likewise make

acrylamide reduction strategies incompatible or extremely difficult.

By way of an example of heated food products that represent unique challenges to reducing acrylamide levels in the final products, snacks can be fabricated from a dough. The term "fabricated snack" means a snack food that uses as its starting ingredient something
5 other than the original and unaltered starchy starting material. For example, fabricated snacks include fabricated potato chips that use a dehydrated potato product as a starting material and corn chips that use a masa flour as its starting material. It is noted here that the dehydrated potato product can be potato flour, potato flakes, potato granules, or any other form in which dehydrated potatoes exist. When any of these terms are used in this
10 application, it is understood that all of these variations are included. Fabricated potato chips start with, for example, potato flakes, which are mixed with water and other minor ingredients to form a dough. This dough is then sheeted and cut before proceeding to a cooking step. The cooking step may involve frying or baking. The chips then proceed to a seasoning step and a packaging step. The mixing of the potato dough generally lends itself to
15 the easy addition of other ingredients. Conversely, the addition of such ingredients to a raw food product, such as potato slices, requires that a mechanism be found to allow for the penetration of ingredients into the cellular structure of the product. However, the addition of any ingredients in the mixing step must be done with the consideration that the ingredients may adversely affect the sheeting characteristics of the dough as well as the final chip
20 characteristics, such as flavor, texture, and color.

It would be desirable to develop one or more methods of reducing the level of acrylamide in the end product of heated or thermally processed foods. Ideally, such a process should substantially reduce or eliminate the acrylamide in the end product without adversely affecting the quality and characteristics of the end product. Further, the method should be
25 easy to implement and, preferably, add little or no cost to the overall process.

SUMMARY OF THE INVENTION

In the inventive process, a divalent or trivalent cation or combination of such cations is added to fabricated foods prior to cooking to reduce the formation of acrylamide. The divalent or trivalent cation can be added during milling, dry mix, wet mix, or other admix, so
5 that the cation is present throughout the food product. In preferred embodiments, the added cation can be chosen from the group of calcium, magnesium, and aluminum salts, and less favorably, iron, zinc, and copper salts. The cation is added to the dough in an amount sufficient to reduce the acrylamide formation in the finished product to a desired level.

The addition of divalent or trivalent cations effectively reduces the amount of
10 acrylamide found in the end product of the heated or thermally processed food while minimally affecting the quality and characteristics of the end product. Further, such a method of acrylamide reduction is generally easy to implement and adds little or no cost to the overall process.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will be best understood by reference to the following

5 detailed description of illustrative embodiments when read in conjunction with the accompanying drawings, wherein:

Figure 1 is a schematic of suspected chemical pathways for acrylamide formation in foods; and

Figure 2 is a schematic of a method for making fabricated potato chips from potato
10 flakes, granules, or flour according to an embodiment of the present invention.

DETAILED DESCRIPTION

The formation of acrylamide in thermally processed foods requires a source of carbon and a source of nitrogen. It is hypothesized that carbon is provided by a carbohydrate source and nitrogen is provided by a protein source or amino acid source. Many plant-derived food ingredients such as rice, wheat, corn, barley, soy, potato and oats contain asparagine and are primarily carbohydrates having minor amino acid components. Typically, such food ingredients have a small amino acid pool, which contains other amino acids in addition to asparagine.

By "thermally processed" is meant food or food ingredients wherein components of the food, such as a mixture of food ingredients, are heated at temperatures of at least 80°C. Preferably the thermal processing of the food or food ingredients takes place at temperatures between about 100°C and 205°C. The food ingredient may be separately processed at elevated temperature prior to the formation of the final food product. An example of a thermally processed food ingredient is potato flakes, which is formed from raw potatoes in a process that exposes the potato to temperatures as high as 170°C. (The terms "potato flakes", "potato granules", and "potato flour" are used interchangeably herein, and are meant to denote any potato based, dehydrated product.) Examples of other thermally processed food ingredients include processed oats, par-boiled and dried rice, cooked soy products, corn masa, roasted coffee beans and roasted cacao beans. Alternatively, raw food ingredients can be used in the preparation of the final food product wherein the production of the final food product includes a thermal heating step. One example of raw material processing wherein the final food product results from a thermal heating step is the manufacture of potato chips from raw potato slices by the step of frying at a temperature of from about 100°C to about 205°C or the production of french fries fried at similar temperatures.

In accordance with the present invention, however, a significant formation of

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acrylamide has been found to occur when the amino acid asparagine is heated in the presence of a reducing sugar. Heating other amino acids such as lysine and alanine in the presence of a reducing sugar such as glucose does not lead to the formation of acrylamide. Surprisingly, the addition of other amino acids to the asparagine sugar mixture can increase or decrease the
5 amount of acrylamide formed.

Having established the rapid formation of acrylamide when asparagine is heated in the presence of a reducing sugar, a reduction of acrylamide in thermally processed foods can be achieved by inactivating the asparagine. By "inactivating" is meant removing asparagine from the food or rendering asparagine non-reactive along the acrylamide formation route by
10 means of conversion or binding to another chemical that interferes with the formation of acrylamide from asparagine.

In the present invention, this is accomplished by the addition of a divalent or trivalent cation to a formula for a snack food prior to the cooking or thermal processing of that snack food. Chemists will understand that cations do not exist in isolation, but are found in the
15 presence of an anion having the same valence. Although reference is made herein to the salt containing the divalent or trivalent cation, it is the cation present in the salt that is believed to provide a reduction in acrylamide formation by reducing the solubility of asparagine in water. These cations are also referred to herein as a cation with a valence of at least two. Interestingly, cations of a single valence are not effective in use with the present invention.
20 In choosing an appropriate compound containing the cation having a valence of at least two in combination with an anion, the relevant factors are water solubility, food safety, and least alteration to the characteristics of the particular food. Combinations of various salts can be used, even though they are discussed herein only as individual salts.

Chemists speak of the valence of an atom as a measure of its ability to combine with
25 other elements. Specifically, a divalent atom has the ability to form two ionic bonds with

other atoms, while a trivalent atom can form three ionic bonds with other atoms. A cation is a positively charged ion, that is, an atom that has lost one or more electrons, giving it a positive charge. A divalent or trivalent cation, then, is a positively charged ion that has availability for two or three ionic bonds, respectively.

5 Simple model systems can be used to test the effects of divalent or trivalent cations on acrylamide formation. Heating asparagine and glucose in 1:1 mole proportions can generate acrylamide. Quantitative comparisons of acrylamide content with and without an added salt measures the ability of the salt to promote or inhibit acrylamide formation. Two sample preparation and heating methods were used. One method involved mixing the dry
10 components, adding an equal amount of water, and heating in a loosely capped vial. Reagents concentrated during heating as most of the water escaped, duplicating cooking conditions. Thick syrups or tars can be produced, complicating recovery of acrylamide. These tests are shown in Examples 1 and 2 below.

A second method using pressure vessels allowed more controlled experiments.

15 Solutions of the test components were combined and heated under pressure. The test components can be added at the concentrations found in foods, and buffers can duplicate the pH of common foods. In these tests, no water escapes, simplifying recovery of acrylamide, as shown in Example 3 below.

Example 1

20 A 20 mL (milliliter) glass vial containing L-asparagine monohydrate (0.15 g, 1 mmole), glucose (0.2 g, 1 mmole) and water (0.4 mL) was covered with aluminum foil and heated in a gas chromatography (GC) oven programmed to heat from 40° to 220°C at 20°/minute, hold two minutes at 220°C, and cool from 220° to 40°C at 20°/min. The residue was extracted with water and analyzed for acrylamide using gas chromatography-mass
25 spectroscopy (GC-MS). Analysis found approximately 10,000 ppb (parts/billion) acrylamide.

Two additional vials containing L-asparagine monohydrate (0.13 g, 1 mmole), glucose (0.2 g, 1 mmole), anhydrous calcium chloride (0.1 g, 1 mmole) and water (0.4 mL) were heated and analyzed. Analysis found 7 and 30 ppb acrylamide, a greater than ninety-nine percent reduction.

5 Given the surprising result that calcium salts strongly reduced acrylamide formation, further screening of salts identified divalent and trivalent cations (magnesium, aluminum) as producing a similar effect. It is noted that similar experiments with monovalent cations, i.e. 0.1/0.2 g sodium bicarbonate and ammonium carbonate (as ammonium carbamate and ammonium bicarbonate) increased acrylamide formation, as seen in Table 1 below.

10

Salt	Micro Mole Salt	Micromole Acrylamide after heating, ppb
None (control)	0	9857
Sodium bicarbonate	1200	13419
Ammonium carbonate	1250	22027
Ammonium carbonate	2500	47897

Table 1

Example 2

In a second experiment, a similar test to that described above was performed, but instead of using anhydrous calcium chloride, two different dilutions of each of calcium chloride and magnesium chloride were used. Vials containing L-asparagine monohydrate (0.15 g, 1 mmole) and glucose (0.2 g, 1 mmole) were mixed with one of the following:

15

- 0.5 mL water (control),
- 0.5 mL 10% calcium chloride solution (0.5 mmole),
- 0.05 mL 10% calcium chloride solution (0.05 mmole) plus 0.45 mL water,
- 0.5 mL 10% magnesium chloride solution (0.5 mmole), or
- 0.05 mL 10% magnesium chloride solution (0.05 mmole) plus 0.45 mL water.

20

Duplicate samples were heated and analyzed as described in Example 1. Results were averaged and summarized in Table 2 below:

Salt ID	Amt added Micromoles	Acrylamide formed Micromoles	Acrylamide reduction
None (control)	0	408	0
Calcium chloride	450	293	27%
Calcium chloride	45	864	None
Magnesium chloride	495	191	53%
Magnesium chloride	50	2225	None

Table 2

5 Example 3

As mentioned above, this test did not involve the loss of water from the container, but was done under pressure. Vials containing 2 mL of buffered stock solution (15 mM asparagine, 15 mM glucose, 500 mM phosphate or acetate) and 0.1 mL salt solution (1000 mM) were heated in a Parr bomb placed in a GC oven programmed to heat from 40 to 150°C at 20°/min and hold at 150°C for 2 minutes. The bomb was removed from the oven and cooled for 10 minutes. The contents were extracted with water and analyzed for acrylamide following the GC-MS method. For each combination of pH and buffer, a control was run without an added salt, as well as with the three different salts. Results of duplicate tests were averaged and summarized in Table 3 below:

Salt	pH	Buffer	Meg Acrylamide Salt added	Meg Acrylamide Control	Acrylamide Reduction
Calcium chloride	5.5	Acetate	337	550	19%
Calcium chloride	7.0	Acetate	990	1205	18%
Calcium chloride	5.5	Phosphate	154	300	49%
Calcium chloride	7.0	Phosphate	762	855	11%
Magnesium chloride	5.5	Acetate	380	550	16%
Magnesium chloride	7.0	Acetate	830	1205	31%
Magnesium chloride	5.5	Phosphate	198	300	34%

Magnesium chloride	7.0	Phosphate	773	855	10%
Potassium aluminum sulfate	5.5	Acetate	205	550	31%
Potassium aluminum sulfate	7.0	Acetate	453	1205	62%
Potassium aluminum sulfate	5.5	Phosphate	64	300	79%
Potassium aluminum sulfate	7.0	Phosphate	787	855	8%

Table 3

Across the three salts used, the greatest reductions occurred in pH 7 acetate and pH 5.5 phosphate. Only small reductions were found in pH 5.5 acetate and pH 7 phosphate.

Example 4

5 Following the model systems results, a small-scale laboratory test was run in which calcium chloride was added to potato flakes before heating. Three ml of a 0.4%, 2%, or 10% calcium chloride solution was added to 3 g of potato flakes. The control was 3 g of potato flakes mixed with 3 ml of de-ionized water. The flakes were mixed to form a relatively uniform paste and then heated in a sealed glass vial at 120° C for 40 min. Acrylamide after
10 heating was measured by GC-MS. Before heating, the control potato flakes contained 46 ppb of acrylamide. Test results are reflected in Table 4 below.

Mixture ID	Acrylamide, ppb	Acrylamide Reduction
Control (water)	2604	None
CaCl ₂ 0.4% solution	1877	28%
CaCl ₂ 2% solution	338	76%
CaCl ₂ 10% solution	86	97%

Table 4

Given the results from above, tests were conducted in which a calcium salt was added to the formula for a fabricated snack food, in this case baked fabricated potato chips. The
15 process for making baked fabricated potato chips consists of the steps shown in Figure 3. The dough preparation step 31 combines potato flakes with water, the cation/anion pair (which in this case is calcium chloride) and other minor ingredients, which are thoroughly mixed to form a dough. (Again, the term "potato flakes" is intended herein to encompass all

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dried potato flakes, granule, or powder preparations, regardless of particle size.) In the sheeting/cutting step 32, the dough is run through a sheetter, which flattens the dough, and then is cut into individual pieces. In the cooking step 33, the formed pieces are cooked to a specified color and water content. The resultant chips are then seasoned in seasoning step 34 and packaged in packaging step 35.

A first embodiment of the invention is demonstrated using the baked, fabricated potato chip process described above. To illustrate this embodiment, a comparison is made between a control and a test batch using a commercial baked, fabricated potato chip dough formulation and processes. Both test and control batches were made according to the formulations listed in Table 5. The only difference between the batches was that the test batch contained calcium chloride.

Ingredient	Control	CaCl ₂ Test
Potato flakes and modified starch	5496 g	5496 g
Sugar	300 g	300 g
Oil	90 g	90 g
Leavening agents	54 g	54 g
Rumaisifier	60 g	60 g
Calcium Chloride (dissolved in water)	0 g	39 g
Total Dry Mix	6000 g	6039 g
Water	3947 ml	3947 ml

Table 5

In all batches, the dry ingredients were first mixed together, then oil was added to each dry blend and mixed. The calcium chloride was dissolved in the water prior to adding to the dough. The moisture level of the dough prior to sheeting was 40% to 45% by weight. The dough was sheeted to produce a thickness of between 0.020 and 0.030 inches, cut into chip-sized pieces, and baked.

After cooking, testing was performed for moisture, oil, and color according to the Hunter L-a-b scale. Samples were tested to obtain acrylamide levels in the finished product. Table 6 below shows the results of these analyses.

		Control	CaCl ₂ Test
H ₂ O, %		2.21	2.58
Oil, %		1.99	2.08
Acrylamide, ppb		1030	160
Color	L	72.34	76.67
	A	1.99	-.67
	B	20.31	24.21

Table 6

As these results show, the addition of calcium chloride to the dough in a ratio by weight of calcium chloride to potato flakes of roughly 1:125 significantly lowers the level of acrylamide present in the finished product, lowering the final acrylamide levels from 1030 ppb to 160 ppb. Additionally, the percentages of oil and water in the final product do not appear to have been affected by the addition of calcium chloride. It is noted, however, that CaCl₂ can cause changes in the taste, texture, and color of the product, depending on the amount used.

The level of divalent or trivalent cation that is added to a food for the reduction of acrylamide can be expressed in a number of ways. In order to be commercially acceptable, the amount of cation added should be enough to reduce the final level of acrylamide production by at least twenty percent (20%). More preferably, the level of acrylamide production should be reduced by an amount in the range of thirty-five to ninety-five percent (35-95%). Even more preferably, the level of acrylamide production should be reduced by an amount in the range of fifty to ninety-five percent (50-95%). To express this in a different manner, the amount of divalent or trivalent cation to be added can be given as a ratio between the moles of cation to the moles of free asparagine present in the food product. The ratio of the moles of divalent or trivalent cation to moles of free asparagine should be at least one to five (1:5). More preferably, the ratio is at least one to three (1:3), and more preferably still, one to two (1:2). In the presently preferred embodiment, the ratio of moles of cations to

moles of asparagine is between about 1:2 and 1:1. In the case of magnesium, which has less effect on the product taste than calcium, the molar ratio of cation to asparagine can be as high as about two to one (2:1).

Additional tests were run, using the same procedure as described above, but with different lots of potato flakes containing different levels of reducing sugars and varying amounts of calcium chloride added. In Table 7 below, lot 1 of potato flakes, which was the test shown above, had 0.81% reducing sugars, lot 2 had 1.0 % and lot 3 had 1.8% reducing sugars.

Added CaCl ₂	Flake Lot	Finished moisture weight %	Finished Color L Value	Finished Acrylamide ppb
0 g	1	2.21	72.34	1030
39 g	1	2.58	76.67	160
0 g	2	1.80	73.35	464
0 g	2	1.61	72.12	1060
17.5 g	2	1.82	74.63	350
39 g	2	2.05	76.95	80
39 g	2	1.98	75.86	192
0 g	3	1.99	71.37	1020
0 g	3	1.71	72.68	599
0 g	3	1.69	71.26	1640
0 g	3	1.63	74.44	1880
39 g	3	1.89	76.59	148
39 g	3	1.82	75.14	275

Table 7

As seen in this table, the addition of CaCl₂ consistently reduces the level of acrylamide in the final product, even when the weight ratio of added CaCl₂ to potato flakes is lower than 1:250.

Any number of salts that form a divalent or trivalent cation (or said another way, produce a cation with a valence of at least two) can be used with the invention disclosed herein, as long as adjustments are made for the collateral effects of this additional ingredient. The effect of lowering the acrylamide level appears to derive from the divalent or trivalent cation, rather than from the anion that is paired with it. Limitations to the cation/anion pair,

other than valence, are related to their acceptability in foods, such as safety, solubility, and their effect on taste, odor, appearance, and texture. Suggested cations include calcium, magnesium, aluminum, iron, copper, and zinc. Suitable salts of these cations include calcium chloride, calcium citrate, calcium lactate, calcium malate, calcium gluconate, calcium phosphate, calcium acetate, calcium sodium EDTA, calcium glycerophosphate, calcium hydroxide, calcium lactobionate, calcium oxide, calcium propionate, calcium carbonate, calcium stearoyl lactate, magnesium chloride, magnesium citrate, magnesium lactate, magnesium malate, magnesium gluconate, magnesium phosphate, magnesium hydroxide, magnesium carbonate, magnesium sulfate, aluminum chloride hexahydrate, aluminum chloride, aluminum hydroxide, ammonium alum, potassium alum, sodium alum, aluminum sulfate, ferric chloride, ferrous gluconate, ferric ammonium citrate, ferric pyrophosphate, ferrous fumarate, ferrous lactate, ferrous sulfate, cupric chloride, cupric gluconate, cupric sulfate, zinc gluconate, zinc oxide, and zinc sulfate. The presently preferred embodiment of this invention uses calcium chloride, although it is believed that the requirements may be best met by a combination of salts of one or more of the appropriate cations. A number of the salts, such as calcium salts, and in particular calcium chloride, are relatively inexpensive and commonly used as food. Calcium chloride can be used in combination with calcium citrate, thereby reducing the collateral taste effects of CaCl_2 . Further, any number of calcium salts can be used in combination with one or more magnesium salts. One skilled in the art will understand that the specific formulation of salts required can be adjusted depending on the food product in question and the desired end-product characteristics.

It should be understood that changes in the characteristics of the final product, such as changes in color, taste, and consistency can be adjusted by various means. For example, color characteristics in potato chips can be adjusted by controlling the amount of sugars in the starting product. Some flavor characteristics can be changed by the addition of various

flavoring agents to the end product. The physical texture of the product can be adjusted by, for example, the addition of leavening agents or various emulsifiers.

While the invention has been particularly shown and described with reference to one or more embodiments, it will be understood by those skilled in the art that various approaches

5 to the reduction of acrylamide in thermally processed foods may be made without departing from the spirit and scope of this invention. For example, while the process has been disclosed herein with regard to potato products, the process can also be used in processing of food products made from corn, barley, wheat, rye, rice, oats, millet, and other starch-based grains. In addition to fabricated potato chips, the invention can be used in making corn chips and

10 other types of snack chips, as well as in cereals, cookies, crackers, hard pretzels, breads and rolls, the breading for breaded meats, and other foods containing asparagine and a reducing sugar. In each of these foods, the cation can be added during the mixing of the dough used to make the product, so that the added cation is available during cooking to provide a reduction in the level of acrylamide. Further, the addition of a divalent or trivalent cation can be

15 combined with other strategies for the reduction of acrylamide to produce an acceptable acrylamide level without adversely affecting the taste, color, odor, or other characteristics of an individual food.

CLAIMS:

What is claimed is:

1. A method of lowering the level of acrylamide in a thermally processed food manufactured from a dough comprising a starch-based material, said method comprising the steps of:
 - a) adding a cation, having a valence of at least two, to a starch-based dough for a thermally processed food; and
 - b) thermally processing said starch-based food;
 wherein said cation is added in an amount sufficient to reduce the final level of acrylamide in said thermally processed food to an acceptable level.
2. The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said thermally processed food by at least 20 percent.
3. The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said thermally processed food by at least 35 percent.
4. The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said thermally processed food by about 50 percent.
5. The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said thermally processed food by a range of 50 to 95 percent.
6. The method of Claim 1, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of at least 1:5.
7. The method of Claim 1, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of at least 1:3.

8. The method of Claim 1, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of about 1:2.
9. The method of Claim 1, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of about 1:1.
10. The method of Claim 1, wherein said adding step a) adds a calcium ion to said starch-based dough, said calcium ion being part of a salt selected from the group of calcium chloride, calcium lactate, calcium citrate, calcium malate, calcium gluconate, calcium phosphate, calcium acetate, calcium sodium EDTA, calcium glycerophosphate, calcium hydroxide, calcium lactobionate, calcium oxide, calcium propionate, calcium carbonate, and calcium stearoyl lactate.
- 5 11. The method of Claim 1, wherein said adding step a) adds a magnesium ion to said starch-based dough, said magnesium ion being part of a salt selected from the group of magnesium chloride, magnesium citrate, magnesium lactate, magnesium malate, magnesium gluconate, magnesium phosphate, magnesium hydroxide, magnesium carbonate, and magnesium sulfate.
12. The method of Claim 1, wherein said adding step a) adds an aluminum ion to said starch-based dough, said ion being part of a salt selected from the group of aluminum chloride hexahydrate, aluminum chloride, aluminum hydroxide, ammonium alum, potassium alum, sodium alum, and aluminum sulfate.
13. The method of Claim 1, wherein said adding step a) adds an iron salt to said food mixture, said salt being selected from the group of ferric chloride, ferrous gluconate, ferric ammonium citrate, ferric pyrophosphate, ferrous fumarate, ferrous lactate, and ferrous sulfate.
14. The method of Claim 1, wherein said adding step a) adds a copper ion to said starch-based dough, said copper ion being part of a salt selected from the group of cupric chloride, cupric gluconate, and cupric sulfate.

15. The method of Claim 1, wherein said thermally processing step b) comprises frying said starch-based dough.
16. The method of Claim 1, wherein said thermally processing step b) comprises baking said starch-based dough.
17. The method of Claim 1, wherein the starch-based dough comprises a starch component selected from the group consisting of potatoes, corn, barley, wheat, rye, rice, oats, and millet.
18. The method of Claim 1, wherein said thermally processed food is a fabricated potato chip.
19. The method of Claim 1, wherein said thermally processed food is a fabricated corn chip.
20. The method of Claim 1, wherein said thermally processed food is a breakfast cereal.
21. The method of Claim 1, wherein said thermally processed food is a cracker.
22. The method of Claim 1, wherein said thermally processed food is a cookie.
23. The method of Claim 1, wherein said thermally processed food is a hard pretzel.
24. The method of Claim 1, wherein said thermally processed food is a bread product.
25. The method of Claim 1, wherein said thermally processed food is a breading for a meat product.
26. The thermally processed food produced by the method of Claim 1.

27. A method of preparing fabricated potato chips, said method comprising the steps of:
- a) preparing a mixture comprising potato flakes, water, and an ingredient that produces a cation having a valence of at least two, said ingredient selected from the group of salts consisting of calcium salts, magnesium salts, aluminum salts, iron salts, and copper salts;
 - b) sheeting and cutting said mixture to form cut pieces; and
 - c) thermally processing said cut pieces, wherein said ingredient reduces the formation of acrylamide in said fabricated potato chips.
- 5
28. The method of Claim 27, wherein said thermal processing of step c) comprises baking.
29. The method of Claim 27, wherein said thermal processing of step c) comprises frying.
30. The method of Claim 27, wherein the formation of acrylamide in said fabricated potato chips is reduced by at least 50 percent over a product without said cation.
31. A fabricated potato chip produced by the method of Claim 27.

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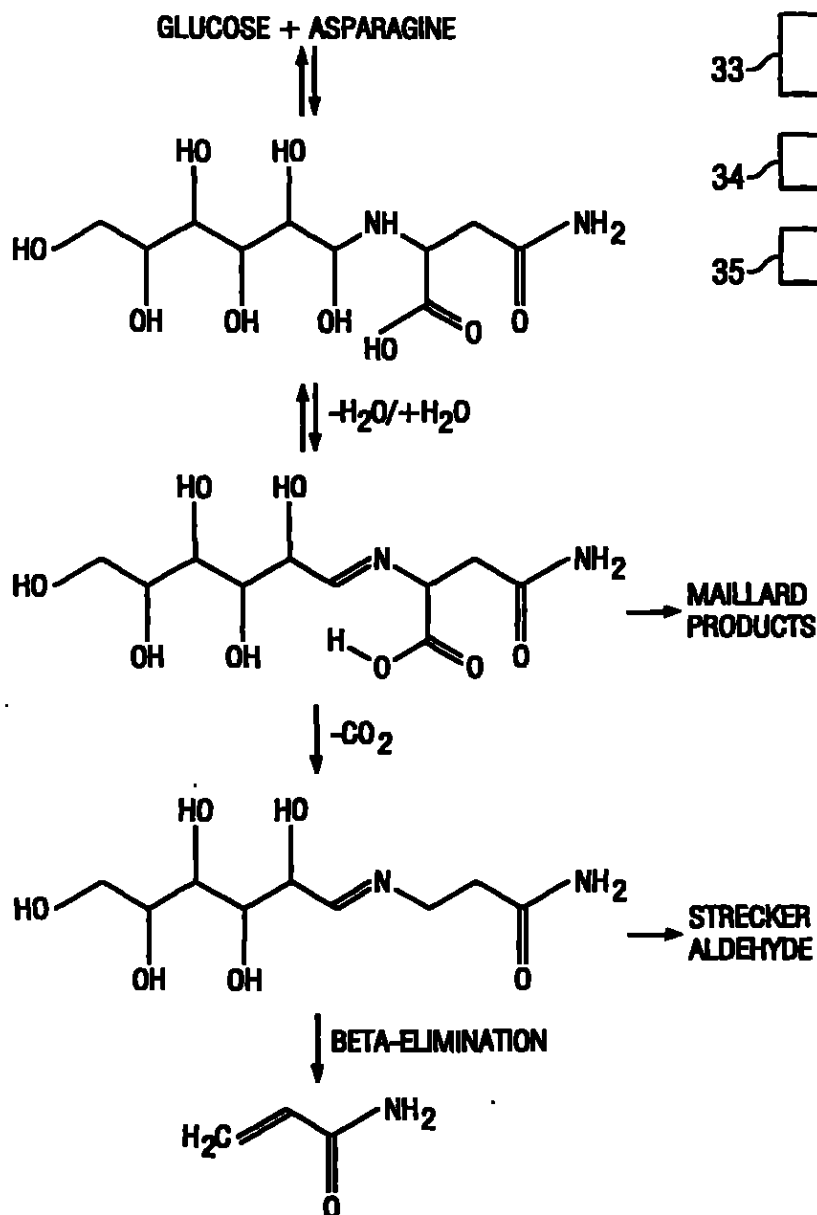


FIG. 1

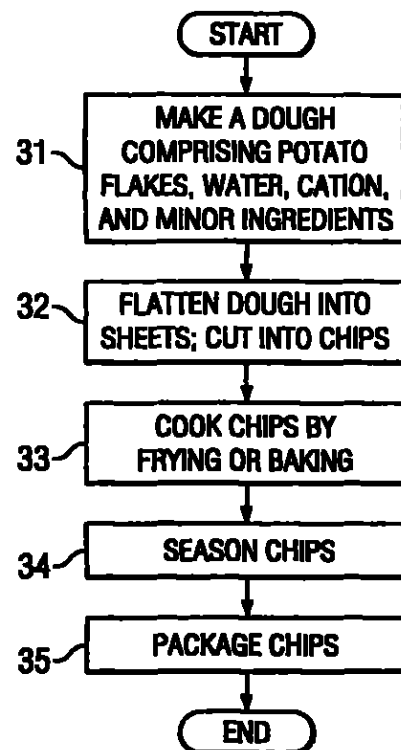


FIG. 2

From the INTERNATIONAL BUREAU

PCT

FIRST NOTICE INFORMING THE APPLICANT OF
THE COMMUNICATION OF THE INTERNATIONAL
APPLICATION (TO DESIGNATED OFFICES WHICH
DO NOT APPLY THE 30 MONTH TIME LIMIT
UNDER ARTICLE 22(1))

(PCT Rule 47.1(c))

Date of mailing (day/month/year) 23 September 2004 (23.09.2004)		To: CAHOON, Colin, P. Carstens Yee & Cahoon, L.L.P. P.O. Box 802334 Dallas, TX 75380 ETATS-UNIS D'AMERIQUE	RECEIVED OCT 04 2004 BY: <i>Jackeb</i>
Applicant's or agent's file reference CFLAY.00179P			
International application No. PCT/US2004/003448		International filing date (day/month/year) 06 February 2004 (06.02.2004)	Priority date (day/month/year) 21 February 2003 (21.02.2003)
Applicant FRITO-LAY NORTH AMERICA, INC. formerly known as RECOT, INC. et al			

IMPORTANT NOTICE

1. **ATTENTION:** For any designated Office(s), for which the time limit under Article 22(1), as in force from 1 April 2002 (30 months from the priority date), does apply, please see Form PCT/IB/308(Second and Supplementary Notice) (to be issued promptly after the expiration of 28 months from the priority date).

2. Notice is hereby given that the following designated Office(s), for which the time limit under Article 22(1), as in force from 1 April 2002, does not apply, has/have requested that the communication of the international application, as provided for in Article 20, be effected under Rule 93bis.1. The International Bureau has effected that communication on the date indicated below:
10 September 2004 (10.09.2004)

CH

In accordance with Rule 47.1(c-bis)(i), those Offices will accept the present notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

3. The following designated Offices, for which the time limit under Article 22(1), as in force from 1 April 2002, does not apply, have not requested, as at the time of mailing of the present notice, that the communication of the international application be effected under Rule 93bis.1:

FI, LU, SE, TZ, UG, ZM

In accordance with Rule 47.1(c-bis)(ii), those Offices accept the present notice as conclusive evidence that the Contracting State for which that Office acts as a designated Office does not require the furnishing, under Article 22, by the applicant of a copy of the international application.

4. **TIME LIMITS** for entry into the national phase

For the designated Office(s) listed above, and unless a demand for international preliminary examination has been filed before the expiration of 19 months from the priority date (see Article 39(1)), the applicable time limit for entering the national phase will, subject to what is said in the following paragraph, be 20 MONTHS from the priority date.

In practice, time limits other than the 20-month time limit will continue to apply, for various periods of time, in respect of certain of the designated Offices listed above. For regular updates on the applicable time limits (20 or 21 months, or other time limit), Office by Office, refer to the PCT Gazette, the PCT Newsletter and the PCT Applicant's Guide, Volume II, National Chapters, all available from WIPO's Internet site, at <http://www.wipo.int/pct/en/index.html>.

It is the applicant's sole responsibility to monitor all these time limits.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. +41 22 740 14 35	Authorized officer Yoshiko Kuwahara Facsimile No. +41 22 338 90 90
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PCT

NOTIFICATION CONCERNING
THE FILING OF AMENDMENTS OF THE CLAIMS
(PCT Administrative Instructions, Section 417)

From the INTERNATIONAL BUREAU

To:

CAHOON, Colin, P.
Carstens Yee & Cahoon, L.L.P.
P.O. Box 802334
Dallas, TX 75380
United States of America

RECEIVED
NOV 1 6 2004
Docketed

Date of mailing (day/month/year) 05 November 2004 (05.11.2004)	
Applicant's or agent's file reference CFLAY.00179P	IMPORTANT NOTIFICATION
International application No. PCT/US2004/003448	International filing date (day/month/year) 06 February 2004 (06.02.2004)
Applicant FRITO-LAY NORTH AMERICA, INC. formerly known as RECOT, INC. et al	

1. The applicant is hereby notified that amendments to the claims under Article 18 were received by the International Bureau on:

20 October 2004 (20.10.2004)

2. This date is within the time limit under Rule 48.1.

Consequently, the International publication of the International application will contain the amended claims according to Rule 48.2(f), (h) and (i).

3. The applicant is reminded that the International application (description, claims and drawings) may be amended during the International preliminary examination under Chapter II, according to Article 34, and in any case, before each of the designated Offices, according to Article 28 and Rule 52, or before each of the elected Offices, according to Article 41 and Rule 78.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. (41-22) 338.90.90	Authorised officer Rémy CALCAGNO (Fax 338 9090) Telephone No. (41-22) 338 9018
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IN THE INTERNATIONAL BUREAU OF WIPO

Int'l Application: PCT/US2004/003448
Applicant: FRITO-LAY NORTH AMERICA, INC.
Filing Date: 06 February 2004 (06.02.2004)
Priority Date: 21 February 2003 (21.02.2003)
Title: Method for Reducing Acrylamide Formation in Thermally Processed Foods

TRANSMITTAL

TO: *Via Telecopy and First Class Mail*
International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20
Switzerland

Dear Sirs:

Enclosed please find the following documents for filing in the above-referenced application:

1. Transmittal Document;
2. Amendment Prior to Examination Demand Pursuant to Article 19 of the Patent Cooperation Treaty; and
3. Postcard Receipt.

Dated: August 18, 2004

Respectfully submitted,

CARSTENS, YEE & CAHOON, L.L.P.
P.O. Box 802334
Dallas, Texas 75380
(972) 367-2001
(972) 367-2002 Fax

By: 

Colin P. Cahoon
Registration No. 38,836

IN THE INTERNATIONAL BUREAU OF WIPO

Int'l Application: PCT/US2004/003448
 Applicant: FRITO-LAY NORTH AMERICA, INC.
 Filing Date: 06 February 2004 (06.02.2004)
 Priority Date: 21 February 2003 (21.02.2003)
 Title: Method for Reducing Acrylamide Formation in Thermally Processed Foods

**AMENDMENT PRIOR TO EXAMINATION DEMAND
 PURSUANT TO ARTICLE 19
 OF THE PATENT COOPERATION TREATY**

In accordance with Article 19 of the Patent Cooperation Treaty, the Applicant offers the following Amendment:

AMENDMENT

Please replace sheets 18-22 with the attached replacement sheets R-18 through R-25.

COMMENT

Claims 1-31 are pending. By the enclosed replacement sheets R-18 through R-25, to be substituted for sheets 18-22 of the pending application, Claims 1-5, 10-16, 26, and 30 have been substantively amended; Claims 17-25 have been cancelled. No substantive changes were made to Claims 6-9, 27-29, and 31. The remaining claims have been renumbered accordingly as Claims 1-22. New claims 23-41 have been added. Therefore, claims 1-41 are now pending in the present application. A redline version of the claims reflecting all amendments is shown below.

Amended Claims:

1. (Currently Amended) A method of lowering the level of acrylamide produced by the thermal processing of a potato chip [in a thermally processed food] manufactured from a dough comprising a starch-based material having free asparagine, said method comprising the steps of:
 - a) adding a cation, having a valence of at least two, to said [a starch-based] dough [for a thermally processed food]; and
 - b) thermally processing said dough to produce a potato chip [starch-based food];

wherein said cation is added in an amount sufficient to reduce the final level of acrylamide in said potato chip to a level that is lower than if the cation had not been added at step a) [thermally processed food to an acceptable level].
2. (Currently Amended) The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said potato chip [thermally processed food] by at least 20 percent.
3. (Currently Amended) The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said potato chip [thermally processed food] by at least 35 percent.
4. (Currently Amended) The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said potato chip [thermally processed food] by about 50 percent.
5. (Currently Amended) The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said potato chip [thermally processed food] by a range of 50 to 95 percent.

10. (Currently Amended) The method of Claim 1, wherein said adding step a) adds a calcium ion to said [starch-based] dough, said calcium ion being part of a salt selected from the group of calcium chloride, calcium lactate, calcium citrate, calcium malate, calcium gluconate, calcium phosphate, calcium acetate, calcium sodium EDTA, calcium glycerophosphate, calcium hydroxide, calcium lactobionate, calcium oxide, calcium propionate, calcium carbonate, and calcium stearoyl lactate.
11. (Currently Amended) The method of Claim 1, wherein said adding step a) adds a magnesium ion to said [starch-based] dough, said magnesium ion being part of a salt selected from the group of magnesium chloride, magnesium citrate, magnesium lactate, magnesium malate, magnesium gluconate, magnesium phosphate, magnesium hydroxide, magnesium carbonate, and magnesium sulfate.
12. (Currently Amended) The method of Claim 1, wherein said adding step a) adds an aluminum ion to said [starch-based] dough, said ion being part of a salt selected from the group of aluminum chloride hexahydrate, aluminum chloride, aluminum hydroxide, ammonium alum, potassium alum, sodium alum, and aluminum sulfate.
13. (Currently Amended) The method of Claim 1, wherein said adding step a) adds an iron salt to said dough [food mixture], said salt being selected from the group of ferric chloride, ferrous gluconate, ferric ammonium citrate, ferric pyrophosphate, ferrous fumarate, ferrous lactate, and ferrous sulfate.
14. (Currently Amended) The method of Claim 1, wherein said adding step a) adds a copper ion to said [starch-based] dough, said copper ion being part of a salt selected from the group of cupric chloride, cupric gluconate, and cupric sulfate.
15. (Currently Amended) The method of Claim 1, wherein said thermally processing step b) comprises frying said [starch-based] dough.

16. (Currently Amended) The method of Claim 1, wherein said thermally processing step b) comprises baking said [starch-based] dough.

17[26]. (Currently Amended) The potato chip [thermally processed food] produced by the method of Claim 1.

18[27]. (Currently Amended) A method of preparing fabricated potato chips, said method comprising the steps of:

10

- a) preparing a mixture comprising potato flakes, water, and an ingredient that produces a cation having a valence of at least two, said ingredient selected from the group of salts consisting of calcium salts, magnesium salts, aluminum salts, iron salts, and copper salts;
- b) sheeting and cutting said mixture to form cut pieces; and
- c) thermally processing said cut pieces, wherein said ingredient reduces the formation of acrylamide in said fabricated potato chips.

19[28]. (Currently Amended) The method of Claim 18[27], wherein said thermal processing of step c) comprises baking.

20[29]. (Currently Amended) The method of Claim 18[27], wherein said thermal processing of step c) comprises frying.

21[30]. (Currently Amended) The method of Claim 18[27], wherein the formation of acrylamide in said fabricated potato chips is reduced by at least 50 percent over fabricated potato chips prepared [a product] without said cation.

22[31]. (Currently Amended) A fabricated potato chip produced by the method of Claim 18[27].

Cancelled Claims

17. (Cancelled) The method of Claim 1, wherein the starch-based dough comprises a starch component selected from the group consisting of potatoes, corn, barley, wheat, rye, rice, oats, and millet.
18. (Cancelled) The method of Claim 1, wherein said thermally processed food is a fabricated potato chip.
19. (Cancelled) The method of Claim 1, wherein said thermally processed food is a fabricated corn chip.
20. (Cancelled) The method of Claim 1, wherein said thermally processed food is a breakfast cereal.
21. (Cancelled) The method of Claim 1, wherein said thermally processed food is a cracker.
22. (Cancelled) The method of Claim 1, wherein said thermally processed food is a cookie.
23. (Cancelled) The method of Claim 1, wherein said thermally processed food is a hard pretzel.
24. (Cancelled) The method of Claim 1, wherein said thermally processed food is a bread product.
25. (Cancelled) The method of Claim 1, wherein said thermally processed food is a bread for a meat product.

Added Claims

23. (New) A method of lowering the level of acrylamide produced by the thermal processing of a chip manufactured from a dough comprising a corn-based material having free asparagine, said method comprising the steps of:
- 5 a) adding a cation, having a valence of at least two, to said dough; and
- b) thermally processing said dough to produce a chip;
- wherein said cation is added in an amount sufficient to reduce the final level of acrylamide in said chip to a level that is lower than if the cation had not been added at step a).
24. (New) The method of Claim 23, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said chip by at least 20 percent.
25. (New) The method of Claim 23, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said chip by at least 35 percent.
26. (New) The method of Claim 23, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said chip by about 50 percent.
27. (New) The method of Claim 23, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said chip by a range of 50 to 95 percent.
28. (New) The method of Claim 23, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of at least 1:5.

29. (New) The method of Claim 23, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of at least 1:3.
30. (New) The method of Claim 23, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of about 1:2.
31. (New) The method of Claim 23, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of about 1:1.
32. (New) The method of Claim 23, wherein said adding step a) adds a calcium ion to said dough, said calcium ion being part of a salt selected from the group of calcium chloride, calcium lactate, calcium citrate, calcium malate, calcium gluconate, calcium phosphate, calcium acetate, calcium sodium EDTA, calcium glycerophosphate, calcium hydroxide, calcium lactobionate, calcium oxide, calcium propionate, calcium carbonate, and calcium stearyl lactate.
33. (New) The method of Claim 23, wherein said adding step a) adds a magnesium ion to said dough, said magnesium ion being part of a salt selected from the group of magnesium chloride, magnesium citrate, magnesium lactate, magnesium malate, magnesium gluconate, magnesium phosphate, magnesium hydroxide, magnesium carbonate, and magnesium sulfate.
34. (New) The method of Claim 23, wherein said adding step a) adds an aluminum ion to said dough, said ion being part of a salt selected from the group of aluminum chloride hexahydrate, aluminum chloride, aluminum hydroxide, ammonium alum, potassium alum, sodium alum, and aluminum sulfate.
35. (New) The method of Claim 23, wherein said adding step a) adds an iron salt to said dough, said salt being selected from the group of ferric chloride, ferrous gluconate, ferric ammonium citrate, ferric pyrophosphate, ferrous fumarate, ferrous lactate, and ferrous sulfate.

36. (New) The method of Claim 23, wherein said adding step a) adds a copper ion to said dough, said copper ion being part of a salt selected from the group of cupric chloride, cupric gluconate, and cupric sulfate.
37. (New) The method of Claim 23, wherein said thermally processing step b) comprises frying said dough.
38. (New) The method of Claim 23, wherein said thermally processing step b) comprises baking said dough.
39. (New) The chip produced by the method of Claim 23.
40. (New) The method of Claim 23 wherein the chip is a corn chip.
41. (New) The method of Claim 23 wherein the chip is a tortilla chip.

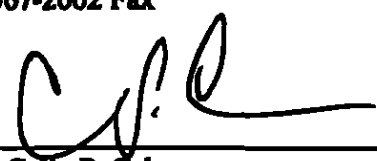
The Applicant considers pending Claims 1-41 to be in proper condition for international preliminary examination. Consideration of the referenced application as amended is hereby requested.

No fees are believed to be necessary. If, however, any fees are required, the Commissioner is hereby authorized to charge these fees to Carstens, Yee & Cahoon LLP, Deposit Account No. 50-0392. No extension of time is believed to be necessary. If, however, an extension of time is required, the extension is requested, and the Commissioner is hereby authorized to charge any fees for this extension to Carstens, Yee & Cahoon LLP, Deposit Account No. 50-0392.

The Examiner is cordially invited to call the undersigned at the below-listed telephone number if, in the opinion of the Examiner, such a telephone conference would expedite or aid the prosecution and examination of this application.

Respectfully submitted,

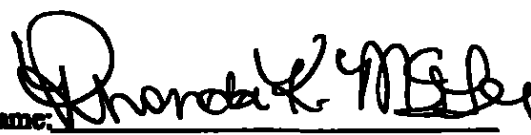
CARSTENS, YEE & CAHOON, L.L.P.
P.O. Box 802334
Dallas, Texas 75380
(972) 367-2001
(972) 367-2002 Fax

By: 

Colin P. Cahoon
Registration No. 38,836

Certificate of Mailing

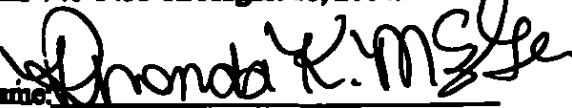
I hereby certify that the above document is being deposited with the United States Postal Service via first class mail, in an envelope addressed to: International Bureau of WIPO, 34, chemin des Colombettes, 1211 Geneva 20, Switzerland on August 18, 2004.


Name: Rhonda K. McGee

Rhonda K. McGee

Certificate of Facsimile Transmission

I hereby certify that the above document is being transmitted to the International Bureau of WIPO via facsimile number 011-41-22-740-1435 on August 18, 2004.


Name: Rhonda K. McGee

Rhonda K. McGee

CLAIMS:

What is claimed is:

1. A method of lowering the level of acrylamide produced by the thermal processing of a potato chip manufactured from a dough comprising a starch-based material having free asparagine, said method comprising the steps of:
 - a) adding a cation, having a valence of at least two, to said dough; and
 - b) thermally processing said dough to produce a potato chip;wherein said cation is added in an amount sufficient to reduce the final level of acrylamide in said potato chip to a level that is lower than if the cation had not been added at step a).
- 5 2. The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said potato chip by at least 20 percent.
3. The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said potato chip by at least 35 percent.
4. The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said potato chip by about 50 percent.
5. The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said potato chip by a range of 50 to 95 percent.

6. The method of Claim 1, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of at least 1:5.
7. The method of Claim 1, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of at least 1:3.
8. The method of Claim 1, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of about 1:2.
9. The method of Claim 1, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of about 1:1.
10. The method of Claim 1, wherein said adding step a) adds a calcium ion to said dough, said calcium ion being part of a salt selected from the group of calcium chloride, calcium lactate, calcium citrate, calcium malate, calcium gluconate, calcium phosphate, calcium acetate, calcium sodium EDTA, calcium glycerophosphate, calcium hydroxide, calcium lactobionate, calcium oxide, calcium propionate, calcium carbonate, and calcium stearoyl lactate.
11. The method of Claim 1, wherein said adding step a) adds a magnesium ion to said dough, said magnesium ion being part of a salt selected from the group of magnesium chloride, magnesium citrate, magnesium lactate, magnesium malate, magnesium gluconate, magnesium phosphate, magnesium hydroxide, magnesium carbonate, and magnesium sulfate.
12. The method of Claim 1, wherein said adding step a) adds an aluminum ion to said dough, said ion being part of a salt selected from the group of aluminum chloride hexahydrate, aluminum chloride, aluminum hydroxide, ammonium alum, potassium alum, sodium alum, and aluminum sulfate.
13. The method of Claim 1, wherein said adding step a) adds an iron salt to said dough, said salt being selected from the group of ferric chloride, ferrous gluconate, ferric ammonium citrate, ferric pyrophosphate, ferrous fumarate, ferrous lactate, and ferrous sulfate.

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14. The method of Claim 1, wherein said adding step a) adds a copper ion to said dough, said copper ion being part of a salt selected from the group of cupric chloride, cupric gluconate, and cupric sulfate.
 15. The method of Claim 1, wherein said thermally processing step b) comprises frying said dough.
 16. The method of Claim 1, wherein said thermally processing step b) comprises baking said dough.
 17. The potato chip produced by the method of Claim 1.

18. A method of preparing fabricated potato chips, said method comprising the steps of:
- a) preparing a mixture comprising potato flakes, water, and an ingredient that produces a cation having a valence of at least two, said ingredient selected from the group of salts consisting of calcium salts, magnesium salts, aluminum salts, iron salts, and copper salts;
 - b) sheeting and cutting said mixture to form cut pieces; and
 - c) thermally processing said cut pieces, wherein said ingredient reduces the formation of acrylamide in said fabricated potato chips.
- 5
19. The method of Claim 18, wherein said thermal processing of step c) comprises baking.
20. The method of Claim 18, wherein said thermal processing of step c) comprises frying.
21. The method of Claim 18, wherein the formation of acrylamide in said fabricated potato chips is reduced by at least 50 percent over fabricated potato chips prepared without said cation.
22. A fabricated potato chip produced by the method of Claim 18.

23. A method of lowering the level of acrylamide produced by the thermal processing of a chip manufactured from a dough comprising a corn-based material having free asparagine, said method comprising the steps of:
- 5 a) adding a cation, having a valence of at least two, to said dough; and
 b) thermally processing said dough to produce a chip;
 wherein said cation is added in an amount sufficient to reduce the final level of acrylamide in said chip to a level that is lower than if the cation had not been added at step a).
24. The method of Claim 23, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said chip by at least 20 percent.
25. The method of Claim 23, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said chip by at least 35 percent.
26. The method of Claim 23, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said chip by about 50 percent.
27. The method of Claim 23, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said chip by a range of 50 to 95 percent.
28. The method of Claim 23, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of at least 1:5.
29. The method of Claim 23, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of at least 1:3.
30. The method of Claim 23, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of about 1:2.
31. The method of Claim 23, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of about 1:1.

32. The method of Claim 23, wherein said adding step a) adds a calcium ion to said dough, said calcium ion being part of a salt selected from the group of calcium chloride, calcium lactate, calcium citrate, calcium malate, calcium gluconate, calcium phosphate, calcium acetate, calcium sodium EDTA, calcium glycerophosphate, calcium hydroxide, calcium lactobionate, calcium oxide, calcium propionate, calcium carbonate, and calcium stearoyl lactate.
- 5
33. The method of Claim 23, wherein said adding step a) adds a magnesium ion to said dough, said magnesium ion being part of a salt selected from the group of magnesium chloride, magnesium citrate, magnesium lactate, magnesium malate, magnesium gluconate, magnesium phosphate, magnesium hydroxide, magnesium carbonate, and magnesium sulfate.
34. The method of Claim 23, wherein said adding step a) adds an aluminum ion to said dough, said ion being part of a salt selected from the group of aluminum chloride hexahydrate, aluminum chloride, aluminum hydroxide, ammonium alum, potassium alum, sodium alum, and aluminum sulfate.
35. The method of Claim 23, wherein said adding step a) adds an iron salt to said dough, said salt being selected from the group of ferric chloride, ferrous gluconate, ferric ammonium citrate, ferric pyrophosphate, ferrous fumarate, ferrous lactate, and ferrous sulfate.
36. The method of Claim 23, wherein said adding step a) adds a copper ion to said dough, said copper ion being part of a salt selected from the group of cupric chloride, cupric gluconate, and cupric sulfate.
37. The method of Claim 23, wherein said thermally processing step b) comprises frying said dough.
38. The method of Claim 23, wherein said thermally processing step b) comprises baking said dough.
39. The chip produced by the method of Claim 23.

40. The method of Claim 23 wherein the chip is a corn chip.
41. The method of Claim 23 wherein the chip is a tortilla chip.

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METHOD FOR REDUCING ACRYLAMIDE FORMATION IN THERMALLY PROCESSED FOODS

ABSTRACT OF THE DISCLOSURE

In fabricated, thermally processed foods, the addition of one of a select group of divalent or trivalent cations to the recipe for the food inhibits the formation of acrylamide during the thermal processing. The cation can come from the group including calcium, magnesium, copper, aluminum, copper, and iron salts.

Mailing Date: August 18, 2004
Attorney: Colin P. Cahoon
Applicants: Elder, et al.
Title of Invention: "Method for Reducing Acrylamide Formation in Thermally Processed Foods"
U.S. Serial No.: 10/372,154
U.S. Filing Date: February 21, 2003
Int'l Serial No.: PCT/US2004/003448
Int'l Filing Date: 06 February 2004 (06.02.2004)
Docst No.: CPLAY.00179PCT

On the date stamped herein, the United States Patent and Trademark Office received the following:

1. PCT Transmittal Form (1 pg.)
2. Amendment Prior to Examination Demand Pursuant to Article 19 of the PCT (7 pgs.)
3. Replacement Sheets R-18 through R-25 (8 pgs.)
4. Forward Receipt (1 pg.)

Total Pages = 17

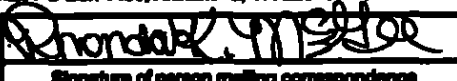
**TRANSMITTAL LETTER TO THE
UNITED STATES RECEIVING OFFICE**

Date	08 February 2004 (08.02.2004)
International Application No.	PCT/US2004/003448
Attorney Docket No.	CFLAY.00178P

I. Certification under 37 CFR 1.10 (if applicable)

EV 001139435 US	November 18, 2004
Express Mail mailing number	Date of Deposit

I hereby certify that the application/correspondence attached hereto is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to Mail Stop PCT, Commissioner for Patents, PO Box 1460, Alexandria, VA 22313-1460.

	Rhonda K. McGee
Signature of person mailing correspondence	Typed or printed name of person mailing correspondence

II. ☐ New International Application

TITLE	Method for Reducing Acrylamide Formation in Thermally Processed Foods	Earliest priority date (Day/Month/Year)
		21 February 2003 (21.02.2003)

SCREENING DISCLOSURE INFORMATION: In order to assist in screening the accompanying international application for purposes of determining whether a license for foreign transmittal should and could be granted and for other purposes, the following information is supplied. (Note: check as many boxes as apply):

A. ☐ The invention disclosed was not made in the United States.

B. ☐ There is no prior U.S. application relating to this invention.

C. ☒ The following prior U.S. application(s) contain subject matter which is related to the invention disclosed in the attached international application. (NOTE: priority to these applications may or may not be claimed on form PCT/RO/101 (Request) and this filing does not constitute a claim for priority.)

application no.	10/372,154	filed on	21 February 2003 (21.02.2003)
application no.		filed on	

D. ☐ The present international application contains additional subject matter not found in the prior U.S. application(s) identified in paragraph C. above. The additional subject matter is found on pages _____ and ☐ DOES NOT ALTER ☐ MIGHT BE CONSIDERED TO ALTER the general nature of the invention in a manner which would require the U.S. application to have been made available for inspection by the appropriate defense agencies under 35 U.S.C. 181 and 37 CFR 5.1. See 37 CFR 5.15.

III. ☐ A Response to an invitation from the RO/US. The following document(s) is (are) enclosed:

A. ☐ A Request for An Extension of Time to File a Response

B. ☐ A Power of Attorney (General or Regular)

C. ☐ Replacement pages:

pages	of the request (PCT/RO/101)	pages	of the figures
pages	of the description	pages	of the abstract
pages	of the claims		

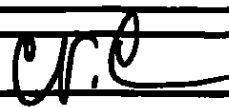
D. ☐ Submission of Priority Documents

Priority document	Priority document
-------------------	-------------------

E. ☐ Fee as specified on attached Fee Calculation sheet form PCT/RO/101 annex

IV. ☐ A Request for Rectification under PCT 81 ☐ A Petition ☐ A Sequence Listing Disclosure

V. ☒ Other (please specify): PCT Demand

The person signing this form is the:	☐ Applicant	Colin P. Cahoon, Registration No. 36,636
	☒ Attorney/Agent (Reg. No.)	Typed name of signer
	☐ Common Representative	 Signature

The demand must be filed directly with the competent International Preliminary Examining Authority or, if two or more Authorities are competent, with the one chosen by the applicant. The full name or two-letter code of that Authority may be indicated by the applicant on the line below:
IPEA/ RO/US

PCT

CHAPTER II

DEMAND

under Article 31 of the Patent Cooperation Treaty:
The undersigned requests that the international application specified below be the subject of international preliminary examination according to the Patent Cooperation Treaty.

For International Preliminary Examining Authority use only		
Identification of IPEA		Date of receipt of DEMAND
Box No. I IDENTIFICATION OF THE INTERNATIONAL APPLICATION		Applicant's or agent's file reference CFLAY.00179P
International application No. PCT/US2004/003448	International filing date (day/month/year) 08 February 2004 (08.02.2004)	(Earliest) Priority date (day/month/year) 21 February 2003 (21.02.2003)
Title of invention Method for Reducing Acrylamide Formation in Thermally Processed Foods		
Box No. II APPLICANT(S)		
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) FRITO-LAY NORTH AMERICA, INC. 7701 Legacy Drive Plano, TX 75024-4099 US		Telephone No.
		Facsimile No.
		Teleprinter No.
		Applicant's registration No. with the Office
State (that is, country) of nationality: US		State (that is, country) of residence: US
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) ELDER, Vincent Allen 2903 Panorama Drive Carrollton, TX 75007 US		
State (that is, country) of nationality: US		State (that is, country) of residence: US
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) FULCHER, John Gregory 9930 Ontario Lane Dallas, TX 75220 US		
State (that is, country) of nationality: US		State (that is, country) of residence: US
☒ Further applicants are indicated on a continuation sheet.		

Sheet No. 2

International application No.
PCT/US2004/003448

Continuation of Box No. II APPLICANT(S)

If none of the following sub-items is used, this sheet should not be included in the demand.

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

LEUNG, Henry Kin-Hang
3704 Ellington Drive
Plano, TX 75093
USState (that is, country) of nationality:
USState (that is, country) of residence:
US

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

TOPOR, Michael Grant
3573 Pinnacle Bay Point
Little Elm, TX 75068
USState (that is, country) of nationality:
USState (that is, country) of residence:
US

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

State (that is, country) of nationality:

State (that is, country) of residence:

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

State (that is, country) of nationality:

State (that is, country) of residence:



Further applicants are indicated on another continuation sheet.

Box No. III AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCEThe following person is ☒ agent ☐ common representativeand ☒ has been appointed earlier and represents the applicant(s) also for international preliminary examination.☐ is hereby appointed and any earlier appointment of (an) agent(s)/common representative is hereby revoked.☐ is hereby appointed, specifically for the procedure before the International Preliminary Examining Authority, in addition to the agent(s)/common representative appointed earlier.Name and address: (Family name followed by given name; for a legal entity, full official designation.
The address must include postal code and name of country.)CAHOON, Colin P.
Carstens & Cahoon, LLP
Customer No. 22,858
P.O. Box 802334
Dallas, TX 75380
US

Telephone No.

972-387-2001

Facsimile No.

972-387-2002

Teleprinter No.

Agent's registration No. with the Office
38,836☐ Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.**Box No. IV BASIS FOR INTERNATIONAL PRELIMINARY EXAMINATION****Statement concerning amendments:***

1. The applicant wishes the international preliminary examination to start on the basis of:

☒ the international application as originally filedthe description ☒ as originally filed
☐ as amended under Article 34the claims ☐ as originally filed
☒ as amended under Article 19 (together with any accompanying statement)
☐ as amended under Article 34the drawings ☒ as originally filed
☐ as amended under Article 342. ☐ The applicant wishes any amendment to the claims under Article 19 to be considered as reversed.3. ☐ The applicant wishes the start of the international preliminary examination to be postponed until the expiration of the applicable time limit under Rule 69.1(d).4. ☒ The applicant expressly wishes the international preliminary examination to start earlier than at the expiration of the applicable time limit under Rule 54bis.1(a).

* Where no check-box is marked, international preliminary examination will start on the basis of the international application as originally filed or, where a copy of amendments to the claims under Article 19 and/or amendments of the international application under Article 34 are received by the International Preliminary Examining Authority before it has begun to draw up a written opinion or the international preliminary examination report, as so amended.

Language for the purposes of international preliminary examination: English

☒ which is the language in which the international application was filed.☐ which is the language of a translation furnished for the purposes of international search.☐ which is the language of publication of the international application.☐ which is the language of the translation (to be) furnished for the purposes of international preliminary examination.**Box No. V ELECTION OF STATES**

The filing of this demand constitutes the election of all Contracting States which are designated and are bound by Chapter II of the PCT.

Box No. VI CHECK LIST

The demand is accompanied by the following elements, in the language referred to in Box No. IV, for the purposes of international preliminary examination:

1. translation of international application	:	sheets	For International Preliminary Examining Authority use only
2. amendments under Article 34	:	sheets	received not received
3. copy (or, where required, translation) of amendments under Article 19	:	25 sheets	☐ ☐
4. copy (or, where required, translation) of statement under Article 19	:	sheets	☐ ☐
5. letter	:	sheets	☐ ☐
6. other (specify) Postcard Receipt	:	1 sheets	☐ ☐

The demand is also accompanied by the item(s) marked below:

1. ☒ fee calculation sheet	5. ☐ statement explaining lack of signature
2. ☐ original separate power of attorney	6. ☐ sequence listing in computer readable form
3. ☐ original general power of attorney	7. ☐ tables in computer readable form related to a sequence listing
4. ☐ copy of general power of attorney; reference number, if any:	8. ☐ other (specify):

Box No. VII SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the demand).


Colin P. Cahoon
Registration No. 38,836

For International Preliminary Examining Authority use only

1. Date of actual receipt of DEMAND:

2. Adjusted date of receipt of demand due to CORRECTIONS under Rule 60.1(b):

3. ☐ The date of receipt of the demand is AFTER the expiration of 19 months from the priority date and item 4 or 5, below, does not apply. ☐ The applicant has been informed accordingly.	6. ☐ The date of receipt of the demand is AFTER the expiration of the time limit under Rule 54bis.1(a) and item 7 or 8, below, does not apply.
4. ☐ The date of receipt of the demand is WITHIN the time limit of 19 months from the priority date as extended by virtue of Rule 80.5.	7. ☐ The date of receipt of the demand is WITHIN the time limit under Rule 54bis.1(a) as extended by virtue of Rule 80.5.
5. ☐ Although the date of receipt of the demand is after the expiration of 19 months from the priority date, the delay in arrival is EXCUSED pursuant to Rule 82.	8. ☐ Although the date of receipt of the demand is after the expiration of the time limit under Rule 54bis.1(a), the delay in arrival is EXCUSED pursuant to Rule 82.

For International Bureau use only

Demand received from IPEA on:

PCT

FEE CALCULATION SHEET

Annex to the Demand

International application No. PCT/US2004/003448 Applicant's or agent's file reference CFLAY.00179P Applicant FRITO-LAY NORTH AMERICA, INC.	For International Preliminary Examining Authority use only Date stamp of the IPBA		
CALCULATION OF PRESCRIBED FEES			
1. Preliminary examination fee	600.00 P		
2. Handling fee (<i>Applicants from certain States are entitled to a reduction of 75% of the handling fee. Where the applicant is (or all applicants are) so entitled, the amount to be entered at H is 25% of the handling fee.</i>)	162.00 H		
3. Total of prescribed fees Add the amounts entered at P and H and enter total in the TOTAL box	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: right; padding: 5px;">762.00</td> </tr> <tr> <td style="text-align: center; padding: 5px;">TOTAL</td> </tr> </table>	762.00	TOTAL
762.00			
TOTAL			
MODE OF PAYMENT <table style="width: 100%;"> <tr> <td style="width: 50%; vertical-align: top;"> ☐ authorization to charge deposit account with the IPBA (see below) ☒ cheque ☐ postal money order ☐ bank draft </td> <td style="width: 50%; vertical-align: top;"> ☐ cash ☐ revenue stamps ☐ coupons ☐ other (specify): </td> </tr> </table>		☐ authorization to charge deposit account with the IPBA (see below) ☒ cheque ☐ postal money order ☐ bank draft	☐ cash ☐ revenue stamps ☐ coupons ☐ other (specify):
☐ authorization to charge deposit account with the IPBA (see below) ☒ cheque ☐ postal money order ☐ bank draft	☐ cash ☐ revenue stamps ☐ coupons ☐ other (specify):		
AUTHORIZATION TO CHARGE (OR CREDIT) DEPOSIT ACCOUNT <i>(This mode of payment may not be available at all IPBAs)</i> ☐ Authorization to charge the total fees indicated above. ☒ <i>(This check-box may be marked only if the conditions for deposit accounts of the IPBA as permitted) Authorization to charge any deficiency or credit any overpayment in the total fees indicated above.</i> IPBA/ <u>RO/US</u> Deposit Account No.: <u>50-0392</u> Date: <u>November 18, 2004</u> Name: <u>Colin P. Cahoon</u> Signature: <u></u>			

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IN THE INTERNATIONAL BUREAU OF WIPO

Int'l Application: PCT/US2004/003448
Applicant: FRITO-LAY NORTH AMERICA, INC. FKA RECOT,
Inc.
Filing Date: 06 February 2004 (06.02.2004)
Priority Date: 21 February 2003 (21.02.2003)
Title: Method for Reducing Acrylamide Formation in
Thermally Processed Foods
Attorney Docket No.: CFLAY.00179PCT

**REPLY TO THE WRITTEN OPINION AND
AMENDMENT PRIOR TO EXAMINATION DEMAND
PURSUANT TO ARTICLE 12
OF THE PATENT COOPERATION TREATY**

This is in timely reply to the Written Opinion issued in this matter on 24 August 2004, and to place the above-identified application claims in better condition for International Preliminary Examination. The Applicant offers the following reply:

AMENDMENT

Please replace sheets 18-22 with the attached replacement sheets R-18 through R-25.

COMMENT

Claims 1-31 are pending. By the enclosed replacement sheets R-18 through R-25, to be substituted for sheets 18-22 of the pending application, Claims 1-5, 10-16, 26, and 30 have been substantively amended; Claims 17-25 have been cancelled. No substantive changes were made to Claims 6-9, 27-29,

and 31. The remaining claims have been renumbered accordingly as Claims 1-22. New claims 23-41 have been added. Therefore, claims 1-41 are now pending in the present application. A redline version of the claims reflecting all amendments is shown below.

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Amended Claims:

1. (Currently Amended) A method of lowering the level of acrylamide produced by the thermal processing of a potato chip [in a thermally processed food] manufactured from a dough comprising a starch-based material having free asparagine, said method comprising the steps of:
 - a) adding a cation, having a valence of at least two, to said [a starch-based] dough [for a thermally processed food]; and
 - b) thermally processing said dough to produce a potato chip [starch-based food];

wherein said cation is added in an amount sufficient to reduce the final level of acrylamide in said potato chip to a level that is lower than if the cation had not been added at step a) [thermally processed food to an acceptable level].

2. (Currently Amended) The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said potato chip [thermally processed food] by at least 20 percent.
3. (Currently Amended) The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said potato chip [thermally processed food] by at least 35 percent.
4. (Currently Amended) The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said potato chip [thermally processed food] by about 50 percent.

5. (Currently Amended) The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said potato chip [thermally processed food] by a range of 50 to 95 percent.
10. (Currently Amended) The method of Claim 1, wherein said adding step a) adds a calcium ion to said [starch-based] dough, said calcium ion being part of a salt selected from the group of calcium chloride, calcium lactate, calcium citrate, calcium malate, calcium gluconate, calcium phosphate, calcium acetate, calcium sodium EDTA, calcium glycerophosphate, calcium hydroxide, calcium lactobionate, calcium oxide, calcium propionate, calcium carbonate, and calcium stearoyl lactate.
11. (Currently Amended) The method of Claim 1, wherein said adding step a) adds a magnesium ion to said [starch-based] dough, said magnesium ion being part of a salt selected from the group of magnesium chloride, magnesium citrate, magnesium lactate, magnesium malate, magnesium gluconate, magnesium phosphate, magnesium hydroxide, magnesium carbonate, and magnesium sulfate.
12. (Currently Amended) The method of Claim 1, wherein said adding step a) adds an aluminum ion to said [starch-based] dough, said ion being part of a salt selected from the group of aluminum chloride hexahydrate, aluminum chloride, aluminum hydroxide, ammonium alum, potassium alum, sodium alum, and aluminum sulfate.
13. (Currently Amended) The method of Claim 1, wherein said adding step a) adds an iron salt to said dough [food mixture], said salt being selected from the group of ferric chloride, ferrous gluconate, ferric ammonium citrate, ferric pyrophosphate, ferrous fumarate, ferrous lactate, and ferrous sulfate.

14. (Currently Amended) The method of Claim 1, wherein said adding step a) adds a copper ion to said [starch-based] dough, said copper ion being part of a salt selected from the group of cupric chloride, cupric gluconate, and cupric sulfate.

15. (Currently Amended) The method of Claim 1, wherein said thermally processing step b) comprises frying said [starch-based] dough.

16. (Currently Amended) The method of Claim 1, wherein said thermally processing step b) comprises baking said [starch-based] dough.

17[26]. (Currently Amended) The potato chip [thermally processed food] produced by the method of Claim 1.

18[27]. (Currently Amended) A method of preparing fabricated potato chips, said method comprising the steps of:

- a) preparing a mixture comprising potato flakes, water, and an ingredient that produces a cation having a valence of at least two, said ingredient selected from the group of salts consisting of calcium salts, magnesium salts, aluminum salts, iron salts, and copper salts;
- b) sheeting and cutting said mixture to form out pieces; and
- c) thermally processing said out pieces, wherein said ingredient reduces the formation of acrylamide in said fabricated potato chips.

19[28]. (Currently Amended) The method of Claim 18[27], wherein said thermal processing of step c) comprises baking.

20[29]. (Currently Amended) The method of Claim 18[27], wherein said thermal processing of step c) comprises frying.

21[30]. (Currently Amended) The method of Claim 18[27], wherein the formation of acrylamide in said fabricated potato chips is reduced by at least 50 percent over fabricated potato chips prepared [a product] without said cation.

22[31]. (Currently Amended) A fabricated potato chip produced by the method of Claim 18[27].

Cancelled Claims

17. (Cancelled) The method of Claim 1, wherein the starch-based dough comprises a starch component selected from the group consisting of potatoes, corn, barley, wheat, rye, rice, oats, and millet.

18. (Cancelled) The method of Claim 1, wherein said thermally processed food is a fabricated potato chip.

19. (Cancelled) The method of Claim 1, wherein said thermally processed food is a fabricated corn chip.

20. (Cancelled) The method of Claim 1, wherein said thermally processed food is a breakfast cereal.

21. (Cancelled) The method of Claim 1, wherein said thermally processed food is a cracker.

22. (Cancelled) The method of Claim 1, wherein said thermally processed food is a cookie.
23. (Cancelled) The method of Claim 1, wherein said thermally processed food is a hard pretzel.
24. (Cancelled) The method of Claim 1, wherein said thermally processed food is a bread product.
25. (Cancelled) The method of Claim 1, wherein said thermally processed food is a breading for a meat product.

Added Claims

23. (New) A method of lowering the level of acrylamide produced by the thermal processing of a chip manufactured from a dough comprising a corn-based material having free asparagine, said method comprising the steps of:
- a) adding a cation, having a valence of at least two, to said dough; and
 - b) thermally processing said dough to produce a chip; wherein said cation is added in an amount sufficient to reduce the final level of acrylamide in said chip to a level that is lower than if the cation had not been added at step a).

24. (New) The method of Claim 23, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said chip by at least 20 percent.
25. (New) The method of Claim 23, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said chip by at least 35 percent.
26. (New) The method of Claim 23, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said chip by about 50 percent.
27. (New) The method of Claim 23, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said chip by a range of 50 to 95 percent.
28. (New) The method of Claim 23, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of at least 1:5.
29. (New) The method of Claim 23, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of at least 1:3.
30. (New) The method of Claim 23, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of about 1:2.
31. (New) The method of Claim 23, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of about 1:1.

32. (New) The method of Claim 23, wherein said adding step a) adds a calcium ion to said dough, said calcium ion being part of a salt selected from the group of calcium chloride, calcium lactate, calcium citrate, calcium malate, calcium gluconate, calcium phosphate, calcium acetate, calcium sodium EDTA, calcium glycerophosphate, calcium hydroxide, calcium lactobionate, calcium oxide, calcium propionate, calcium carbonate, and calcium stearoyl lactate.
33. (New) The method of Claim 23, wherein said adding step a) adds a magnesium ion to said dough, said magnesium ion being part of a salt selected from the group of magnesium chloride, magnesium citrate, magnesium lactate, magnesium malate, magnesium gluconate, magnesium phosphate, magnesium hydroxide, magnesium carbonate, and magnesium sulfate.
34. (New) The method of Claim 23, wherein said adding step a) adds an aluminum ion to said dough, said ion being part of a salt selected from the group of aluminum chloride hexahydrate, aluminum chloride, aluminum hydroxide, ammonium alum, potassium alum, sodium alum, and aluminum sulfate.
35. (New) The method of Claim 23, wherein said adding step a) adds an iron salt to said dough, said salt being selected from the group of ferric chloride, ferrous gluconate, ferric ammonium citrate, ferric pyrophosphate, ferrous fumarate, ferrous lactate, and ferrous sulfate.
36. (New) The method of Claim 23, wherein said adding step a) adds a copper ion to said dough, said copper ion being part of a salt selected from the group of cupric chloride, cupric gluconate, and cupric sulfate.

37. (New) The method of Claim 23, wherein said thermally processing step b) comprises frying said dough.
38. (New) The method of Claim 23, wherein said thermally processing step b) comprises baking said dough.
39. (New) The chip produced by the method of Claim 23.
40. (New) The method of Claim 23 wherein the chip is a corn chip.
41. (New) The method of Claim 23 wherein the chip is a tortilla chip.

Comments in Response to the Written Opinion

The written opinion states:



Claims 1-31 are objected to under PCT Rule 66.2(a)(v) as lacking clarity under PCT Article 6 because said claims are indefinite for the following reason(s):

Within the claims, the terms "lowering", and "reduce" are relative terms which render the claims indefinite. The specification does not provide a standard for ascertaining the requisite degree. It is unclear over what original amount the acrylamide concentrations are reduced or lowered. For example, claim 1 recites "a method of lowering the level of acrylamide in a thermally processed food", yet the thermally processed food is not the starting material processed with in the claimed method, in order for the (original) acrylamide amount to be "lowered". The process may provide a reduced amount of acrylamide in a food product as compared to the same food product which has been similarly-processed, except for the step(s) of adding the cation; however, it does not appear that a food product actually undergoes a reduction in the amount of acrylamide it contains.

Applicant's Response:

Applicants believe that this rejection has been adequately addressed by amendments made to Claim 1. Specifically, in the preamble, Applicants have made clear that the method is directed to lowering the level of acrylamide "produced by the thermal processing of a potato chip" and have inserted the phrase "having free asparagine" in order to provide an antecedent basis for the use of the term in Claims 6-9. Independent claim 18 clearly indicates the ingredient reduces the formation of acrylamide and is not believed indefinite. Claim 30 has also been amended to clarify which product is experiencing a reduction in the production of acrylamide.

By way of these amendments, Applicants believe that all of Examiner's rejections have been adequately addressed and should be withdrawn.

Claims 1-10, 16, 21-24 and 26 lack novelty under PCT Article 33(2) as being anticipated by Zimmerman et al. (US PAT 5,514,387).

Examiner further asserts,

Zimmerman et al. disclose a "calcium-enriched baked good and method of making", which comprises adding a calcium compound to the flour or dough ingredients. At column 6, it is stated that "the calcium component may be one or more edible acidic, neutral or basic inorganic or acid salts", such as calcium citrate or calcium malate (col. 6, lines 51-56). "The flour component may be any comminuted cereal grain or edible seed or vegetable meal", including flour and starches from corn, wheat, potato and rice (top col. 12). Reducing sugars such as fructose may be added to the flour component mixture as well. The dough compositions are then baked at temperatures above 250°F, or 121°C (col. 20). The process may be used to form "cookies, brownies, snacks, snack chips, bagel chips, Malba toast, pretzels and the like" (abstract and col. 6).

As stated in the first paragraph of column 5, "calcium carbonate is the preferred calcium component for enriching the calcium content of baked goods in accordance with the present invention."

Specific amount of calcium carbonate are provided therein. Thus, the instantly-claimed invention is anticipated by the reference. As the examined claims do not recite specific ranges or amounts of the added cations, and encompass broad ranges of the cations, so long as they provide a "reduced" amount of acrylamide in the thermally processed food, the ranges recited in the reference would be expected to meet the instant claim limitations. Note that the amounts recited in the reference meet or exceed the amounts exemplified by applicant's examples in the specification, being the best available amounts to compare. Regarding claims 6-9, it is noted that free asparagines occurs in many vegetables, including high amounts in cereal grain products and potato, and thus this interaction between the free asparagines and cation would naturally take place upon the addition of the magnesium carbonate or calcium carbonate to the flour dough product, as performed in the reference.

Applicant's Response:

Independent Claim 1 has been amended and new independent Claim 23 added, thus narrowing the scope of the claims presented herein to methods for

reducing acrylamide in potato chips and corn-based chips, respectively. For at least this reason, the rejection of all of the claims under *Zimmerman* should be withdrawn, as the reference does not disclose the addition of divalent or trivalent cations to the process for making either potato chips or corn-based chips.

Claims 1-19, 21-23 and 26-31 lack novelty under PCT Article 33(2) as being anticipated by Proise et al. (US PAT 6,716,462).

Examiner further asserts,

Proise et al. disclose snack foods which "provide a balanced mix of an amino acid source, fat, and carbohydrates" (abstract). Columns 3 and 5 recite various snacks which may be produced by the invention, including baked and fried snack foods such as potato crisps, corn chips, crackers, cookies and pretzels. Each of these requires the processing of a starch-based dough. Column 23 discloses the fortification of the snack food dough with various minerals and their salts. "Embodiments of the present invention may be fortified with minerals such as calcium, phosphorus, magnesium, iron, zinc, iodine, selenium, copper, manganese, fluoride, chromium, molybdenum, sodium, potassium, and chloride." Specific amount of calcium, magnesium, iron, copper, phosphorus, and zinc are provided therein. Furthermore, the salts of these minerals may be utilized. "The source of the mineral salt, both those with established U.S. RDA levels or with safe and adequate intake levels, as well as those with no as yet established human requirement, used in the practice of this invention, can be any of the well known salts including carbonate, oxide, hydroxide, chloride, sulfate, phosphate, pyrophosphate, gluconate, lactate, acetate, fumarate, citrate, malate, amino acids and the like for the cationic minerals and sodium, potassium, calcium, magnesium and the like ingredients. Elemental iron (electrolytic or reduced iron) is another preferred source of iron." Example 21 provides a fabricated potato crisp made according to the methods outlined in the reference. Example one provides an exemplified amount of sodium aluminum phosphate, at 0.76%.

Applicant's Response:

Examiner cites passing references from several disparate and unconnected sources when using *Proise* as a reference. For example, Examiner looks to columns 3 and 5 for laundry lists of what the *Proise* disclosure considers to be

"traditional snacks" or "snacks." The listed items, which *Prosize* nowhere suggests are all applicable to the methods disclosed, include potato chips and corn chips as well as about forty other examples ranging from "pies" to "popcorn" to "pork rinds" to "nuts" to "candy." Examiner then looks to column 23 for disclosure of a laundry list of numerous minerals and their salts, any one of which may or may not be used by the *Prosize* method. Examiner ignores the proviso that embodiments of the *Prosize* method "may optionally be fortified with vitamins and minerals" and instead leaps to the conclusions that all forty disclosed "snacks," including pork rinds, nuts, candy, meat snacks, dips, dried fruits, and potato chips, are necessarily thus fortified by the *Prosize* method. (Column 21, lines 34-35). In fact, of the twenty-five examples of the *Prosize* method specifically disclosed, only one, Example 21, relates to a method for making fabricated potato crisps. In Example 21, no minerals or their salts are used. Further, *Prosize* does not disclose any example of an application to corn or tortilla chips of the *Prosize* method. In point of fact, *Prosize* does not teach the use of the addition of divalent or trivalent cations in the production of fabricated potato chips or fabricated corn-based chips, just as it does not teach the addition of such to popcorn or pork rinds. Rather, *Prosize* teaches away from adding divalent or trivalent cations to a potato based dough by not disclosing such in the only example (Example 21) of the *Prosize* method applied to potato chips.

It is well established that a "reference must clearly and unequivocally disclose the claimed compound or direct those skilled in the art to the compound without any need for picking, choosing, and combining various disclosures not directly related to each other by the teachings of the cited reference" in order to support an anticipation rejection under §102. *In re Artley*, 455 F.2d 586, 587 (CCPA 1972). "To anticipate, every single element and limitation of the claimed invention must be found in a single prior art reference, arranged as in the claim." *Brown v. 3M*, 265 F.3d 1349, 1351 (Fed. Cir. 2001). "It is not sufficient that each element be found somewhere in the reference. The elements must be 'arranged as in the claims.'" *Lindemann Maschinenfabrik GmbH v. American Holt & Derrick Co.*, 730 F.2d 1452, 1458 (Fed. Cir. 1984). "Not only must all claimed elements

be present in the prior device, but the elements must be found in substantially the same situation where they do substantially the same work." *Gillette Co. v. Warner-Lambert Co.*, 690 F.Supp. 115, 117 (D.Mass. 1988).

The use of *Proslie* as an anticipation rejection does not comport with the overwhelming case law requiring that the specific elements disclosed therein must be arranged as in the claims. "Such picking and choosing ... has no place in the making of a 102, anticipation rejection." *Brown*, at 1351. Consequently, Applicants believe no claims are anticipated by the *Proslie* reference.

Claims 1-11, 16-17 and 26 lack novelty under PCT Article 33(2) as being anticipated by Dapper (GB 335,214).

Examiner further asserts,

Dapper discloses the addition of magnesium carbonate or calcium carbonate to flour or dough components, for use in producing baked goods. The exemplified quantity disclosed incorporates 50 grams of magnesium carbonate per 100 kg of flour. Thus, applicant's claims are anticipated by the reference.

Applicant's Response:

Independent Claim 1 has been amended and new independent Claim 23 added, thus narrowing the scope of the claims presented herein to methods for reducing acrylamide in potato chips and corn-based chips, respectively. Thus, the *Dapper* reference does not disclose the addition of divalent or trivalent cations to the process for making either potato chips or corn-based chips.

Claims 1-10, 15-17 20, 23 and 26 lack novelty under PCT Article 33(2) as being anticipated by Leusner et al. (US 6,210,720).

Examiner further asserts,

Leusner et al. disclose calcium fortified ready-to-eat cereal products. These products are made by producing a dough from various cereal grains such as wheat, rice, oats or barley (col. 7). The products may be baked, extruded, puffed or fried (bottom col. 8 through mid-col. 10). The preferred calcium source is calcium carbonate, but may also include calcium phosphate (col. 5). Specific amounts of these mineral salts are provided at columns 4-5. The cereal dough may also be formed as "half-products", which are subsequently formed into other foodstuffs. "Also, the present invention can be used to provide pretzel snack products fortified with calcium"(top col. 9). Furthermore, the "finished products are remarkably free of the undesirable discoloration heretofore associated with finished light colored dried cereal products high in calcium content."

Applicant's Response:

Independent Claim 1 has been amended and new independent Claim 23 added, thus narrowing the scope of the claims presented herein to methods for reducing acrylamide in potato chips and corn-based chips, respectively. Thus, the Leusner reference does not disclose the addition of divalent or trivalent cations to the process for making either potato chips or corn-based chips.

Claim 25 lacks novelty under PCT Article 33(2) as being obvious over any of the following: Zimmerman et al., Prosser et al., Dapper, or Leusner et al.

Examiner further asserts,

Claim 25 is directed to a "breeding for a meat product." The definition of a breeding is open to interpretation, and yet is commonly accepted in the art as a collection of bread crumbs, or small crumbled pieces of another cooked grain product, which are applied as a coating to various foodstuffs, including meat. While the prior art references do not specifically recite the use of the cooked dough material as a breeding, it would have been obvious to one of ordinary skill in the art to have utilized these materials as

such, given this common and well-known utility of the product. Furthermore, as the disclosed products would naturally form crumb pieces themselves, there is nothing in the instant claim which would differentiate the invention from the prior art. It is noted that the coating of a meat product would not materially affect the composition of the breading, *per se*. Since the prior art structure is capable of performing the intended use, it meets the claim.

Applicant's Response:

While Applicants respectfully disagree with and traverse this rejection, in order to advance the prosecution of this case, Claim 25 has been withdrawn.

The examiner is invited to call the undersigned at the below-listed telephone number, in the opinion of the examiner, such a telephone conference would expedite or aid the prosecution and examination of this application.

Date: October 13, 2004

Respectfully submitted,



Chad Walter
Registration No. 54,625
Attorney for Applicant

CARSTENS, YEE & CAHOON, L.L.P.
P.O. Box 802334
Dallas, TX 75380
Telephone 972.367.2001
Facsimile 972.367.2002

CLAIMS:

What is claimed is:

1. A method of lowering the level of acrylamide produced by the thermal processing of a potato chip manufactured from a dough comprising a starch-based material having free asparagine, said method comprising the steps of:
 - a) adding a cation, having a valence of at least two, to said dough; and
 - b) thermally processing said dough to produce a potato chip;
 wherein said cation is added in an amount sufficient to reduce the final level of acrylamide in said potato chip to a level that is lower than if the cation had not been added at step a).
2. The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said potato chip by at least 20 percent.
3. The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said potato chip by at least 35 percent.
4. The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said potato chip by about 50 percent.
5. The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said potato chip by a range of 50 to 95 percent.

6. The method of Claim 1, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of at least 1:5.
7. The method of Claim 1, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of at least 1:3.
8. The method of Claim 1, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of about 1:2.
9. The method of Claim 1, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of about 1:1.
- 5 10. The method of Claim 1, wherein said adding step a) adds a calcium ion to said dough, said calcium ion being part of a salt selected from the group of calcium chloride, calcium lactate, calcium citrate, calcium malate, calcium gluconate, calcium phosphate, calcium acetate, calcium sodium EDTA, calcium glycerophosphate, calcium hydroxide, calcium lactobionate, calcium oxide, calcium propionate, calcium carbonate, and calcium stearoyl lactate.
11. The method of Claim 1, wherein said adding step a) adds a magnesium ion to said dough, said magnesium ion being part of a salt selected from the group of magnesium chloride, magnesium citrate, magnesium lactate, magnesium malate, magnesium gluconate, magnesium phosphate, magnesium hydroxide, magnesium carbonate, and magnesium sulfate.
12. The method of Claim 1, wherein said adding step a) adds an aluminum ion to said dough, said ion being part of a salt selected from the group of aluminum chloride hexahydrate, aluminum chloride, aluminum hydroxide, ammonium alum, potassium alum, sodium alum, and aluminum sulfate.
13. The method of Claim 1, wherein said adding step a) adds an iron salt to said dough, said salt being selected from the group of ferric chloride, ferrous gluconate, ferric ammonium citrate, ferric pyrophosphate, ferrous fumarate, ferrous lactate, and ferrous sulfate.

14. The method of Claim 1, wherein said adding step a) adds a copper ion to said dough, said copper ion being part of a salt selected from the group of cupric chloride, cupric gluconate, and cupric sulfate.
15. The method of Claim 1, wherein said thermally processing step b) comprises frying said dough.
16. The method of Claim 1, wherein said thermally processing step b) comprises baking said dough.
17. The potato chip produced by the method of Claim 1.

18. A method of preparing fabricated potato chips, said method comprising the steps of:
- a) preparing a mixture comprising potato flakes, water, and an ingredient that produces a cation having a valence of at least two, said ingredient selected from the group of salts consisting of calcium salts, magnesium salts, aluminum salts, iron salts, and copper salts;
 - b) sheeting and cutting said mixture to form cut pieces; and
 - c) thermally processing said cut pieces, wherein said ingredient reduces the formation of acrylamide in said fabricated potato chips.
- 5
19. The method of Claim 18, wherein said thermal processing of step c) comprises baking.
20. The method of Claim 18, wherein said thermal processing of step c) comprises frying.
21. The method of Claim 18, wherein the formation of acrylamide in said fabricated potato chips is reduced by at least 50 percent over fabricated potato chips prepared without said cation.
22. A fabricated potato chip produced by the method of Claim 18.

23. A method of lowering the level of acrylamide produced by the thermal processing of a chip manufactured from a dough comprising a corn-based material having free asparagine, said method comprising the steps of:
- a) adding a cation, having a valence of at least two, to said dough; and
 - b) thermally processing said dough to produce a chip;
- 5 wherein said cation is added in an amount sufficient to reduce the final level of acrylamide in said chip to a level that is lower than if the cation had not been added at step a).
24. The method of Claim 23, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said chip by at least 20 percent.
25. The method of Claim 23, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said chip by at least 35 percent.
26. The method of Claim 23, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said chip by about 50 percent.
27. The method of Claim 23, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said chip by a range of 50 to 95 percent.
28. The method of Claim 23, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of at least 1:5.
29. The method of Claim 23, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of at least 1:3.
30. The method of Claim 23, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of about 1:2.
31. The method of Claim 23, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of about 1:1.

32. The method of Claim 23, wherein said adding step a) adds a calcium ion to said dough, said calcium ion being part of a salt selected from the group of calcium chloride, calcium lactate, calcium citrate, calcium malate, calcium gluconate, calcium phosphate, calcium acetate, calcium sodium EDTA, calcium glycerophosphate, calcium hydroxide, calcium lactobionate, calcium oxide, calcium propionate, calcium carbonate, and calcium stearoyl lactate.
33. The method of Claim 23, wherein said adding step a) adds a magnesium ion to said dough, said magnesium ion being part of a salt selected from the group of magnesium chloride, magnesium citrate, magnesium lactate, magnesium malate, magnesium gluconate, magnesium phosphate, magnesium hydroxide, magnesium carbonate, and magnesium sulfate.
34. The method of Claim 23, wherein said adding step a) adds an aluminum ion to said dough, said ion being part of a salt selected from the group of aluminum chloride hexahydrate, aluminum chloride, aluminum hydroxide, ammonium alum, potassium alum, sodium alum, and aluminum sulfate.
35. The method of Claim 23, wherein said adding step a) adds an iron salt to said dough, said salt being selected from the group of ferric chloride, ferrous gluconate, ferric ammonium citrate, ferric pyrophosphate, ferrous fumarate, ferrous lactate, and ferrous sulfate.
36. The method of Claim 23, wherein said adding step a) adds a copper ion to said dough, said copper ion being part of a salt selected from the group of cupric chloride, cupric gluconate, and cupric sulfate.
37. The method of Claim 23, wherein said thermally processing step b) comprises frying said dough.
38. The method of Claim 23, wherein said thermally processing step b) comprises baking said dough.
39. The chip produced by the method of Claim 23.

40. The method of Claim 23 wherein the chip is a corn chip.

41. The method of Claim 23 wherein the chip is a tortilla chip.

**METHOD FOR REDUCING ACRYLAMIDE FORMATION
IN THERMALLY PROCESSED FOODS**

ABSTRACT OF THE DISCLOSURE

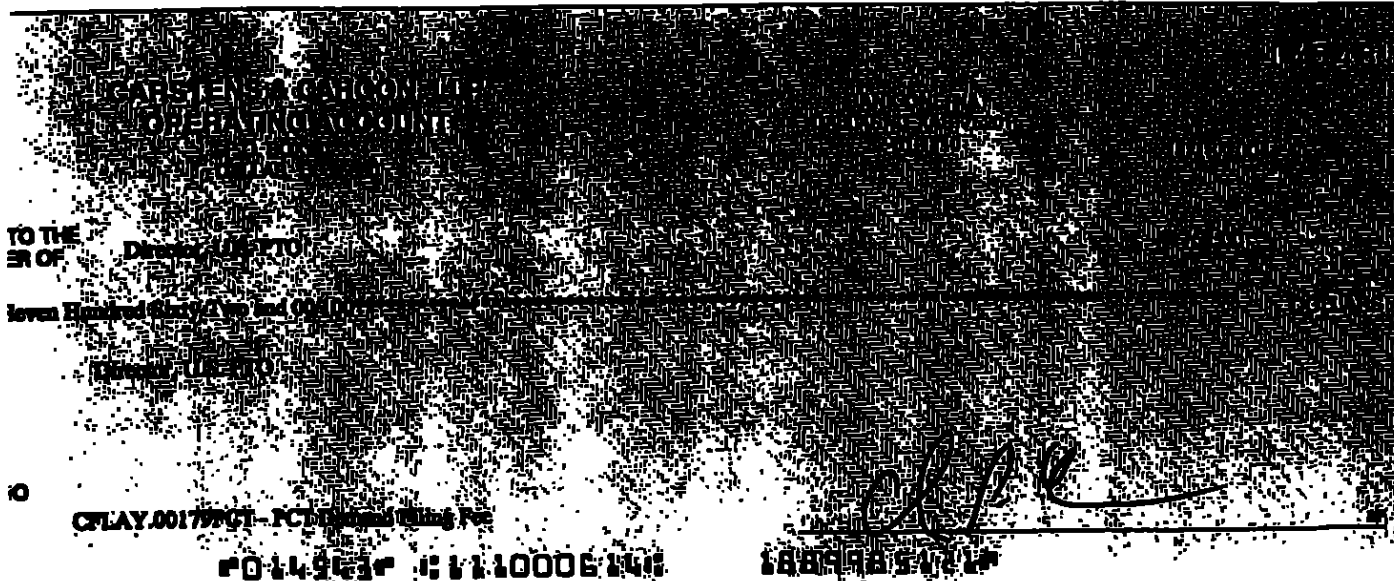
In fabricated, thermally processed foods, the addition of one of a select group of divalent or trivalent cations to the recipe for the food inhibits the formation of acrylamide during the thermal processing. The cation can come from the group including calcium, magnesium, copper, aluminum, copper, and iron salts.

Mailing Date: November 18, 2004
Attorney: Colin P. Cahoon
Applicant: Elder, et al.
Title of Invention: "Method for Reducing Acrylamide Formation in Thermally Processed Foods"
U.S. Serial No.: 10/372,154
U.S. Filing Date: February 21, 2003
Int'l Serial No.: PCT/US2004/003448
Int'l Filing Date: 06 February 2004 (06.02.2004)
Docket No.: CFLAY.00179PCT

On the date stamped herein, the United States Patent and Trademark Office received the following:

1. PCT Transmittal Form (1 pg.)
2. PCT Demand (4 pgs.)
3. PCT Fee Calculation Sheet (1 pg.)
4. Copy of Article 19 Amendment (25 pgs.)
5. Check in the Amount of \$762.00 (1 pg.)
6. Postcard Receipt (1 pg.)

Total Pages = 33



CARSTENS & CAHOON, LLP
OPERATING ACCOUNT
Director, U.S. PTO
Fees-Patent Fees

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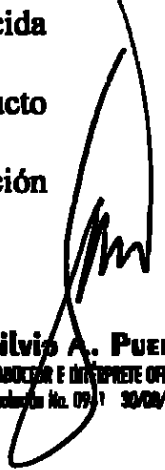
Official Translation code: PCT-COMEN179 of a document written in Spanish, sealed by the undersigned Official Translator, September 8th two thousand and five, Bogotá, D.C., Republic of Colombia.

Comentarios en respuesta a la opinión escrita

La opinión escrita dice:

Se objetan las Afirmaciones 1-31 bajo la Regla PCT 66.2(a)(v) por falta claridad bajo el Artículo 6 PCT porque dichas afirmaciones son indefinidas por las siguientes razones:

Dentro de las afirmaciones, los términos “disminuir” y “reducir” son términos relativos que hacen que las afirmaciones sean indefinidas. La especificación no brinda una norma para establecer el grado necesario. No es claro qué cantidad original de las concentraciones de acrilamida se reducen o disminuyen. Por ejemplo, la afirmación 1 dice “un método para reducir el nivel de acrilamida en un alimento procesado térmicamente”, aunque el alimento procesado térmicamente no es el material de inicio procesado en el método afirmado, para que la cantidad de acrilamida (original) se “reduzca”. El proceso puede brindar una cantidad reducida de acrilamida en un producto alimenticio en comparación con el mismo producto alimenticio que se ha procesado de manera similar, excepto por el paso de adición



Silvio A. PUERTAS P.
TRANSLADOR E INTERPRETE OFICIAL - INGLES
Resolución No. 0991 30/08/96

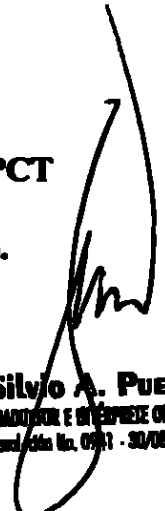
del catión. Sin embargo, no parece que un producto alimenticio realmente sufra reducción en la cantidad de acrilamida que contiene.

Respuesta del solicitante:

Los solicitantes creen que esta objeción ha sido explicada apropiadamente mediante las reformas hechas a la Afirmación 1. En particular, en el preámbulo, los Solicitantes han explicado que el método se orienta a la reducción del nivel de acrilamida “producido por el procesamiento térmico de un pasabocas de papa” y han insertado la frase “que tiene asparagina libre” con el fin de brindar una base antecedente para el uso del término en las Afirmaciones 6-9. La Afirmación independiente 8 claramente indica que el ingrediente reduce la formación de acrilamida y no se cree indefinida. La Afirmación 30 también ha sido reformada para explicar qué producto experimenta una reducción en la producción de acrilamida.

Mediante estas reformas, los Solicitantes creen que todas las objeciones del Examinador han sido tratadas adecuadamente y deberían retirarse.

Las Afirmaciones 1-10, 16, 21-24 y 26 carecen de novedad bajo el Artículo PCT 33(2) ya que han sido anticipadas por Zimmerman et al. (US PAT 5.514.387).

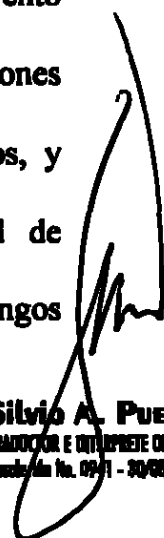


Silvio A. PUERTAS P.
TRADUCTOR E INTERPRETE OFICIAL - BILINGÜE
Reg. N.º 10.091 - 30/04/96

El Examinador afirma además que Zimmerman et al. revelan un "producto horneado enriquecido con calcio y un método de fabricación", que comprende la adición de un compuesto de calcio a la harina o los ingredientes de la masa. En la columna 6, se afirma que "el componente de calcio puede ser una o más sales acídicas, neutrales o inorgánicas básicas o ácidas comestibles", como el citrato de calcio o el malato de calcio (col. 6, líneas 51-56). "El componente de harina puede ser un grano de cereal triturado o una semilla comestible o una comida vegetal", incluyendo la harina y los almidones de maíz, trigo, papa y arroz (columna superior 12). Los azúcares reductores como la fructosa pueden añadirse también a la mezcla de componentes de la harina. Las composiciones de la masa se hornean luego a temperaturas por encima de los 250°F ó 121°C (col. 20). El proceso puede usarse para formar "galletas, brownies, pasabocas, fritos, pasabocas bagel, tostada Melba, pretzels y semejantes" (resumen y col. 6).

Como se afirmó en el primer párrafo de la columna 5, "el carbonato de calcio es el componente de calcio preferido para enriquecer el contenido de calcio de los productos horneados según el presente invento".

La cantidad específica de carbonato de calcio se brinda allí. Así, el invento afirmado instantáneamente está anticipado por la referencia. Como las afirmaciones examinadas no recitan rangos específicos o cantidades de cationes añadidos, y abarca rangos amplios de cationes, siempre que "reduzcan" la cantidad de acrilamida en el alimento procesado térmicamente, se espera que los rangos



Silvio A. PUERTAS P.
TRADUCTOR E INTERPRETE OFICIAL - IDOLIS
Puedes/da No. 07-1 - 30/08/96 Alapalido

recitados en la referencia cumplan con las limitaciones puntuales de la afirmación. Nótese que las cantidades recitadas en la referencia cumplen o exceden las cantidades ejemplificadas por los ejemplos del solicitante en la especificación, siendo las mejores cantidades disponibles para comparar. Considerando las afirmaciones 6-9, se observa que las asparaginas libres ocurren en muchos vegetales, incluyendo grandes cantidades en los productos de granos cereales y la papa, y por lo tanto esta interacción entre las asparaginas libres y el catión ocurrirán naturalmente con la adición de carbonato de magnesio o carbonato de calcio en el producto de masa de harina, según se realiza en la referencia.

Respuesta del solicitante:

La Afirmación independiente 1 ha sido reformada y se añadió la Afirmación independiente 23, reduciendo así el alcance de las afirmaciones presentadas aquí sobre los métodos para reducir la acrilamida en las papas fritas y los pasabocas a base de maíz, respectivamente. Por al menos esta razón, el rechazo de todas las afirmaciones bajo Zimmerman deberían retirarse, ya que la referencia no revela la adición de cationes bivalentes o trivalente en el proceso para la fabricación de pasabocas de papa o a base de maíz.



Silvio A. PUERTAS P.
TRADUCTOR E INTERPRETE OFICIAL - INGLES
Traducción No. 094 30/08/96 Alajuela

Las Afirmaciones 1-19, 21-31 y 26-31 carecen de novedad bajo el Artículo PCT 33(2) ya que han sido anticipadas por Prosise et al. (US PAT 6.716.462).

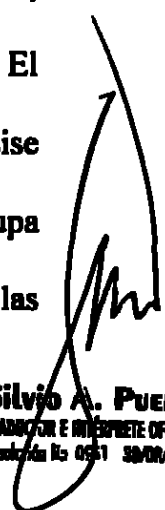
El Examinador afirma además que Prosise et al. revelan alimentos de pasabocas que “brindan una mezcla balanceada de una fuente de aminoácidos, grasa y carbohidratos” (resumen). Las columnas 3 y 5 recitan varios pasabocas que pueden producirse mediante el invento, incluyendo alimentos de pasabocas horneados y fritos como las papitas fritas, los pasabocas de maíz, las galletas saladas, las galletas dulces y los pretzels. Cada una de ellas requiere el procesamiento de una masa a base de almidón. La Columna 23 revela la fortificación de la masa del alimento de pasabocas con varios minerales y sus sales. “La configuraciones del presente invento pueden fortificarse con minerales como el calcio, el fósforo, el magnesio, el hierro, el zinc, el yodo, el selenio, el cobre, el manganeso, el flúor, el cromo, el molibdeno, el sodio, el potasio y el cloro”. Las cantidades específicas de calcio, magnesio, hierro, cobre, fósforo y zinc se suministran allí. Además, se pueden utilizar las sales de estos minerales. “La fuente de la sal minera, así como los niveles establecidos de la RDA de los Estados Unidos o con niveles de ingesta seguros y adecuados, así como los requerimientos humanos aún no establecidos, usados en la práctica de este invento, pueden ser cualquiera de las sales bien conocidas que incluyen carbonato, óxido, hidróxido, cloruro, sulfato, fosfato, pirofosfato, gluconato, lactato, acetato, fumarato, citrato, malato, aminoácidos y

Silvio A. PUERTAS P.
TRANSCRIPTOR E INTERPRETE OFICIAL - U.S. LES
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semejantes para los minerales catiónicos y el sodio, el potasio, el calcio el magnesio e ingredientes similares. El hierro elemental (hierro electrolítico o reducido) es otra fuente preferida de hierro". El Ejemplo 21 brinda un pasabocas de papa frita fabricado según los métodos esbozados en la referencia. El Ejemplo 1 brinda una cantidad ejemplificada del fosfato de aluminio sodio, a 0.76%.

Respuesta del solicitante:

El Examinador cita referencias someras de varias fuentes disparejas e inconexas cuando usa a Prosise como referencia. Por ejemplo el Examinador mira las columnas 3 y 5 para listas comunes de lo que el descubrimiento de Prosise considera como "pasabocas tradicionales" o "pasabocas". Los elementos enumerados, que Prosise en ninguna parte sugiere que sean completamente aplicables a los métodos descubiertos, incluyen los pasabocas de papa y de maíz así como aproximadamente otros cuarenta ejemplos que van desde los "pasteles" hasta las "palomitas de maíz", las "tocinetas", las "nueces" y los "dulces". El Examinador luego mira la columna 23 para el descubrimiento de una lista común de numerosos minerales y sus sales, cualquiera de las cuales puede o no usarse mediante el método Prosise. El Examinador ignora concientemente que las configuraciones del método Prosise "pueden opcionalmente fortificarse con vitaminas y minerales" y en cambio agrupa las conclusiones de que todos los cuarenta "pasabocas" mencionados, incluyendo las



Silvio A. PUERTAS P.
TRANSCRIPCION E INTERPRETE OFICIAL - DINES
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tocinetas, las nueces, los dulces, los pasabocas de carne, los mojos, las frutas secas y las papas fritas, necesariamente se fortifican con el método Prosise. (Columna 21, líneas 34-35). De hecho, de los veinticinco ejemplos del método Prosise específicamente revelados, sólo uno, el Ejemplo 21, se relaciona con un método para la fabricación de papas fritas. En el Ejemplo 21, no se usa ningún mineral o sus sales. Además, Prosise no revela ningún ejemplo de aplicación a maíz o pasabocas de harina de maíz del método Prosise. De hecho, Prosise no enseña el uso de la adición de cationes bivalentes o trivalentes en la producción de papas fritas fabricadas o pasabocas fabricados a base de maíz, así como no enseña la adición de los mismos a las palomitas de maíz o a las tocinetas. Además, Prosise se aparta de la adición de cationes bivalentes o trivalentes a una masa a base de papa al no revelarlo en único ejemplo (Ejemplo 21) del método Prosise aplicado a los pasabocas de papa.

Se establece bien que una "referencia debe revelar clara e inequívocamente el compuesto afirmado o instruir a los expertos en la técnica sobre el compuesto sin necesidad de tomar, escoger o combinar diversos descubrimientos no relacionados directamente entre sí por las enseñanzas de la referencia citada" con el fin de sustentar un rechazo por anticipado bajo la Sección 102. *In re Arkley*, 455 F.2d 586, 587 (CCPA 1972). "Para anticipar, cada elemento simple y la limitación de la invención afirmada debe encontrarse en una referencia a la técnica anterior simple, organizada como en la afirmación". *Brown v. 3M*, 265 F.3d 1349, 1351 (Fed. Cir.

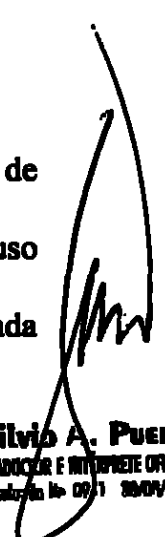
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Regulación No. 0943 30/08/96 #Rebustillo

2001). "No es suficiente que cada elemento se encuentre en algún lado de la referencia. Los elementos deben estar organizados como en las afirmaciones." *Lindemann Maschinenfabrik GmbH v. American Hoit & Derrick Co.*, 730 F.2d 1452, 1458 (Fed. Cir. 1984). "No sólo deben estar presentes todos los elementos afirmados en el dispositivo previo, sino que todos los elementos deben encontrarse en sustancialmente a misma situación cuando realizan sustancialmente el mismo trabajo." *Gillette Co. V. Warner-Lambert Co.*, 690 F. Supp. 115, 117 (D. Mass. 1988).

El uso de Prosise como un rechazo anticipado no concuerda con la ley de casos abundante que exige que los elementos específicos revelados allí deban organizarse como en las afirmaciones. "Dicha toma y escogencia... no tiene lugar en la elaboración de un rechazo de anticipación 102". Brown, en 1351. En consecuencia, los Solicitantes creen que ninguna afirmación se anticipa mediante la referencia a Prosise.

Las Afirmaciones 1-11, 16-17 y 26 carecen de novedad bajo el Artículo PCT 33(2) ya que han sido anticipadas por Dapper (GB 335.214).

El Examinador afirma además que Dapper revela la adición de carbonato de magnesio o carbonato de calcio a los componentes de la harina o masa, para su uso en la producción de productos horneados. La cantidad ejemplificada revelada



Silvio A. PUERTAS P.
TRADUCTOR E INTÉRPRETE OFICIAL - INGLÉS
Licencia No. 0211 2804946 Montecarlo

incorpora 50 gramos de carbonato de magnesio por cada 100 kg de harina. Así, las afirmaciones del solicitante están anticipadas por la referencia.

Respuesta del solicitante:

La Afirmación independiente 1 ha sido reformada y se ha añadido la Afirmación independiente 23, reduciendo así el alcance de las afirmaciones presentadas aquí para los métodos de reducción de acrilamida en las papas fritas y los pasabocas a base de maíz, respectivamente. Así, la referencia Dapper no revela la adición de cationes bivalentes o trivalentes al proceso para fabricar pasabocas de papa o a base de maíz.

Las Afirmaciones 1-10, 15-17, 20, 23 y 26 carecen de novedad bajo el Artículo PCT 33(2) ya que han sido anticipadas por Leusner et al. (US 6.210.720).

El Examinador afirma además que Leusner et al. revelan productos de cereal listos para consumir fortificados con calcio. Estos productos se fabrican produciendo una masa de varios granos de cereal como el trigo, arroz, avena o cebada (col. 7). Los productos pueden hornearse, extrudirse, inflarse o freírse (abajo col. 8 hasta col 0 medio). La fuente preferida de calcio es el carbonato de calcio, pero puede incluir también el fosfato de calcio (col. 5). Las cantidades específicas de estas sales



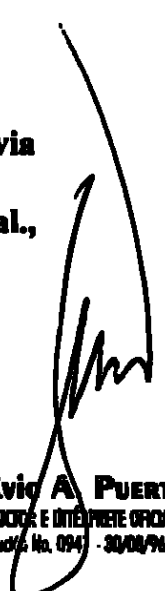
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TRADUCTOR E INTERPRETE OFICIAL - INELES
Resolución No. 0941 28/02/96 Montevideo

minerales se brinda en las columnas 4-5. La masa de cereal puede formarse también como "producto intermedio", que se forma luego para otros productos alimenticios. "Además, la invención presente puede usarse para brindar productos de pasabocas de pretzel fortificados con calcio" (arriba col. 9). Además, los "productos terminados están notablemente libres de la decoloración indeseable hasta ahora asociada con los productos terminados de cereal seco de color suave altos en contenido de calcio."

Respuesta del solicitante:

La Afirmación independiente 1 ha sido reformada y se ha añadido la Afirmación independiente 23, reduciendo así el alcance de las afirmaciones presentadas aquí para los métodos de reducción de acrilamida en las papas fritas y los pasabocas a base de maíz, respectivamente. Así, la referencia Leusner no revela la adición de cationes bivalentes o trivalentes al proceso para fabricar pasabocas de papa o a base de maíz.

La Afirmación 25 carece de novedad bajo el Artículo PCT 33(2) ya que es obvia ante cualquiera de las siguientes referencias: Zimmerman et al., Prosise et al., Dapper, o Leusner et al.



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El Examinador afirma además que la Afirmación 25 está orientada a un "apanado para un producto de carne". La definición de un apanado está abierta a interpretación, e incluso se acepta comúnmente en la técnica como una colección de migas de pan, o pedazos migados pequeños de otro producto de grano cocido, que se aplican como revestimiento de diversos productos alimenticios, incluyendo la carne. Mientras las referencias a la técnica anterior no recitan específicamente el uso de material de masa cocido como apanado, sería obvio para una persona experta en la técnica utilizar estos materiales como tales, dada esta utilidad común y bien conocida del producto. Además, como los productos revelados naturalmente harían migas por sí mismos, no hay nada en la afirmación puntual que pudiera diferenciar la forma del invento con la técnica anterior. Se observa que el revestimiento de un producto de carne no afectaría materialmente la composición del apanado, en sí. Como la estructura de la técnica anterior es capaz de producir el uso pretendido, cumple con la afirmación.

Respuesta del solicitante:

Como los Solicitantes desaprueban respetuosamente y contienden con este rechazo, con el fin de avanzar en la consecución de este caso, se ha retirado la Afirmación 25.



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Perú: 01/01/1984 - 30/04/1984

Se invita al examinador a llamar al signatario al número telefónico que aparece al final. En opinión del examinador, dicha conferencia telefónica agilizaría o ayudaría a la continuación o examen de esta solicitud.

Fecha: Octubre 13 de 2004

Muy atentamente,

(Firmado) Chad Walter, Registro No. 54,625, Defensor del solicitante

CARTENS & CAHOON, L.L.P.

P.O.Box 802334

Dallas, TX 75380

Teléfono: 972.367.2001

Facsímil: 972.367.2002

CFLAY.00179PCT – RESPUESTA A LA OPINIÓN ESCRITA

AFIRMACIONES:

Nosotros afirmamos:



Silvio A. Puertas P.
TRADUCTOR E INTERPRETE OFICIAL INGLÉS
Bachiller No. 094 30/04/94 Almería.

1. Un método para disminuir el nivel de acrilamida producida por el procesamiento térmico de un pasabocas de papa fabricado a partir de una masa que contiene un material a base de almidón con asparagina libre, en donde dicho método consta de los pasos de:

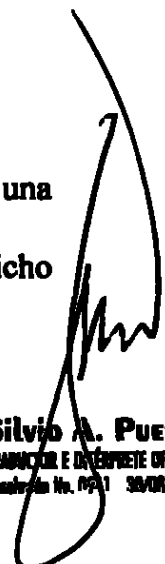
- a) añadir un catión con una valencia mínima de 2, a dicha masa; y
- b) procesamiento térmico de dicha masa para producir un pasabocas de papa;

En donde dicho catión se añade en cantidad suficiente como para reducir el nivel final de acrilamida en dicho pasabocas de papa a un nivel que es inferior al que se hubiera obtenido si no se hubiera añadido el catión en el paso a).

2. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente para reducir el nivel final de acrilamida en dicho pasabocas de papa en al menos 20%.

3. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente para reducir el nivel final de acrilamida en dicho pasabocas de papa en al menos 35%.

4. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente para reducir el nivel final de acrilamida en dicho pasabocas de papa en aproximadamente 50%.



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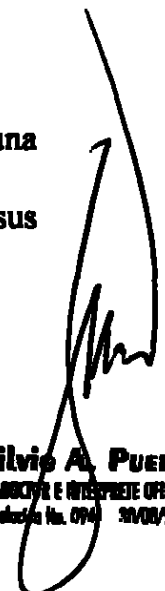
5. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente para reducir el nivel final de acrilamida en dicho pasabocas de papa en un rango aproximado de 50 a 95%.

6. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente para reducir una razón molar de catión versus asparagina libre de al menos 1:5.

7. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente para reducir una razón molar de catión versus asparagina libre de al menos 1:3.

8. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente para reducir una razón molar de catión versus asparagina libre de al menos 1:2.

9. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente para reducir una razón molar de catión versus asparagina libre de al menos 1:1.



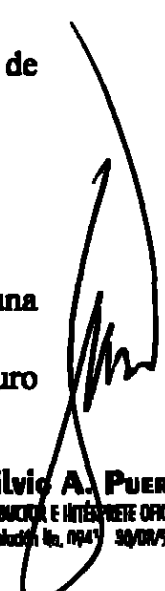
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Licencia No. 074 20/00/96 Honduras

10. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora un ión de calcio a dicha masa, siendo dicho ión de calcio parte de una sal seleccionada del grupo de cloruro de calcio, lactato de calcio, citrato de calcio, malato de calcio, gluconato de calcio, fosfato de calcio, acetato de calcio, EDTA sódico de calcio, glicerofosfato de calcio, hidróxido de calcio, lactobionato de calcio, óxido de calcio, propionato de calcio, carbonato de calcio y estearoil-lactato de calcio.

11. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora un ión de magnesio a dicha masa, siendo dicho ión de magnesio parte de una sal seleccionada del grupo de cloruro de magnesio, citrato de magnesio, lactato de magnesio, malato de magnesio, gluconato de magnesio, fosfato de magnesio, hidróxido de magnesio, carbonato de magnesio y sulfato de magnesio.

12. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora un ión de aluminio a dicha masa, siendo dicho ión parte de una sal seleccionada del grupo de cloruro de aluminio hexahidratado, cloruro de aluminio, hidróxido de aluminio, alumbre de amonio, alumbre de potasio, alumbre de sodio y sulfato de aluminio.

13. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora una sal de hierro a dicha masa, siendo dicha sal seleccionada del grupo de cloruro



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férico, gluconato ferroso, citrato amonio férrico, pirofosfato férrico, fumarato ferroso, lactato ferroso y sulfato ferroso.

14. El método de la Afirmación 1, en donde dicho paso de adición a) incorpora un ión de cobre a dicha masa, siendo dicho ión de cobre parte de una sal seleccionada del grupo de cloruro cúprico, gluconato cúprico y sulfato cúprico.

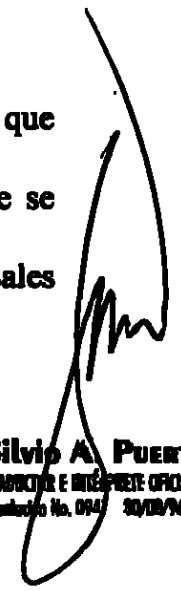
15. El método de la Afirmación 1, en donde dicho paso de procesamiento térmico b) implica freír dicha masa.

16. El método de la Afirmación 1, en donde dicho paso de procesamiento térmico b) implica hornear dicha masa.

17. El pasabocas de papa producido por el método de la Afirmación 1.

18. Un método de elaboración de pasabocas de papa fabricados, en donde dicho método comprende los pasos de:

a) preparar una mezcla que consta de hojuelas de papa, agua y un ingrediente que produce un catión que tiene una valencia mínima de dos, y dicho ingrediente se selecciona del grupo de sales que constan de sales de calcio, sales de magnesio, sales de aluminio, sales de hierro y sales de cobre;



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Votación No. 094 30/08/94 Alameda

- b) laminado y corte de dicha mezcla para formar piezas cortadas; y
- c) el procesamiento térmico de dichas piezas cortadas, en donde dicho ingrediente reduce la formación de acrilamida en dichos pasabocas de papa fabricados.

19. El método de la Afirmación 18, en donde dicho procesamiento térmico del paso c) implica horneado.

20. El método de la Afirmación 18, en donde dicho procesamiento térmico del paso c) implica fritura.

21. El método de la Afirmación 18, en donde la formación de acrilamida en dicho pasabocas de papa fabricado se reduce en al menos 50% más que el pasabocas de papa fabricado preparado sin dicho catión.

22. Un pasabocas de papa fabricado producido por el método de la Afirmación 18.

23. Un método para disminuir el nivel de acrilamida producida por el procesamiento térmico de un pasabocas fabricado a partir de una masa que consta de un material a base de maíz que tiene asparagina libre, en donde dicho método consta de los pasos de:

- a) adición de un catión, que tiene una valencia mínima de 2 a dicha masa; y



Silvio A. PUERTAS P.
TRADUCTOR E INTERPRETE OFICIAL - INGLÉS
Credencial No. 094 200876 Montevideo

b) procesamiento térmico de dicha masa para producir un pasabocas;

En donde dicho catión se añade en cantidad suficiente como para reducir el nivel final de acrilamida en dicho pasabocas a un nivel que es menor que si el catión no se hubiera añadido en el paso a).

24. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente como para reducir dicho nivel final de acrilamida en dicho pasabocas en al menos 20%.

25. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente como para reducir dicho nivel final de acrilamida en dicho pasabocas en al menos 35%.

26. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente como para reducir dicho nivel final de acrilamida en dicho pasabocas en aproximadamente 50%.

27. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente como para reducir dicho nivel final de acrilamida en dicho pasabocas en un rango aproximado de 50 a 95%.



Silvio A. PUERTAS P.
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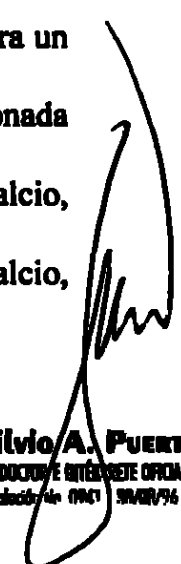
28. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente como para producir una razón molar de catión libre de asparagina de al menos 1:5.

29. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente como para producir una razón molar de catión libre de asparagina de al menos 1:3.

30. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente como para producir una razón molar de catión libre de asparagina de aproximadamente 1:2.

31. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora una cantidad de dicho catión suficiente como para producir una razón molar de catión libre de asparagina de aproximadamente 1:1.

32. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora un ión de calcio a dicha masa, siendo dicho ión de calcio parte de una sal seleccionada del grupo de cloruro de calcio, lactato de calcio, citrato de calcio, malato de calcio, gluconato de calcio, fosfato de calcio, acetato de calcio, EDTA sódico de calcio,



Silvio A. PUERTAS P.
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Traductor No. 07401 29/04/96 (Molise)

glicerofosfato de calcio, hidróxido de calcio, lactobionato de calcio, óxido de calcio, propionato de calcio, carbonato de calcio y estearoil-lactato de calcio.

33. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora un ión de magnesio a dicha masa, siendo dicho ión de magnesio parte de una sal seleccionada del grupo de cloruro de magnesio, citrato de magnesio, lactato de magnesio, malato de magnesio, gluconato de magnesio, fosfato de magnesio, hidróxido de magnesio, carbonato de magnesio y sulfato de magnesio.

34. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora un ión de aluminio a dicha masa, siendo dicho ión parte de una sal seleccionada del grupo de cloruro de aluminio hexahidratado, cloruro de aluminio, hidróxido de aluminio, alumbre de amonio, alumbre de potasio, alumbre de sodio y sulfato de aluminio.

35. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora una sal de hierro a dicha masa, siendo dicha sal seleccionada del grupo de cloruro férrico, gluconato ferroso, citrato amonio férrico, pirofosfato férrico, fumarato ferroso, lactato ferroso y sulfato ferroso.



Silvio A. PUERTAS P.
TRADUCTOR E INTERPRETE OFICIAL - ANGLÉS
Licencia No. 0941 / 21/02/94 Abasco

36. El método de la Afirmación 23, en donde dicho paso de adición a) incorpora un ión de cobre a dicha masa, siendo dicho ión de cobre parte de una sal seleccionada del grupo de cloruro cúprico, gluconato cúprico y sulfato cúprico.

37. El método de la Afirmación 23, en donde dicho paso de procesamiento térmico b) implica freír dicha masa.

38. El método de la Afirmación 23, en donde dicho paso de procesamiento térmico b) implica hornear dicha masa.

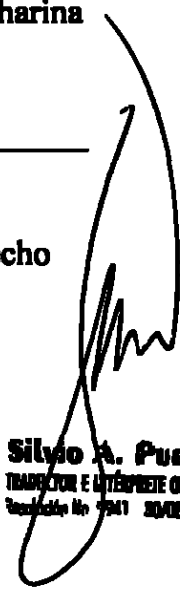
39. El pasabocas de papa producido por el método de la Afirmación 23.

40. El método de la Afirmación 23, en donde el pasabocas es un pasabocas de maíz.

41. El método de la Afirmación 23, en donde el pasabocas es un pasabocas de harina de maíz.

Traductor: SILVIO ALEJANDRO PUERTAS PINO

Resolución 0941 del 30 de agosto de 1996 del Ministerio de Justicia y del Derecho



Silvio A. PUERTAS P.
TRADUCTOR E INTERPRETE OFICIAL - UNDES
Resolución No. 9941 30/08/96 (Ministerio)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT: Vincent Allen Elder,	§	GROUP ART UNIT: 1761
John Gregory Fulcher,	§	
Henry Kin-Hang Leung, and	§	
Michael Grant Topor	§	
	§	
FILED: February 21, 2003	§	
	§	
INVENTION: Method for Reducing	§	EXAMINER:
Acrylamide Formation in Thermally	§	
Processed Foods	§	
	§	
SERIAL No: 10/372,154	§	ATTY FILE: CFLAY.00179

CORRECTED**DECLARATION AND POWER OF ATTORNEY - JOINT INVENTORS**

As below-named inventors, we hereby declare that:

Our residence, post office address, and citizenship are as stated below next to our respective names.

We believe that we are the original, first, joint, and sole inventors of the subject matter which is claimed and for which a patent is sought on the invention, design, or discovery entitled:

**METHOD FOR REDUCING ACRYLAMIDE FORMATION
IN THERMALLY PROCESSED FOODS**

the specification of which is attached hereto.

We have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above;

We acknowledge the duty to disclose to the Office all information known to us to be material to the patentability of this application as defined by Title 37, Code of Federal Regulations, §1.56.

We hereby claim no foreign priority benefits under 35 U.S.C. §119 of any foreign application(s) for patent or inventor's certificate.

We hereby claim no foreign priority benefits under 35 U.S.C. §120 of any United States application for patent.

We acknowledge the duty to disclose to the Office all information known to us to be material to patentability as defined in §1.56 which became available between the filing date of any prior application(s) and the national or PCT international filing date of this application.

CFLAY.00179

-1-

- Assignment

265

We hereby appoint Colin P. Cahoon, Registration No. 38,836; David W. Carstens, Registration No. 34,134; Duke W. Yee, Registration No. 34,285; Vincent J. Allen, Registration No. 45,514; Jeffrey G. Degenfelder, Registration No. 44,647; Priscilla L. Ferguson, Registration No. 42,531; Betty G. Formby, Registration No. 36,536; Casey L. Griffith, Registration No. 47,610; Scott L. Harper, Registration No. 45,783; Patrick C.R. Holmes, Registration No. 46,380; Michael R. Nichols, Registration No. 46,959; Christopher P. O'Hagan, Registration No. 46,966; Stephen R. Tkacs, Registration No. 46,430; Stephen J. Walder, Registration No. 41,534; William S. Wang, Registration No. 52,341; and Lisa L.B. Yociss, Registration No. 36,975, of the firm of Carstens, Yee & Cahoon, L.L.P., my attorneys/agents with full power of substitution and revocation, to prosecute this application, and to transact all business in the United States Patent and Trademark Office connected therewith, and to file and prosecute any international patent applications filed thereon before any international authorities under the Patent Cooperation Treaty.

Send all correspondence to: Carstens, Yee & Cahoon, L.L.P.
P.O. Box 802334
Dallas, TX 75380

Direct telephone calls to: (972) 367-2001

Attorney Docket No.: CFLAY.00179

We hereby declare that all statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Full name of first inventor:

Vincent Allen Elder

Inventor's signature:

Vincent A. Elder

Date:

May 12, 2003.

Residence (City, County, State):

2903 Panorama Drive
Carrollton, Dallas County, Texas 75007

Residence Telephone:

972-242-0342

Citizenship:

United States

Post Office Address:

Same as residence.

Full name of second inventor:

John Gregory Fulcher

Inventor's signature:

John G. Fulcher

Date:

May 15, 2003.

Residence (City, County, State):

9930 Ontario Lane
Dallas, Dallas County, Texas 75220

Residence Telephone:

214-358-5498

Citizenship:

United States

Post Office Address:

Same as residence.

Full name of third inventor:

Henry Kin-Hang Leung

Inventor's signature:

Henry Kin-Hang Leung

Date:

May 12, 2003.

Residence (City, County, State):

3704 Ellington Drive
Plano, Collin County, Texas 75093

Residence Telephone:

972-403-9038

Citizenship:

United States

Post Office Address:

Same as residence.

Full name of fourth inventor:

Michael Grant Topor

Inventor's signature:

Michael Grant Topor

Date:

May 13, 2003.

Residence (City, County, State):

2312 Evergreen
Carrollton, Dallas County, Texas 75006

Residence Telephone:

972-446-4047

Citizenship:

United States

Post Office Address:

Same as residence.

Traducción Oficial código: PCT-00179 de un documento escrito en inglés, sellada por el suscrito Traductor Oficial, septiembre 7 de dos mil cinco, Bogotá, D.C., República de Colombia.

**EN LA OFICINA DE PATENTES Y MARCAS REGISTRADAS
DE ESTADOS UNIDOS**

SOLICITANTE: Vicent Allen Elder

John Gregory Fulcher,

Henry Kin-Hang Leung, y

Michael Grant Topor

PRESENTADO: Febrero 21 de 2003

INVENTO: Método para reducir la formación de acrilamida en alimentos
procesados térmicamente

No. DE SERIE: 10/372,154

UNIDAD DEL GRUPO DE TÉCNICA: 1761

EXAMINADOR:

ARCHIVO JURÍDICO: CFLAY.00179

CORREGIDO

DECLARACIÓN Y PODER – CO-INVENTORES

Silvio A. PUERTAS P.
TRADUCTOR E INTERPRETE OFICIAL - INGLES
Carácter No. 0941 30/09/96 Ministerio

Como los suscritos inventores, por medio la presente, declaramos que:

Nuestra residencia, dirección postal y ciudadanía son las que se nombran después de nuestros respectivos nombres.

Creemos que somos los primeros y únicos co-inventores originales del asunto que se reclama y por el cual se busca la patente del invento, diseño o descubrimiento llamado:

**MÉTODO PARA REDUCIR LA FORMACIÓN DE ACRILAMIDA EN LOS
ALIMENTOS PROCESADOS TÉRMICAMENTE**

cuya especificación se anexa a este documento.

Hemos revisado y entendido los contenidos de la especificación antes identificada, incluyendo las afirmaciones, enmendadas mediante cualquier enmienda a la que se haya hecho previa referencia;

Reconocemos el deber de divulgarle a la Oficina toda la información que sabemos que es material para la patentabilidad de esta aplicación, según lo define el Título 37, Código de Reglamentos Federales, §1.56.

Por medio de este documento no reclamamos beneficios de prioridad en el exterior de acuerdo con el numeral 35 U.S.C. §119 para cualquier solicitud extranjera de patente o certificado de inventor.

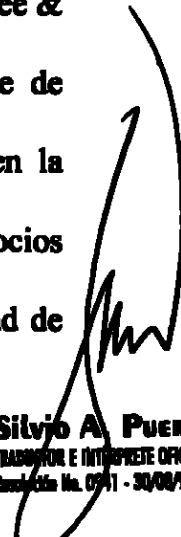


Silvio A. PUERTAS P.
TRANSLADOR E INTERPRETE OFICIAL - INGLÉS
Resolución No. 0941 - 20/02/96 (Bogotá)

Por medio de este documento, no reclamamos beneficios de prioridad en el exterior de acuerdo con el numeral 35 U.S.C. §120 para cualquier solicitud de patente en los Estados Unidos.

Reconocemos el deber de divulgarle a la Oficina toda la información que sabemos que es material para la patentabilidad, según se define en §1.56, que estuviera disponible entre la fecha de presentación de cualquier solicitud previa y la fecha de presentación PCT nacional o internacional de esta solicitud.

Por medio de la presente, designamos a Colin P. Cahoon, Registro No. 38,836; David W. Carstens, Registro No. 34,134; Duke W. Yee, Registro No. 34,285; Vincent J. Allen, Registro No. 45,514; Jeffrey G. Degenfelder, Registro No. 44,647; Priscilla L. Ferguson, Registro No. 42,531; Betty G. Formby, Registro No. 36,536; Casey L. Griffith, Registro No. 47,610; Scott L. Harper, Registro No. 45,783; Patrick C.R. Holmes, Registro No. 46,380; Michael R. Nichols, Registro No. 46,959; Christopher P. O'Hagan, Registro No. 46,966; Stephen R. Tkacs, Registro No. 46,430; Stephen J. Walder, Registro No. 41,534; William S. Wang, Registro No. 52,341; y Lisa L.B. Yociss, Registro No. 36,975; de la firma de Carstens, Yee & Cahoon, L.L.P., como nuestros abogados/representantes con poder suficiente de sustitución y revocación, para proceder con esta solicitud y para negociar en la Oficina de Patentes y Marcas Registradas de los Estados Unidos todos los negocios relacionados con nuestro asunto, y para presentar y procesar cualquier solicitud de



Silvio A. Puertas P.
TRADUCTOR E INTERPRETE OFICIAL - INGLÉS
Inscripción No. 0741 - 30/08/96 Alajuela

patente internacional presentada sobre el mismo asunto ante cualquier autoridad internacional según el Tratado de Cooperación para Patentes.

Enviar correspondencia a: Carstens, Yee & Cahoon, L.L.P.
P.O. Box 802334
Dallas, TX 75380

Llamar telefónicamente a: (972) 367-2001

Registro jurídico No. CFLAY.00179

Por medio de la presente expresamos que todas declaraciones hechas aquí son de nuestro conocimiento y son verdaderas, y que todas las declaraciones hechas sobre la información y creencia se consideran verdaderas; y además que estas declaraciones se hicieron con el conocimiento de que las declaraciones deliberadamente falsas y obrar de esa manera, son cosas punibles con sanciones o encarcelación, o ambas, según el numeral §1001 del Título 18 del Código de los Estados Unidos y que dichas declaraciones deliberadamente falsas pueden poner en riesgo la validez de la solicitud o cualquier patente expedida sobre el asunto.

Nombre completo del primer inventor: Vincent Allen Elder



Silvio A. PUERTAS P.
TRADUCTOR E INTERPRETE OFICIAL - INGLÉS
Firma No. 0241 30/08/96 Alapartida

Firma del inventor: (Firmado)
Fecha: Mayo 12 de 2003
Residencia (ciudad, condado, estado): 2903 Panorama Drive
Carrollton, Dallas County, Texas 75007
Teléfono de la residencia: 972-242-0342
Ciudadanía: Estados Unidos
Dirección de la oficina postal: La misma de residencia

Nombre completo del segundo inventor: **John Gregory Fulcher**

Firma del inventor: (Firmado)
Fecha: Mayo 15 de 2003
Residencia (ciudad, condado, estado): 9930 Ontario Lane
Dallas, Dallas County, Texas 75220
Teléfono de la residencia: 214-358-5498
Ciudadanía: Estados Unidos
Dirección de la oficina postal: La misma de residencia

Nombre completo del tercer inventor: **Henry Kin-Hang Leung**
Firma del inventor: (Firmado)
Fecha: Mayo 12 de 2003
Residencia (ciudad, condado, estado): 3704 Ellington Drive



Silvio A. PUERTAS P.
TRADUCTOR E INTERPRETE OFICIAL - INGLÉS
Licencia No. 09811 30/08/96 Alameda

Plano, Collin County, Texas 75093

Teléfono de la residencia: 972-403-9038

Ciudadanía: Estados Unidos

Dirección de la oficina postal: La misma de residencia

Nombre completo del cuarto inventor: **Michael Grant Topor**

Firma del inventor: (Firmado)

Fecha: Mayo 13 de 2003

Residencia (ciudad, condado, estado): 2312 Evergreen
Carrollton, Dallas County, Texas 75006

Teléfono de la residencia: 972-446-4047

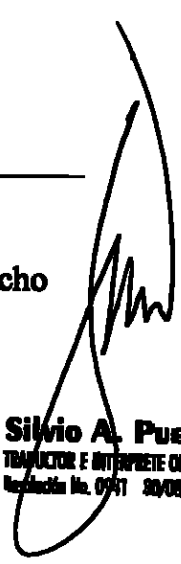
Ciudadanía: Estados Unidos

Dirección de la oficina postal: La misma de residencia

CFLAY.00179 NOMBRAMIENTO

Traductor: **SILVIO ALEJANDRO PUERTAS PINO**

Resolución 0941 del 30 de agosto de 1996 del Ministerio de Justicia y del Derecho



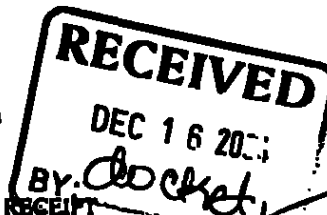
Silvio A. PUERTAS P.
TRADUCTOR E INTERPRETE OFICIAL - INGLES
Resolución No. 0941 30/08/96

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:
COLIN P. CAHOON
CARSTENS, YEE & CAHOON, LLP
PO BOX 802334
DALLAS, TEXAS 75380

PCT



NOTIFICATION OF RECEIPT
OF DEMAND BY COMPETENT INTERNATIONAL
PRELIMINARY EXAMINING AUTHORITY

(PCT Rules 59.3(c) and 61.1(b), first sentence
and Administrative Instructions, Section 601(a))

Date of mailing
(day/month/year) 14 DEC 2004

Applicant's or agent's file reference
CFAY.00179P

IMPORTANT NOTIFICATION

International application No.
PCT/US2004/003448

International filing date (day/month/year) 06 Feb 2004

Priority date (day/month/year) 21 Feb 2003

Applicant
FRITO-LAY NORTH AMERICAS, INC.

1. The applicant is hereby notified that this International Preliminary Examining Authority considers the following date as the date of receipt of the demand for international preliminary examination of the international application:

18 November 2004

2. That date of receipt is:

- ☒ the actual date of receipt of the demand by this Authority (Rule 61.1(b)).
☐ the actual date of receipt of the demand on behalf of this Authority (Rule 59.3(e)).
☐ the date on which this Authority has, in response to the invitation to correct defects in the demand (Form PCT/IPEA/404), received the required corrections.

3. ☐ **ATTENTION:** That date of receipt is after the expiration of 19 months from the priority date. Consequently, in respect of some Offices, the demand does not have the effect of postponing the entry into the national phase until 30 months from the priority date (or later in some Offices) (Article 39(1)) and the acts for entry into the national phase must therefore be performed within 30 months from the priority date (or later in some Offices). However, in respect of some other Offices, the time limit of 30 months (or later) may nevertheless apply. See the Annex to Form PCT/IB/301 and, for details about the applicable time limits, Office by Office, see the *PCT Applicant's Guide*, Volume II, National Chapters and the WIPO Internet site.

- ☐ (If applicable) This notification confirms the information given by telephone, facsimile transmission or in person on:

4. Only where paragraph 3 applies, a copy of this notification has been sent to the International Bureau.

Name and mailing address of the IPEA/
Mail Stop PCT, Commissioner for Patents
P.O. Box 1450, Alexandria, VA 22313-1450
Facsimile No. 703-305-3230

Authorized official
Annette Short
Telephone No. 703-305-3628

From the INTERNATIONAL BUREAU

PCT**NOTIFICATION CONCERNING
TRANSMITTAL OF COPY OF INTERNATIONAL
APPLICATION AS PUBLISHED OR REPUBLISHED**

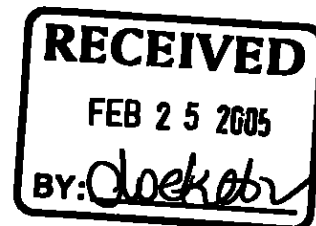
To:

CAHOON, Colln, P.
Carstens Yee & Cahoon, L.L.P.
P.O. Box 802334
Dallas, TX 75380
ETATS-UNIS D'AMERIQUE

Date of mailing (day/month/year) 17 February 2005 (17.02.2005)		IMPORTANT NOTICE	
Applicant's or agent's file reference CFLAY.00179P			
International application No. PCT/US2004/003448	International filing date (day/month/year) 06 February 2004 (06.02.2004)	Priority date (day/month/year) 21 February 2003 (21.02.2003)	
Applicant FRITO-LAY NORTH AMERICA, INC. formerly known as RECOT, INC. et al			

The International Bureau transmits herewith the following documents:

- ☐ copy of the international application as published by the International Bureau on under No. WO
- ☒ copy of international application as republished by the International Bureau on 17 February 2005 (17.02.2005) under No. WO 2004/075657
For an explanation as to the reason for this republication of the international application, reference is made to INID codes (15), (48) or (88) (as the case may be) on the front page of the attached document.



The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. +41 22 740 14 35	Authorized officer Yoshiko Kuwahara Facsimile No. +41 22 338 90 90
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(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
10 September 2004 (10.09.2004)

PCT

(10) International Publication Number
WO 2004/075657 A3

(51) International Patent Classification⁷: A23L 1/29,
1/304, 1/305, 1/015, 1/217, 3/358, A21D 2/02, 2/06, 8/02

TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM,
ZW.

(21) International Application Number:
PCT/US2004/003448

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),
Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), Euro-
pean (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR,
GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
ML, MR, NE, SN, TD, TG).

(22) International Filing Date: 6 February 2004 (06.02.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10/372,154 21 February 2003 (21.02.2003) US

Declarations under Rule 4.17:

— as to applicant's entitlement to apply for and be granted
a patent (Rule 4.17(ii)) for the following designations AE,
AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ,
CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE,
EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS,
JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA,
MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM,
PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ,
TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM,
ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, SD,
SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY,
KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG,
CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT,
LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ,
CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD,
TG)

— of inventorship (Rule 4.17(iv)) for US only

(71) Applicant (for all designated States except US):
FRITO-LAY NORTH AMERICA, INC. formerly
known as RECOT, INC. [US/US]; 7701 Legacy Drive,
Piano, TX 75266 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): ELDER, Vincent,
Allen [US/US]; 2903 Panorama Drive, Carrollton, TX
75007 (US). FULCHER, John, Gregory [US/US]; 9930
Ontario Lane, Dallas, TX 75220 (US). LEUNG, Henry,
Kin-Hang [US/US]; 3704 Ellington Drive, Plano, TX
75093 (US). TOPOR, Michael, Grant [US/US]; 2312
Evergreen, Carrollton, TX 75006 (US).

(74) Agent: CAHOON, Collin, P.; Carstens Yee & Cahoon,
L.L.P., P.O. Box 802334, Dallas, TX 75380 (US).

Published:

— with international search report
— with amended claims

(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN,
CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI,
GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE,
KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD,
MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG,
PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM,

(88) Date of publication of the international search report:
11 November 2004

Date of publication of the amended claims: 17 February 2005

For two-letter codes and other abbreviations, refer to the "Guid-
ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.

(54) Title: METHOD FOR REDUCING ACRYLAMIDE FORMATION IN THERMALLY PROCESSED FOODS

(57) Abstract: In fabricated, thermally processed foods, the addition of one of a select group of divalent or trivalent cations to the recipe for the food inhibits the formation of acrylamide during the thermal processing. The cation can come from the group including calcium, magnesium, copper, aluminum, copper, and iron salts.

WO 2004/075657 A3

AMENDED CLAIMS

[received by the International Bureau on 20 October 2004 (20.10.04);
original claims 1-31 replaced by amended claims 1-22;
new claims 23-41 added (7 pages)]

1. A method of lowering the level of acrylamide produced by the thermal processing of a potato chip manufactured from a dough comprising a starch-based material having free asparagine, said method comprising the steps of:
 - a) adding a cation, having a valence of at least two, to said dough; and
 - b) thermally processing said dough to produce a potato chip;wherein said cation is added in an amount sufficient to reduce the final level of acrylamide in said potato chip to a level that is lower than if the cation had not been added at step a).
2. The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said potato chip by at least 20 percent.
3. The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said potato chip by at least 35 percent.
4. The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said potato chip by about 50 percent.
5. The method of Claim 1, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said potato chip by a range of 50 to 95 percent.

AMENDED SHEET (ARTICLE 19)

6. The method of Claim 1, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of at least 1:5.
7. The method of Claim 1, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of at least 1:3.
8. The method of Claim 1, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of about 1:2.
9. The method of Claim 1, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of about 1:1.
- 5 10. The method of Claim 1, wherein said adding step a) adds a calcium ion to said dough, said calcium ion being part of a salt selected from the group of calcium chloride, calcium lactate, calcium citrate, calcium malate, calcium gluconate, calcium phosphata, calcium acetate, calcium sodium EDTA, calcium glycerophosphate, calcium hydroxide, calcium lactobionate, calcium oxide, calcium propionate, calcium carbonate, and calcium stearyl lactate.
11. The method of Claim 1, wherein said adding step a) adds a magnesium ion to said dough, said magnesium ion being part of a salt selected from the group of magnesium chloride, magnesium citrate, magnesium lactate, magnesium malate, magnesium gluconate, magnesium phosphate, magnesium hydroxide, magnesium carbonate, and magnesium sulfate.
12. The method of Claim 1, wherein said adding step a) adds an aluminum ion to said dough, said ion being part of a salt selected from the group of aluminum chloride hexahydrate, aluminum chloride, aluminum hydroxide, ammonium alum, potassium alum, sodium alum, and aluminum sulfate.
13. The method of Claim 1, wherein said adding step a) adds an iron salt to said dough, said salt being selected from the group of ferric chloride, ferrous gluconate, ferric ammonium citrate, ferric pyrophosphate, ferrous fumarate, ferrous lactate, and ferrous sulfate.

AMENDED SHEET (ARTICLE 19)

14. The method of Claim 1, wherein said adding step a) adds a copper ion to said dough, said copper ion being part of a salt selected from the group of cupric chloride, cupric gluconate, and cupric sulfate.
15. The method of Claim 1, wherein said thermally processing step b) comprises frying said dough.
16. The method of Claim 1, wherein said thermally processing step b) comprises baking said dough.
17. The potato chip produced by the method of Claim 1.

AMENDED SHEET (ARTICLE 19)

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18. A method of preparing fabricated potato chips, said method comprising the steps of:
- a) preparing a mixture comprising potato flakes, water, and an ingredient that produces a cation having a valence of at least two, said ingredient selected from the group of salts consisting of calcium salts, magnesium salts, aluminum salts, iron salts, and copper salts;
 - b) sheeting and cutting said mixture to form cut pieces; and
 - c) thermally processing said cut pieces, wherein said ingredient reduces the formation of acrylamide in said fabricated potato chips.
- 5
19. The method of Claim 18, wherein said thermal processing of step c) comprises baking.
20. The method of Claim 18, wherein said thermal processing of step c) comprises frying.
21. The method of Claim 18, wherein the formation of acrylamide in said fabricated potato chips is reduced by at least 50 percent over fabricated potato chips prepared without said cation.
22. A fabricated potato chip produced by the method of Claim 18.

AMENDED SHEET (ARTICLE 19)

23. A method of lowering the level of acrylamide produced by the thermal processing of a chip manufactured from a dough comprising a corn-based material having free asparagine, said method comprising the steps of:
- a) adding a cation, having a valence of at least two, to said dough; and
 - b) thermally processing said dough to produce a chip;
- wherein said cation is added in an amount sufficient to reduce the final level of acrylamide in said chip to a level that is lower than if the cation had not been added at step a).
24. The method of Claim 23, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said chip by at least 20 percent.
25. The method of Claim 23, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said chip by at least 35 percent.
26. The method of Claim 23, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said chip by about 50 percent.
27. The method of Claim 23, wherein said adding step a) adds an amount of said cation sufficient to reduce said final level of acrylamide in said chip by a range of 50 to 95 percent.
28. The method of Claim 23, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of at least 1:5.
29. The method of Claim 23, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of at least 1:3.
30. The method of Claim 23, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of about 1:2.
31. The method of Claim 23, wherein said adding step a) adds a quantity of said cation sufficient to produce a molar ratio of cation to free asparagine of about 1:1.

AMENDED SHEET (ARTICLE 19)

32. The method of Claim 23, wherein said adding step a) adds a calcium ion to said dough, said calcium ion being part of a salt selected from the group of calcium chloride, calcium lactate, calcium citrate, calcium malate, calcium gluconate, calcium phosphate, calcium acetate, calcium sodium EDTA, calcium glycerophosphate, calcium hydroxide, calcium lactobionate, calcium oxide, calcium propionate, calcium carbonate, and calcium stearoyl lactate.
33. The method of Claim 23, wherein said adding step a) adds a magnesium ion to said dough, said magnesium ion being part of a salt selected from the group of magnesium chloride, magnesium citrate, magnesium lactate, magnesium malate, magnesium gluconate, magnesium phosphate, magnesium hydroxide, magnesium carbonate, and magnesium sulfate.
34. The method of Claim 23, wherein said adding step a) adds an aluminum ion to said dough, said ion being part of a salt selected from the group of aluminum chloride hexahydrate, aluminum chloride, aluminum hydroxide, ammonium alum, potassium alum, sodium alum, and aluminum sulfate.
35. The method of Claim 23, wherein said adding step a) adds an iron salt to said dough, said salt being selected from the group of ferric chloride, ferrous gluconate, ferric ammonium citrate, ferric pyrophosphate, ferrous fumarate, ferrous lactate, and ferrous sulfate.
36. The method of Claim 23, wherein said adding step a) adds a copper ion to said dough, said copper ion being part of a salt selected from the group of cupric chloride, cupric gluconate, and cupric sulfate.
37. The method of Claim 23, wherein said thermally processing step b) comprises frying said dough.
38. The method of Claim 23, wherein said thermally processing step b) comprises baking said dough.
39. The chip produced by the method of Claim 23.

AMENDED SHEET (ARTICLE 19)

28c

40. The method of Claim 23 wherein the chip is a corn chip.
41. The method of Claim 23 wherein the chip is a tortilla chip.

AMENDED SHEET (ARTICLE 19)

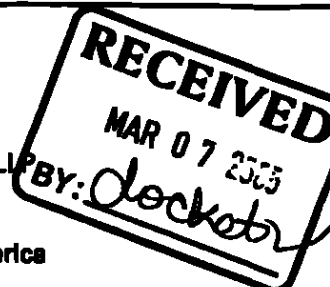
PATENT COOPERATION TREATY

PCT

NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

CAHOON, Colln, P.
Carstens & Cahoon, LLP
P.O. Box 802334
Dallas, TX 75380
United States of America

Date of mailing (day/month/year) 21 February 2005 (21.02.2005)	
Applicant's or agent's file reference CFLAY.00179P	IMPORTANT NOTIFICATION
International application No. PCT/US2004/003448	International filing date (day/month/year) 08 February 2004 (08.02.2004)

1. The following indications appeared on record concerning:

☒ the applicant ☒ the inventor ☐ the agent ☐ the common representative

Name and Address TOPOR, Michael, Grant 2312 Evergreen Carrollton, TX 75006 United States of America	State of Nationality US	State of Residence US
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☐ the person ☐ the name ☒ the address ☐ the nationality ☐ the residence

Name and Address TOPOR, Michael, Grant 3573 Pennacle Bay Point Little Elm, TX 75068 United States of America	State of Nationality	State of Residence
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

☒ the receiving Office	☐ the designated Offices concerned
☐ the International Searching Authority	☒ the elected Offices concerned
☒ the International Preliminary Examining Authority	☐ other:

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. (41-22) 338.90.90	Authorized officer Jaime LEITAO Telephone No. (41-22) 338 9470
--	--

From the INTERNATIONAL BUREAU

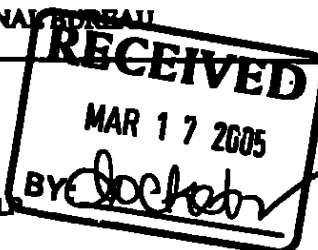
PCT

INFORMATION CONCERNING ELECTED
OFFICES NOTIFIED OF THEIR ELECTION

(PCT Article 31(7) and Rule 61.3)

To:

CAHOON, Colln, P.
Carstens & Cahoon, LL
P.O. Box 802334
Dallas, TX 75380
ETATS-UNIS D'AMERIQUE



Date of mailing (day/month/year) 10 March 2005 (10.03.2005)		
Applicant's or agent's file reference CFLAY.00179P		IMPORTANT INFORMATION
International application No. PCT/US2004/003448	International filing date (day/month/year) 06 February 2004 (06.02.2004)	
Applicant FRITO-LAY NORTH AMERICA, INC. et al		Priority date (day/month/year) 21 February 2003 (21.02.2003)

- The applicant is hereby informed that the International Bureau has, according to Article 31(7), notified each of the following Offices of its election:
EP: AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR
National: BG, CA, CN, CZ, DE, JP, KP, KR, MN, NO, PL, RO, RU, SK, US
- The following Offices have waived the requirement for the notification of their election; the notification will be sent to them by the International Bureau only upon their request:
AP: BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW
EA: AM, AZ, BY, KG, KZ, MD, RU, TJ, TM
OA: BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG
National: AB, AG, AL, AM, AT, AU, AZ, BA, BB, BR, BW, BY, BZ, CH, CO, CR, CU, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, KE, KG, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MW, MX, MZ, NA, NI, NZ, OM, PG, PH, PT, SC, SD, SE, SG, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW
- Since the election(s) was (were) made after the expiration of 19 months from the priority date, the applicant is reminded that he must, subject to the following paragraph, enter the national phase within 30 months from the priority date (or later in some Offices) before some of the designated Offices in respect of which Article 22(1), as modified with effect of 1 April 2002, does not apply, by paying the national fee(s) and furnishing, if prescribed, a translation of the international application.

 However, in respect of most other designated Offices, the time limit of 30 months (or later) may nevertheless apply. See the Annex to Form PCT/IB/301 and, for details about the applicable time limits, Office by Office, see the *PCT Applicant's Guide*, Volume II, National Chapters, the *PCT Newsletter* and the WIPO Internet site, updated regularly.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.+41 22 740 14 35	Authorized officer Yoshiko Kuwahara Facsimile No.+41 22 338 90 90
--	---

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:
COLIN P. CAHOON
CARSTENS, YEE & CAHOON, LLP
PO BOX 802334
DALLAS, TX 75380

PCT

NOTIFICATION OF TRANSMITTAL OF
INTERNATIONAL PRELIMINARY
REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Rule 71.1)

283
RECEIVED
MAR 22 2005
BY: *clerk*

Date of mailing
(day/month/year) **17 MAR 2005**

Applicant's or agent's file reference

CFAY.00179P

IMPORTANT NOTIFICATION

International application No.

PCT/US04/03448

International filing date (day/month/year)

06 February 2004 (06.02.2004)

Priority date (day/month/year)

21 February 2003 (21.02.2003)

Applicant

FRITO-LAY NORTH AMERICAS, INC.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary report on patentability and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.
4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary report on patentability. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the *PCT Applicant's Guide*.

The applicant's attention is drawn to Article 33(5), which provides that the criteria of novelty, inventive step and industrial applicability described in Article 33(2) to (4) merely serve the purposes of international preliminary examination and that "any Contracting State may apply additional or different criteria for the purposes of deciding whether, in that State, the claimed invention is patentable or not" (see also Article 27(5)). Such additional criteria may relate, for example, to exemptions from patentability, requirements for enabling disclosure, clarity and support for the claims.

Name and mailing address of the IPEA/ US

Mail Stop PCT, Attn: IPEA/US
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
Facsimile No. (703) 305-3230

Authorized officer

Keth Hendrick *[Signature]*
Telephone No. 571-272-1700

Form PCT/IPEA/416 (January 2004)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY (Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference CFAY.00179P	FOR FURTHER ACTION		See Form PCT/IPBA/416																								
International application No. PCT/US04/03448	International filing date (day/month/year) 06 February 2004 (06.02.2004)	Priority date (day/month/year) 21 February 2003 (21.02.2003)																									
International Patent Classification (IPC) or national classification and IPC IPC(7): A23L 1/29, 1/304, 1/305, 1/015, 1/217, 3/358; A21D 2/02, 2/06, 8/02 and US Cl.: 426/ 72, 74, 549, 556, 560, 652, 653, 618, 619, 620, 622																											
Applicant FRITO-LAY NORTH AMERICAS, INC.																											
1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36. 2. This REPORT consists of a total of <u>12</u> sheets, including this cover sheet. 3. This report is also accompanied by ANNEXES, comprising: a. ☐ (sent to the applicant and to the International Bureau) a total of <u>0</u> sheets, as follows: ☐ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions). ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box. b. ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) _____, containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions). 4. This report contains indications relating to the following items: <table style="width: 100%; border: none;"> <tr> <td style="width: 10%;">☒</td> <td style="width: 20%;">Box No. I</td> <td>Basis of the report</td> </tr> <tr> <td>☐</td> <td>Box No. II</td> <td>Priority</td> </tr> <tr> <td>☐</td> <td>Box No. III</td> <td>Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</td> </tr> <tr> <td>☐</td> <td>Box No. IV</td> <td>Lack of unity of invention</td> </tr> <tr> <td>☒</td> <td>Box No. V</td> <td>Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</td> </tr> <tr> <td>☐</td> <td>Box No. VI</td> <td>Certain documents cited</td> </tr> <tr> <td>☐</td> <td>Box No. VII</td> <td>Certain defects in the international application</td> </tr> <tr> <td>☐</td> <td>Box No. VIII</td> <td>Certain observations on the international application</td> </tr> </table>				☒	Box No. I	Basis of the report	☐	Box No. II	Priority	☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability	☐	Box No. IV	Lack of unity of invention	☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement	☐	Box No. VI	Certain documents cited	☐	Box No. VII	Certain defects in the international application	☐	Box No. VIII	Certain observations on the international application
☒	Box No. I	Basis of the report																									
☐	Box No. II	Priority																									
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability																									
☐	Box No. IV	Lack of unity of invention																									
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement																									
☐	Box No. VI	Certain documents cited																									
☐	Box No. VII	Certain defects in the international application																									
☐	Box No. VIII	Certain observations on the international application																									
Date of submission of the demand 18 November 2004 (18.11.2004)		Date of completion of this report 06 March 2005 (06.03.2005)																									
Name and mailing address of the IPEA/ US Mail Stop PCT, Attn: IPEA/US Commissioner for Patents P.O. Box 1490 Alexandria, Virginia 22313-1490 Facsimile No. (703) 305-3230		Authorized officer Keith Hendricks  Telephone No. (571) 272-1700																									

Form PCT/IPBA/409 (cover sheet)(January 2004)

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/US04/03448

Box No. I Basis of the report

1. With regard to the language, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
 - ☐ This report is based on translations from the original language into the following language _____, which is the language of a translation furnished for the purposes of:
 - ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the elements of the international application, this report is based on (replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):
 - ☐ the international application as originally filed/furnished
 - ☒ the description:
 - pages 1-17 as originally filed/furnished
 - pages* NONE received by this Authority on _____
 - pages* NONE received by this Authority on _____
 - ☒ the claims:
 - pages none as originally filed/furnished
 - pages* 18-24 as amended (together with any statement) under Article 19
 - pages* NONE received by this Authority on _____
 - pages* NONE received by this Authority on _____
 - ☒ the drawings:
 - pages 1/1 as originally filed/furnished
 - pages* NONE received by this Authority on _____
 - pages* NONE received by this Authority on _____
 - ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing.
3. ☒ The amendments have resulted in the cancellation of:
 - ☒ the description, pages none
 - ☒ the claims, Nos. none
 - ☒ the drawings, sheets/figs none
 - ☒ the sequence listing (specify): none
 - ☒ any table(s) related to the sequence listing (specify): none
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
 - ☐ the description, pages _____
 - ☐ the claims, Nos. _____
 - ☐ the drawings, sheets/figs _____
 - ☐ the sequence listing (specify): _____
 - ☐ any table(s) related to the sequence listing (specify): _____

* If item 4 applies, some or all of those sheets may be marked "superseded."

Form PCT/HPBA/409 (Box No. I) (January 2004)

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/US04/03448

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims <u>NONE</u>	YES
	Claims <u>1-41</u>	NO
Inventive Step (IS)	Claims <u>NONE</u>	YES
	Claims <u>1-41</u>	NO
Industrial Applicability (IA)	Claims <u>1-41</u>	YES
	Claims <u>NONE</u>	NO

2. Citations and Explanations (Rule 70.7)
Please See Continuation Sheet

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/US04/03448

Supplemental Box Relating to Sequence Listing

Continuation of Box No. 1, Item 2:

1. With regard to any nucleotide and/or amino acid sequence disclosed in the international application and necessary to the claimed invention, this opinion was established on the basis of:

a. type of material

- ☐ a sequence listing
☐ table(s) related to the sequence listing

b. format of material

- ☐ in written format
☐ in computer readable form

c. time of filing/furnishing

- ☐ contained in the international application as filed
☐ filed together with the international application in computer readable form
☐ furnished subsequently to this Authority for the purposes of search and/or examination
☐ received by this Authority as an amendment* on _____

2. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table(s) relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

3. Additional comments:

* If item 4 in Box No. 1 applies, the listing and/or table(s) related thereto, which form part of the basis of the report, may be marked "superseded."

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of:

V. 2. Citations and Explanations:

(i) Claims 1-10, 16, 18-32 and 37-41 lack novelty under PCT Article 33(2) as being anticipated by Zimmerman et al. (US PAT 5,514,387).

Zimmerman et al. disclose a "calcium-enriched baked good and method of making", which comprises adding a calcium compound to the flour or dough ingredients. At column 6, it is stated that "the calcium component may be one or more edible acidic, neutral or basic inorganic or acid salts", such as calcium citrate or calcium malate (col. 6, lines 51-56). "The flour component may be any comminuted cereal grain or edible seed or vegetable meal", including flour and starches from corn, wheat, potato and rice (top col. 12). Reducing sugars such as fructose may be added to the flour component mixture as well. The dough compositions are then baked at temperatures above 250°F, or 121°C (col. 20). The process may be used to form "cookies, brownies, snacks, snack chips, bagel chips, Melba toast, pretzels and the like" (abstract and col. 6).

As stated in the first paragraph of column 5, "calcium carbonate is the preferred calcium component for enriching the calcium content of baked goods in accordance with the present invention."

Specific amounts of calcium carbonate are provided therein. Thus, the instantly-claimed invention is anticipated by the reference. As the examined claims do not recite specific ranges or amounts of the added cations, and encompass broad ranges of the cations, so long as they provide a "reduced" amount of acrylamide in the thermally processed food, the ranges recited in the reference would be expected to meet the instant claim limitations. Note that the amounts recited in the reference meet or exceed the amounts exemplified by applicant's examples in the specification, being the best available amounts to compare. Regarding claims 6-9, it is noted that free asparagine occurs in many vegetables, including high amounts in cereal grain products and potato, and thus this interaction between the free asparagine and cation would naturally take place upon the addition of the magnesium carbonate or calcium carbonate to the flour dough product, as performed in the reference.

In the reply to the Written Opinion, applicant has stated that because the independent claims have been amended or added, "narrowing the scope of the claims presented herein to methods for reducing acrylamide in potato chips and corn-based chips," the rejection over Zimmerman et al. should be withdrawn. This is not deemed persuasive, as Zimmerman et al. still clearly discloses the use of calcium ions in corn- or potato-based food products, including "snacks, snack chips, bagel chips, Melba toast, pretzels and the like." Thus the claims lack novelty as being anticipated by Zimmerman et al.

(ii) Claims 1-41 lack novelty under PCT Article 33(2) as being anticipated by Prosser et al. (US 6,716,462).

Prosser et al. disclose snack foods which "provide a balanced mix of an amino acid source, fat, and carbohydrates" (abstract).

Columns 3 and 5 recite various snacks which may be produced by the invention, including baked and fried snack foods such as potato crisps, corn chips, crackers, cookies and pretzels. Each of these requires the processing of a starch-based dough.

Supplemental Box

Column 23 discloses the fortification of the snack food dough with various minerals and their salts. "Embodiments of the present invention may be fortified with minerals such as calcium, phosphorus, magnesium, iron, zinc, iodine, selenium, copper, manganese, fluoride, chromium, molybdenum, sodium, potassium, and chloride."

Specific amounts of calcium, magnesium, iron, copper, phosphorus, and zinc are provided therein. Furthermore, the salts of these minerals may be utilized. "The source of the mineral salt, both those with established U.S. RDA levels or with safe and adequate intake levels, as well as those with no as yet established human requirement, used in the practice of this invention, can be any of the well known salts including carbonate, oxide, hydroxide, chloride, sulfate, phosphate, pyrophosphate, gluconate, lactate, acetate, fumarate, citrate, malate, amino acids and the like for the cationic minerals and sodium, potassium, calcium, magnesium and the like for the anionic minerals. However, the particular salt used and the level will depend upon their interaction with other food product ingredients. Elemental iron (electrolytic or reduced iron) is another preferred source of iron."

Example 21 provides for a fabricated potato crisp made according to the methods outlined in the reference. Example one provides an exemplified amount of sodium aluminum phosphate, at 0.76 %.

In the reply to the Written Opinion, applicant has stated that the reference "does not disclose any example of an application to corn or tortilla chips of the Prossie method", and that "Prossie does not teach the use of the addition of divalent or trivalent cations in the production of fabricated potato chips or fabricated corn-based chips." Applicants state that Prossie et al. simply provides a "laundry list" from which one is to "pick" and "choose" a combination. This is not deemed persuasive for the reasons of record. Applicant's own claims were originally drawn to such food items broadly encompassed by "a thermally processed food manufactured from a dough", very similar to the disclosure of Prossie et al. Similarly, applicant's current claims broadly recite the addition of a cation, where certain dependent claims provide a "laundry list" of different cations from which to choose. The added components as recited by Prossie are "found in substantially the same situation where they do substantially the same work". The number of components provided does not detract from the fact that the reference specifically teaches and suggests the invention.

NEW CITATIONS

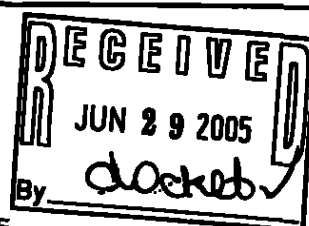
From the INTERNATIONAL BUREAU

PCT

SECOND AND SUPPLEMENTARY NOTICE
INFORMING THE APPLICANT OF THE
COMMUNICATION OF THE INTERNATIONAL
APPLICATION (TO DESIGNATED OFFICES
WHICH APPLY THE 30 MONTH TIME
LIMIT UNDER ARTICLE 22(1))

(PCT Rule 47.1(c))

To:

CAHOON, Colin, P.
Carstens & Cahoon, LLP
P.O. Box 802334
Dallas, TX 75380
ETATS-UNIS D'AMERIQUE

Date of mailing (day/month/year) 23 June 2005 (23.06.2005)		
Applicant's or agent's file reference CFLAY.00179P		IMPORTANT NOTICE
International application No. PCT/US2004/003448	International filing date (day/month/year) 06 February 2004 (06.02.2004)	Priority date (day/month/year) 21 February 2003 (21.02.2003)
Applicant FRITO-LAY NORTH AMERICA, INC. et al		

1. **ATTENTION:** For any designated Office(s), for which the time limit under Article 22(1), as in force from 1 April 2002 (30 months from the priority date), does not apply, please see Form PCT/IB/308(First Notice) issued previously.
2. Notice is hereby given that the following designated Office(s), for which the time limit under Article 22(1), as in force from 1 April 2002, does apply, has/have requested that the communication of the international application, as provided for in Article 20, be effected under Rule 93bis.1. The International Bureau has effected that communication on the date indicated below:
10 September 2004 (10.09.2004)

AU, AZ, BY, CN, CO, DZ, EP, HU, KG, KP, KR, MD, MK, MZ, NA, RU, SY, TM, US

In accordance with Rule 47.1(c-bis)(i), those Offices will accept the present notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

3. The following designated Offices, for which the time limit under Article 22(1), as in force from 1 April 2002, does apply, have not requested, as at the time of mailing of the present notice, that the communication of the international application be effected under Rule 93bis.1:

AE, AG, AL, AM, AP, AT, BA, BB, BG, BF, BW, BZ, CA, CR, CU, CZ, DE, DK, DM, EA, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, ID, IL, IN, IS, JP, KE, KZ, LC, LK, LR, LS, LT, LV, MA, MG, MN, MW, MX, NI, NO, NZ, OA, OM, PG, PH, PL, PT, RO, SC, SD, SG, SK, SL, TJ, TN, TR, TT, UA, UZ, VC, VN, YU, ZA, ZW

In accordance with Rule 47.1(c-bis)(ii), those Offices accept the present notice as conclusive evidence that the Contracting State for which that Office acts as a designated Office does not require the furnishing, under Article 22, by the applicant of a copy of the international application.

4. **TIME LIMITS** for entry into the national phase

For the designated or elected Office(s) listed above, the applicable time limit for entering the national phase will, subject to what is said in the following paragraph, be 30 MONTHS from the priority date.

In practice, time limits other than the 30-month time limit will continue to apply, for various periods of time, in respect of certain of the designated or elected Office(s) listed above. For regular updates on the applicable time limits (30 or 31 months, or other time limit), Office by Office, refer to the *PCT Gazette*, the *PCT Newsletter* and the *PCT Applicant's Guide*, Volume II, National Chapters, all available from WIPO's Internet site, at <http://www.wipo.int/pct/en/index.html>.

It is the applicant's sole responsibility to monitor all these time limits.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Yoshiko Kuwahara
Facsimile No.+41 22 740 14 35	Facsimile No.+41 22 338 90 90

Form PCT/IB/308(Second and Supplementary Notice) (January 2004)

293

Este recibo debe ser utilizado
Únicamente para tramites de
Mario Delgado Echeverry e Hijos Ltda.
Marca: PCT ERITO LA Y
Expediente: _____

69

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO

NIT : 800176089-2

RECIBO OFICIAL DE CAJA : 05 - 63,842
FECHA : AGOSTO 23 DE 2005

SUPERINDUSTRIA Y COMERCIO
Radicacion : 45891264 000000000
Fecha (UND): 2005-08-23 15:50:33 Folios: 000
Frente : 011 PCT-PATENT 379 FASE NACI 411 PRESENTAC
Dependencia: 2000 DIVISION DE NUEVAS CREACIONES

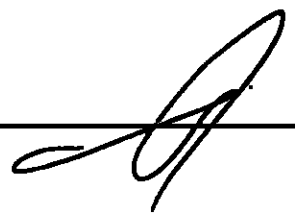
CONSIGNACION

DEPOSITANTE	TIPO PAGO	BANCO	CUENTA	No. PAGO	FECHA PGO	Vr. PAGO
MARIO DELGADO ECHEVERRY	CONSIGNACION	BANCO POPULAR	030-00110-6	14464947	23/08/2005	9,894,000.00

CONCEPTO

CANT.	RENTISTICO	CONCEPTO	TOTAL CONCEPTO
1	50005-01-01	SOLICITUDES	
1		TRAMITES DE SOL. DE PATENTE DE IN	443,000.00
		TOTAL :	443,000.00

SOM: CUATROCIENTOS CUARENTA Y TRES MIL PESOS

RESPONSABLE : _____


RECIBO DE CAJA APLICADO AL EXPEDIENTE No. _____

MDE

Mario Delgado Echeverry e Hijos Ltda.

Miembros ACPI – ASIPi – APPPi

Documents to which herein, the

on July 20, 2004.

del cas de
22-05

be authenticated with
alized by Apostille for the

18-28-2005

COMO NOTARIO 18 DE BOGOTA
QUE ESTA FOTOCOPIA CONFORME
CON SU ORIGINAL CON QUE HA
SOLAMENTE ENTREGADO

19 JUL 2005

NOTARIO 18
SANTAFE DE BOGOTA

CYNTHIA L. HUDDLETON
NOTARY PUBLIC
STATE OF TEXAS
EXPIRES



The State of Texas

Secretary of State

APOSTILLE

(Convention de La Haye du 5 Octobre 1961)

1. **Country:** **United States of America**
- This public document**
2. **has been signed by** **CYNTHIA L HUDDLESTON**
3. **acting in the capacity of** **Notary Public, State of Texas**

4. **and bears the seal/stamp of** **CYNTHIA L HUDDLESTON, Notary Public,
State of Texas, Commission Expires: 10-22-05**

CERTIFIED

5. **at Austin, Texas** 6. **on July 23, 2004**
7. **by the Secretary of State of Texas**
8. **Certificate No. N-417700**
9. **Seal** 10. **Signature:**



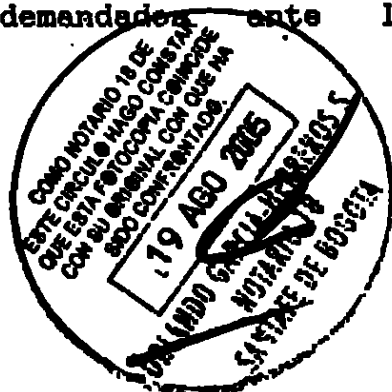
A handwritten signature in black ink, appearing to read "G. Connor".

Geoffrey S. Connor
Secretary of State
ST/wn



PODER

Atentamente se dirige a Usted Thomas P. Schur, ciudadano mayor y vecino de Dallas, Texas, Estados Unidos, para manifestarle que en mi condición de Representante legal de la firma Frito-Lay North America, Inc., domiciliada en 7701 Legacy Drive, Plano, Texas 75024-4099, Estados Unidos, confiero poder general, amplio y suficiente a los Doctores JAIME EDUARDO DELGADO VILLEGAS, y/o CLEMENCIA DELGADO VILLEGAS, Abogados, mayores y vecinos de Bogotá, D.C. (Colombia), para que en nuestro nombre y representación adelanten ante Ustedes toda clase de diligencias y procedimientos especiales para el Registro y Renovación en su Despacho, de toda clase de Marcas de Producto y Servicio, Depósitos de Nombre y Enseña Comercial, Diseños Industriales y Patentes de Invención, Patentes Modelo de Utilidad, Esquemas de Circuitos Integrados, Nombres de Dominio, Derechos de Autor, Variedades Vegetales, registros agrícolas, veterinarios y sanitarios, certificados de capacidad, renovación, modificación, traspaso y ampliación de los mismos y atiendan como apoderados generales todo asunto referente a la propiedad industrial e intelectual, quedando facultados para presentar y retirar Oposiciones, interponer recursos, solicitar testimonios, recibir documentos, cancelar costos legales, probar explotaciones, aceptar transacciones, llegar a acuerdos marcarios con terceras personas o entidades jurídicas, desistir, sustituir y hacer cuanto fuere necesario ante cualquier autoridad administrativa para los fines arriba indicados; y en caso de que el procedimiento debiera pasar a conocimiento judicial, quedan facultados para actuar como demandantes o demandados ante los Jueces que sean



GABRIEL MEDINA CHADID
Traductor e Interpreté Oficial
Pura. 1988 de 1988 del Min. de Justicia
Min. de Relaciones Exteriores

competentes, con poder amplio, pudiendo transar, someter a árbitros, desistir, interponer recursos y con todas las demás facultades especiales que fueren necesarias.

Con éste objeto, ruego le confieran personería suficiente a nuestros Apoderados quienes podrán obrar en forma conjunta o independiente.

El presente poder revoca y cancela cuantos poderes se hubieren otorgado por la Compañía con anterioridad a esta fecha en el territorio de la República de Colombia.

Atentamente, Firmado por: Thomas P. Schur

Secretario Adjunto de Frito-Lay North America, Inc.

Certificación Notarial:

El infrascrito Notario Público certifica que la firma que antecede y dice THOMAS P. SCHUR es auténtica: que el firmante es SECRETARIO ADJUNTO de FRITO-LAY NORTH AMERICA, INC., que tiene facultad para otorgar este poder y que dicha compañía existe y está debidamente organizada de conformidad con las Leyes del Estado de Delaware, Estados Unidos.

Todos los hechos anteriores le constan por haber examinado los documentos respectivos y de todo ello da fé.

Dado y firmado en Plano, Texas, a los 20 días del mes de Julio de 2004.

Firmado y Sellado por: Notario Público

Estado de Texas, Condado de Collin

CYNTHIA L. HUDDLESTON

Fecha de Vencimiento: 10-22-2005

Este poder debe ser legalizado con Apostille. Favor reducir a Escritura Pública ante Notario



GABRIEL FUEDA CHADID
Traductor e Interpreté Oficial
Res. 8508 de 1997 del Min. de Justicia
Min. de Relaciones Exteriores

-ESTADO DE TEXAS

Secretario de Estado

APOSTILLE

(Convention de La Haya du 5 Octobre 1961)

- 1. País: Estados Unidos de América
- El presente documento público...
- 2. ha sido firmado por CYNTHIA L. HUDDLESTON
- 3. en su condición de Notario Publico, Estado de Texas.
- 4. lleva el sello/estampilla de CYNTHIA L. HUDDLESTON, Notario Publico, Estado de Texas, Fecha de Vencimiento de la Comisión Notarial: 10-22-05.

SE CERTIFICA

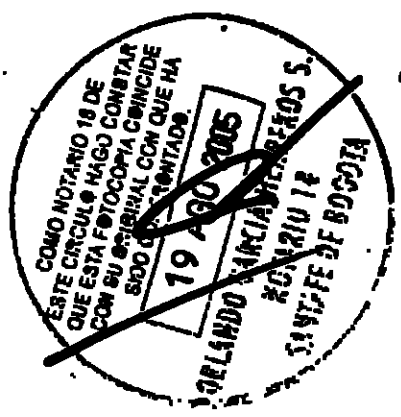
- 5. en Austin, Texas
- 6. el día 23 de Julio del 2004
- 7. por el Secretario de Estado de Texas
- 8. Certificado No. N-417700
- 9. Sello
- 10. Firma:

Geoffrey S. Connor
Secretario de Estado

La anterior es Traducción Oficial de un documento presentado originalmente en inglés. Esta traducción fue realizada por GABRIEL RUEDA CHADID (Traductor Oficial). Resolución 5896 del Minjusticia, por lo cual estampo mi Sello y Firmo.

Bogotá D.C.

MINISTERIO DE RELACIONES EXTERIORES
Carrera 2a
5550922
NO SE ASUME RESPONSABILIDAD DEL TEXTO
2004 AGO 13 A 9 188
COPIA FIRMADA APARECE EN EL DOCUMENTO DESEMPLEA LAS FUENTES INDICADAS
JEFES DE LEGALIZACIONES SANTAFE DE BOGOTÁ A.C.



LEADIC TECNICAL DE COLOMBIA
NIT 17.124.146-4