



PCR

Industria y Comercio

SUPERINTENDENCIA



SOLICITUD

PATENTE DE INVENCION

10-53449

21. EXPEDIENTE N°

54. TÍTULO BARRA HORNEADA LAMINADA.

51. CLASIFICACIÓN INTERNACIONAL No clasificada

71. SOLICITANTE Corporativo Internacional Mexicano, S. DE R.L. DE C.V.

DOMICILIO Industrial Vallejo, Mexico D.F., Mexico

74. APODERADO DILIA MARIA RODRIGUEZ D'ALEMAN

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Título, Poder. Com.
31-05-2010



**FORMULARIO ÚNICO DE SOLICITUD DE PATENTE
PCT
ENTRADA EN FASE NACIONAL**

1

SOLICITUD DE:



Patente de Invención



Patente de Modelo de Utilidad



Capítulo I.



Capítulo II.

2

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PCT (86)

Solicitud Internacional No. PCT/IB2008/002933

Fecha 31 de octubre de 2008

Publicación Internacional No. WO 2009/056971 A2

Fecha 07 de mayo de 2009

6 **TÍTULO (54)**

BARRA HORNEADA LAMINADA.

(Folio 120)

7 **Clasificación Internacional (51)**

No clasificada

8 **Prioridad**

SI



NO



(33) País de Origen

Estados Unidos de América

(32) Fecha

31 de octubre de 2007

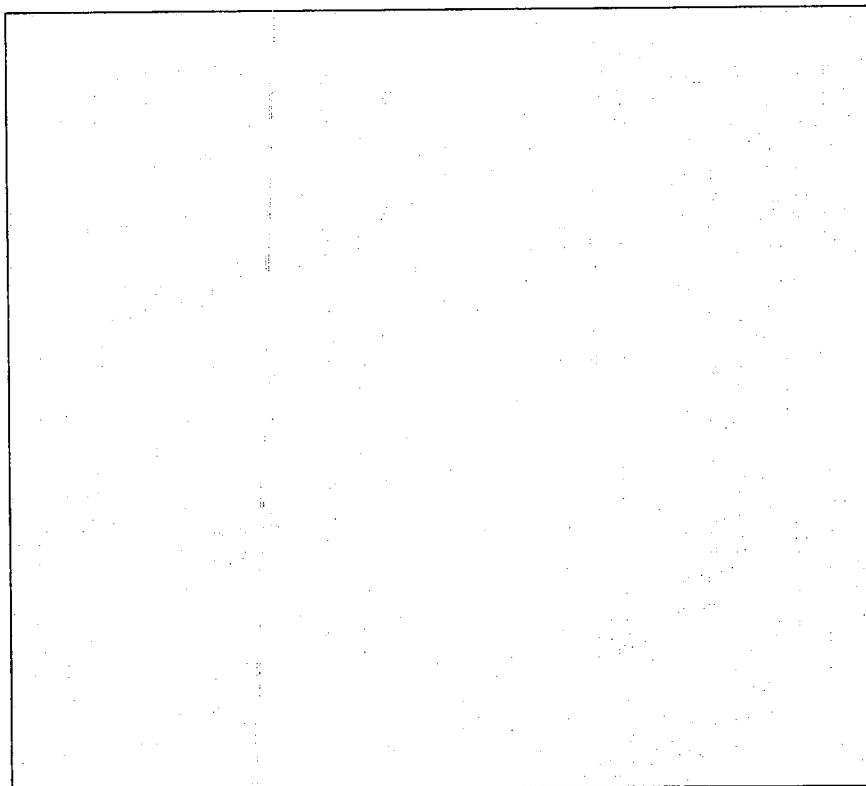
(31) Número de Solicitud

11/932,111

9 **Comprobante de pago No.** 10-24,894 // 10-18,108 // 10-24,967 **Fecha** 05/04/10 // 08/03/10 // 05/04/10

- ☐ Comprobante de pago de la tasa de presentación de la solicitud
- ☐ Documento que acredita la existencia y representación legal cuando el solicitante sea persona jurídica
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- ☐ Copia de la solicitud internacional. (Resumen, descripción, reivindicaciones, dibujos)
- ☐ Traducción de la solicitud internacional al castellano. (Resumen, descripción, reivindicaciones, dibujos)
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- ☐ Arte final 12 X 12 .
- ☐ De ser el caso, información sobre otras solicitudes de patente o títulos obtenidos en el extranjero por el mismo titular o su causante, relacionadas parcial o totalmente con la invención de esta solicitud.
- ☐ De ser el caso, modificaciones efectuadas a la solicitud internacional
- ☐ Otros Opinión escrita

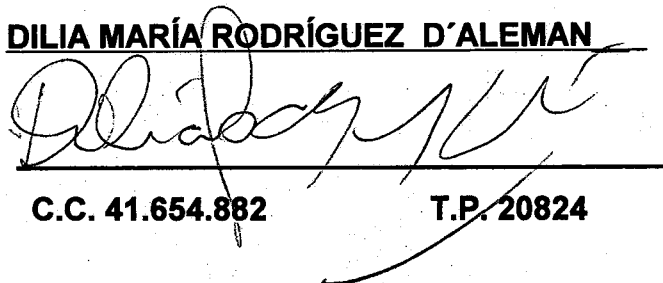
11 FIGURA CARACTERÍSTICA



12 Solicito la concesión de la patente

NOMBRE : DILIA MARÍA RODRÍGUEZ D'ALEMAN

FIRMA:



C.C. 41.654.882

T.P. 20824

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO

NIT : 800176089-2

CERTIFICACION DE EXCEDENTE : 10 - 24,894
FECHA : ABRIL 5 DE 2010

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO



No. 10-053449- -00000-0000

Fecha: 2010-05-05 16:03:55 Dep. 2020 DIR.NUEVASCR
Tra. 11 PATENTEIYII Eve: 379 FASENACIONALII
Act. 411 PRESENTACION Folios: 116

***** CONSIGNACION *****

DEPOSITANTE	TIPO PAGO	BANCO	CUENTA	No. PAGO	FECHA PAGO	Vr. PAGO
CLARKE MODET Y CO. COLOMB	CONSIGNACION	BANCO DE BOGOTA	062754387	353190121	31/03/2010	84,780,000.00

***** CONCEPTO *****

CANT.	RENTISTICO	CONCEPTO	TOTAL CONCEPTO
1	50005-01-09	OTROS SERVICIOS DE PROPIEDAD I	
		99 OTROS SERVICIOS ADMINISTRATIVOS	500,000.00
		TOTAL :	\$ 500,000.00

SON: QUINIENTOS MIL PESOS

RESPONSABLE : 

RECIBO DE CAJA APLICADO AL EXPEDIENTE No. _____

ESTA CERTIFICACION DE EXCEDENTE DE PAGO SOLO PODRA SER UTILIZADA
COMO PARTE DE LA CANCELACION DE UNA TARIFA VIGENTE Y NO PODRA SER
SUSTITUIDA POR NINGUN RECIBO.

P-2560
3

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO

NIT 1.200.176.085-2

CERTIFICACION DE EXCEDENTE : 10 - 18,10
FECHA : MARZO 8 DE 2010

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO



No. 10-053449-00000-0000

Fecha: 2010-05-05 16:03:55 Dep. 2020 DIR.NUEVASCR
Tra. 11 PATENTEIYII Eve: 379 FASENACIONALII
Act. 411 PRESENTACION Folios: 116

***** CONSIGNACION *****

DEPOSITANTE	TIPO PAGO	BANCO	CUENTA	Nº. PAGO	FECHA PAGO	Vr. PAGO
CLARKE MORET Y CO. COLOMBIA	CONSIGNACION	BANCO DE BOGOTA	062754387	16937491	08/03/2010	89,370,000.00

***** CONCEPTO *****

CANT.	CONCEPTO	TOTAL CONCEPTO
1	50005-01-09 OTROS SERVICIOS DE PROPIEDAD I	99 OTROS SERVICIOS ADMINISTRATIVOS
		TOTAL :
		200,000.00
		200,000.00

SON: DOSCIENTOS MIL PESOS

RESPONSABLE :

[Signature]

RECIBO DE CAJA APLICADO AL EXPEDIENTE No. _____

ESTA CERTIFICACION DE EXCEDENTE DE PAGO SOLO PODRA SER UTILIZADA
COMO PARTE DE LA CANCELACION DE UNA TARIFA VIGENTE Y NO PODRA SER
SUSTITUIDA POR NINGUN RECIBO.

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO

NIT : 800176089-2

RECIBO OFICIAL DE CAJA : 10 - 24,967
FECHA : ABRIL 5 DE 2010

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO



No. 10-053449- -00000-0000

Fecha: 2010-05-05 16:03:55 Dep. 2020 DIR.NUEVASCR
Tra. 11 PATENTEIYII Eve: 379 FASENACIONALII
Act. 411 PRESENTACION Folios: 116

***** CONSIGNACION *****

DEPOSITANTE	TIPO PAGO	BANCO	CUENTA	No. PAGO	FECHA PGO	Vr. PAGO
CLARKE MODET Y CO. COLOMB	CONSIGNACION	BANCO DE BOGOTA	062754387	353190121	31/03/2010	84,780,000.00

***** CONCEPTO *****

CANT.	RENTISTICO	CONCEPTO	TOTAL CONCEPTO
1	50005-01-03	CAMBIO DE MODALIDAD Y MODIFICA	
		12 MARCAS Y LEHAS COMERCIALES	114,000.00
		TOTAL :	\$ 114,000.00

SON: CIENTO CATORCE MIL PESOS

RESPONSABLE :

RECIBO DE CAJA APLICADO AL EXPEDIENTE No. _____

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RESUMEN

Una barra horneada laminada incluye una capa de relleno laminado de baja humedad entre dos capas delgadas de masa. Las capas de masa de la barra tienen una textura
5 crujiente similar a la de una galleta salada, mientras que la capa de relleno permanece suave. El grosor total de la barra horneada es de preferencia menor que 7 milímetros. La barra se prepara al calibrar láminas de masa con un grosor menor que 1 milímetro cada una, seguido por el depósito de una
10 composición de relleno que tiene una estabilidad de resistencia al calor alta en una de las láminas de masa calibrada y colocar una segunda lámina de masa calibrada encima del relleno para formar una lámina. Posteriormente, la lámina se calibra, se corta en barras y se hornea, utilizando
15 un perfil de horneado leve. La barra puede tener un diseño moldeado en la superficie superior y/o una composición de cubierta, de preferencia, que incluye avena, depositada sobre la lámina.

BARRA HORNEADA LAMINADA**DESCRIPCIÓN DE LA INVENCION**

Esta invención se relaciona con barras. En particular, esta invención se relaciona con barras horneadas laminadas que tienen un relleno que incluye fruta.

Desde hace mucho tiempo, se conoce la producción de aperitivos de varias composiciones. Se desea obtener composiciones nuevas y mejoradas que cumplan con las cambiantes demandas del mercado. En particular, se detecta una demanda en el mercado para aperitivos bajos en calorías con sabor, apariencia y textura agradable. Por ejemplo, numerosas barras distintas horneadas y suaves con relleno de fruta se encuentran disponibles a nivel comercial.

El laminado de masa es un método común para producir capas de masa para productos horneados que incluyen galletas, galletas saladas, pasteles, bizcochos, pasta, trozos de cereal, pastas para pizza y varios otros artículos similares. Las láminas de masa pueden producirse al depositar masa mezclada de manera generalmente homogénea en una banda transportadora e introducirla entre por lo menos dos rodillos que giran en dirección contraria, cada uno de los cuales se extiende a través de la anchura del transportador. Los rodillos comprimen la masa en una lámina de grosor predeterminado y la lámina de masa se desplaza en la banda transportadora en movimiento para procesamiento adicional.

Las láminas de masa pueden reducirse a un grosor específico mediante el proceso de calibración. La calibración consiste en pasar una lámina de masa a través de un conjunto de rodillos que giran en dirección contraria colocados a una distancia exacta entre sí. El grosor de la lámina de masa calibrada puede monitorearse, por ejemplo, mediante una sonda láser. La medición se realiza para asegurar que la lámina de masa se calibre de manera precisa y que el espacio entre los rodillos pueda ajustarse según se necesite.

El laminado es el proceso de crear una lámina, que es un artículo que tiene dos o más capas unidas entre sí. Las capas pueden estar compuestas por los mismos materiales, tales como piezas de madera en contrachapado o diferentes materiales, tales como película plástica unida con calor alrededor de una hoja de papel. En la industria alimenticia, una barra laminada puede incluir una capa de relleno de fruta comprimido entre dos capas de láminas de masa.

De esta manera, aunque las estructuras y composiciones alimenticias en barra de acuerdo con la técnica anterior proporcionan un número de características ventajosas, cuentan con ciertas limitaciones. Por ejemplo, un problema común con los productos alimenticios rellenos laminados, tales como barras, es que la humedad del relleno suele ser absorbida por las capas de masa adyacentes. Por lo general, esto no es deseable, ya que las capas de masa se

humedecen. La presente invención busca superar algunas de estas limitaciones y otras desventajas de la técnica anterior y proporcionar nuevas características nunca antes vistas. En consecuencia, se desea proporcionar una barra laminada baja
5 en calorías que, al mismo tiempo, incluya capas de masa similares a galletas saladas y una capa intermedia húmeda de relleno. El relleno permanece suave sin humedecer las capas crujientes de masa. Las características y ventajas adicionales de la invención o de ciertas modalidades de la
10 invención serán aparentes para aquellos con experiencia en la técnica a partir de la siguiente descripción de las modalidades ejemplares.

De acuerdo con un primer aspecto, se proporciona una barra horneada laminada. Ciertas modalidades ejemplares
15 de la barra descrita en la presente comprenden dos capas de masa crujiente con una capa húmeda de relleno entre las capas de masa. El grosor total de la barra puede ser menor que 7 milímetros.

De acuerdo con otro aspecto, se proporciona una
20 composición de masa que muestra una textura similar a la de las galletas saladas al ser horneada. La composición de masa incluye de preferencia harina de trigo, harina de avena, almidón modificado y enzimas.

De acuerdo con un aspecto adicional, se proporciona
25 una composición de relleno que mantiene la suavidad y más del

noventa por ciento de su masa al ser horneada. La composición de relleno tiene un alto contenido sólido y puede comprender fruta.

De acuerdo con aún otro aspecto, un método para
5 preparar una barra horneada comprende las etapas de calibrar láminas de masa con un grosor menor que 1 milímetro cada una, posteriormente, depositar una composición de relleno en una de las láminas de masa calibrada y colocar una segunda lámina de masa calibrada sobre el relleno. Después de ello, la
10 lámina se calibra, se corta en barras y se hornea, utilizando un perfil de horneado leve. Ciertas modalidades ejemplares del método descrito en la presente también comprenden moldear un diseño en la parte superior de la lámina y/o depositar una composición de cubierta sobre la lámina.

15 BREVE DESCRIPCIÓN DE LOS DIBUJOS

La Figura 1 es una vista en perspectiva de una barra horneada laminada de una modalidad de la invención.

La Figura 2 es una vista en planta de un diseño de molde para aplicar un patrón en la parte superior de una
20 barra de acuerdo con una modalidad de la invención.

La Figura 2b es un corte transversal de una porción del diseño tomada a lo largo de las líneas 2b-2b de la Figura 2a.

La Figura 2c es un corte transversal de otra
25 porción del diseño de la Figura 2a tomada a lo largo de las

líneas 2c-2c.

La Figura 3 es una vista en elevación lateral de un aparato que puede emplearse para preparar una barra horneada laminada de acuerdo con una modalidad de la invención.

5 La Figura 4 es una vista en perspectiva parcial de un aparato utilizado para realizar una etapa del método para formar la barra, en donde se aplica una composición de relleno a una capa de masa de acuerdo con una modalidad de la invención.

10 La Figura 5 es una vista en perspectiva con acercamiento parcial del aparato mostrado en la Figura 4, en donde una capa de masa se aplica sobre una capa de relleno.

Debe entenderse que la barra de acuerdo con esta descripción puede tener cualquiera de numerosas y distintas
15 formulaciones o constituciones específicas. La formulación de una barra puede variar en cierta medida, dependiendo de factores tales como el sector comercial previsto para el producto, sus características nutricionales deseadas, perfil de sabor y similares. Por ejemplo, pueden añadirse
20 saborizantes, edulcorantes, vitaminas, conservadores y/o agentes colorantes a cualquiera de las formulaciones para variar el sabor, textura, características nutricionales, etc. En general, una barra de acuerdo con esta descripción por lo general incluye masa que comprende por lo menos harina, agua,
25 almidón, enzimas, grasa y un agente catalizador. La barra

también incluye una composición de relleno de baja humedad, que, por lo general, comprende edulcorantes, fruta, glicerina, almidón y pectina. De manera alternativa, puede utilizarse una composición de relleno apetitosa en la barra.

- 5 Aquellos con experiencia en la técnica reconocerán ingredientes adecuados adicionales y alternativos que cuentan con el beneficio de esta descripción.

Con referencia a la Figura 1, se proporciona una vista en perspectiva de una modalidad de la invención. La barra 10 ilustrada en la Figura 1 incluye una primera capa 1 de masa y una segunda capa 3 de masa, que forman la capa inferior y superior de la barra 10, respectivamente. Una capa 5 de relleno se dispone entre las dos capas 1, 3 de masa y, en esencia, llena por completo el área entre las dos capas 1, 3. Como se muestra en la figura, el relleno es visible desde el lado de la barra 10 y se extiende hacia los bordes de las capas de masa. Además, la barra 10 puede comprender una cubierta 9 y/o una composición para dar brillo (no mostrada) añadida a la parte superior de la barra 10. De preferencia, la cubierta 9 incluye avena, tal como avena tostada y hojuelas de avena, que pueden fijarse a la barra 10 con la composición para dar brillo. Las capas 1, 3 de masa pueden comprender harina de avena para proporcionar un total de más de 3 gramos de avena por barra. Una barra 10 completa de 25 gramos puede proporcionar menos de 100 calorías.

Opcionalmente, puede moldearse un diseño 7 en la parte superior de la capa de masa (Figura 1). El diseño 7 se muestra con más detalle en la forma de un diseño de moldeo mostrado en la Figura 2a, aunque pueden moldearse diseños concebibles en la barra 10. La Figura 2a ilustra un diseño 7 que comprende una pluralidad de círculos 4 y anillos 4. La vista del corte transversal mostrada en la Figura 2b indica la topografía variable que puede obtenerse con el moldeo de masa. De manera similar, la vista del corte transversal mostrado en la Figura 2 muestra que el diseño 7 incluye proyecciones 6 angulares en el centro de los anillos 4.

La receta de la masa debe proporcionar una masa capaz de laminarse y calibrarse con un grosor menor que 1 milímetro para su uso en la barra 10. Además, las capas 1 y 3 de masa están hechas a partir de una composición de masa que comprende por lo menos harina, almidón modificado y enzimas. La cantidad de harina, tal como harina de trigo, presente en la composición de masa va de entre alrededor de 30% y 80% en peso de la composición total de masa. El almidón modificado incluido en la composición de masa constituye entre alrededor de 3% y 20% en peso de la composición total de masa. Por ejemplo, el almidón modificado puede ser un almidón de maíz ceroso. Cualquier enzima de degradación de pentosano adecuada puede incluirse en la composición de masa en una cantidad de entre alrededor 0.1% y 0.4% en peso de la composición total

de masa. La enzima puede añadirse como una solución diluida, tal como una solución que contiene una parte en peso de un concentrado enzimático y nueve partes en peso de agua. De preferencia, la composición de masa no incluye la reducción que comprende grasas transgénicas. La Tabla 1 proporciona muchos de los ingredientes de la composición de masa de una modalidad ejemplar de la barra.

Tabla 1 Ingredientes de Composición de la Masa

Ingredientes	Porcentaje en peso
Agua	17.0%
Harina de trigo	45.28%
Harina de avena	11.32%
Almidón modificado	5.15%
Enzimas	0.01%
Gluten de trigo	1.04%
Inulina	3.22%
Azúcar	3.66%
Grasa	7.7%
Agente catalizador	0.9%
Levadura	0.04%
Sal	0.89%
Emulsionante	0.26%
Saborizante	0.23%

Las capas 1 y 3 de masa, al hornearse, muestran una textura similar a las galletas saladas, que puede determinarse en términos cualitativos mediante un panel sensorial utilizando un sistema tal como el Análisis Descriptivo Cualitativo (QDA) y/o en términos cuantitativos al medir el peso requerido para fracturar la capa de masa. El peso requerido para romper las capas 1 y 3 de masa, que tienen una textura de galleta salada, va de entre alrededor

de 0.09 kg y 1.40 kg.

Como se debate en lo anterior, la capa 5 de relleno de la barra 10 puede ser ya sea dulce o apetitosa. En una modalidad, la capa 5 de relleno puede comprender fruta, tal como fresa y/o manzana, ciruela pasa, piña, durazno o arándanos. De manera importante, la composición de relleno tiene un alto contenido de sólidos y un bajo nivel de humedad, lo que ayuda a minimizar la transferencia de humedad de la capa 5 de relleno a las capas 1 y 3 de masa, con lo que se mantiene la textura crujiente de las capas 1 y 3 de masa horneada. De preferencia, la composición de relleno incluye entre alrededor de 75% y 80% de sólidos, menos de 2% de agua y una actividad de agua reducida, tal como entre alrededor de 0.56 y 0.65. Los sólidos pueden proporcionarse mediante varios de los ingredientes de la composición de relleno, tal como la fruta, pectina, azúcar, almidón, etc. Además, los trozos o inclusiones de fruta o verduras que tienen un contenido de humedad por debajo de alrededor de 5.5% también pueden incluirse en el relleno. Algunos ejemplos de inclusiones abarcan pasas, arándanos deshidratados, trozos de manzana deshidratada y trozos de tomate deshidrato. De manera similar a la composición de masa, la composición de relleno de preferencia no incluye ninguna fuente de grasas transgénicas. La Tabla 2 en lo siguiente incluye varios ingredientes para una composición de relleno de fruta de una

modalidad de la barra.

Tabla 2 Composición de Relleno de fruta

Ingredientes	Porcentaje en peso
Azúcar	27.97%
Fructuosa	24.12%
Glicerina	12.0%
Fresa	10.0%
Manzana	7.0%
Dextrosa	8.73%
Almidón modificado	5.50%
Pectina	1.35%
Ácido cítrico	0.75%
Agua	0.89%

La presencia de pectina, almidón y, opcionalmente, estabilizadores de goma, puede contribuir a la elevada estabilidad de resistencia al calor (RHS) de la composición de relleno. La RHS se define como el porcentaje de masa de una composición que permanece después del horneado, de esta manera, una composición de relleno con un valor de RHS de 90% perdería 10% de su masa durante el proceso de horneado. La RHS de la composición de relleno utilizada para la capa 5 de relleno debe tener por lo menos 90% y de preferencia por lo menos 97%. Además, de manera ventajosa, la composición de relleno en la capa 5 de relleno no se expande más allá de los bordes de las capas 1 y 3 de masa durante el horneado. La pectina, almidón y estabilizadores de goma opcionales también sirven para ayudar a retener la humedad dentro de la capa 5 de relleno y son un factor que contribuye a la actividad baja de agua de la composición de relleno. Esto es importante, ya

que la retención de humedad impide que la capa 5 de relleno se deshidrate y que las capas 1 y 3 de masa se humedezcan con el paso del tiempo.

Las modalidades de la barra 10 horneada pueden producirse al emplear, por ejemplo, el sistema 50 del aparato ilustrado en la Figura 3. El sistema 50 incluye por lo general una sección 40 de calibración, una sección 42 de laminación y una sección 44 de acabado. La sección 40 de calibración comprende por lo general una unidad 12 de liberación de masa, un distribuidor 14 de masa, un primer y segundo formador 16 y 18 de laminado de masa y una pluralidad de rodillos 20 calibradores y unidades 22 de calibración. De preferencia, la masa se transporta a lo largo del sistema 50 del aparato utilizando una pluralidad de transportadores 24, pero cualquier equipo o método adecuado puede emplearse para transferir las capas de masa entre los diferentes elementos del sistema 50 del aparato.

En la sección 40 de calibración, la masa mezclada de manera sustancialmente homogénea se proporciona primero a la unidad 12 de liberación de masa. La unidad 12 de liberación transfiere la masa al distribuidor 14 de masa, que posteriormente desvía una primera porción de la masa a un primer formador 16 de laminado de masa y una segunda porción de la masa a un segundo formador 18 de laminado de masa. Como se muestra, el primer formador 16 de laminado de masa también

puede contener dos o más rodillos 20 calibradores. Cuando la primera porción de masa pasa a través del primer formador 16 de laminado de masa, se produce una primera lámina de masa. Los rodillos 20 calibradores reducen posteriormente el grosor de la primera lámina de masa por debajo de 1 milímetro (mm),
5 opcionalmente por debajo de 0.9 mm o alrededor de 0.83 mm, lo que forma una primera capa de masa calibrada.

Los rodillos calibradores pueden ubicarse de manera opcional en una unidad 22 de calibración separada como se
10 ilustra en combinación con el segundo formador 18 de laminado de masa. La segunda porción de masa pasa a través del segundo formador 18 de laminado de masa y se produce una segunda lámina de masa. La segunda lámina de masa puede transportarse lejos del formador 18 a través de un transportador 24 y
15 llevada a la unidad 22 de calibración. Además, una lámina de masa puede calibrarse varias veces. La Figura 3 muestra tres unidades 22 de calibración en secuencia y separadas por transportadores. Las unidades 22 de calibración reducen el grosor de la segunda lámina de masa por debajo de 1 mm, de
20 manera opcional por debajo de 0.9 mm o alrededor de 0.83 mm, lo que forma una segunda capa de masa calibrada.

A continuación, la primera y segunda capas de masa calibrada son transportadas a la sección 42 de laminación. La sección 42 de laminación comprende por lo general por lo
25 menos un decantador 26 de relleno, un alimentador 27 de capas

de masa y una unidad 28 de calibración. Con referencia a la Figura 4, se deposita un relleno en la segunda capa calibrada conforme pasa por debajo de uno o más decantadores 26. En una modalidad, el relleno se deposita en una serie de hileras
5 largas ubicadas adyacentes entre sí en toda la anchura de la segunda capa de masa calibrada, sin embargo, puede utilizarse cualquier método adecuado para depositar el relleno en la segunda capa de masa calibrada para cubrir por completo y de manera sustancial la superficie de la capa de masa. La
10 primera capa de masa calibrada es transportada, de preferencia desde la parte superior, y es introducida por el alimentador 27 de capas de masa para yacer encima de la segunda capa de masa calibrada y rellenar y formar una lámina. La Figura 5 muestra una vista en acercamiento de la
15 formación de la lámina de acuerdo con una modalidad. De nuevo, con referencia a la Figura 3, la lámina de la primera capa de masa calibrada/relleno/segunda capa de masa calibrada se somete a un proceso de calibración en una unidad 28 de calibración, que reduce ligeramente el grosor de la lámina a
20 menos de 4 mm, y de preferencia alrededor de 3.65 mm.

La sección 44 de acabado comprende un cortador 30, un alimentador 32 de banda y un aplicador 34 de brillo. La lámina calibrada es transportada a un cortador 30, que incluye cuchillas delgadas para separar la lámina en trozos
25 individuales, tales como barras. El cortador 30 comprende

además de manera opcional un molde de diseño para imprimir un diseño en la superficie superior de la lámina, al mismo tiempo que la lámina se corta en barras. Como se debate en lo anterior, la Figura 2a ilustra un diseño de muestra y la

5 Figura 1 muestra una barra 10 a la que se le ha impreso el diseño de la Figura 2a. En ciertas modalidades, la cubierta 9 se añade a las barras laminadas utilizando un alimentador 32 de banda o una tolva (no mostrada). También es opcional la aplicación de una composición de brillo en el aplicador 34 de

10 brillo. La composición para dar brillo puede comprender una proteína de leche, agua y azúcar y puede funcionar para asegurar la cubierta 9 a la superficie de la barra 10.

Las barras 10 laminadas se hornean en un horno, tal como un horno de convección. Durante el horneado, se expulsa

15 la humedad de las barras 10 laminadas mediante agujeros realizados en las capas de masa calibrada para evitar la generación de canales de aire dentro de las barras. La cantidad de humedad producida por las barras 10 laminadas durante el horneado también se minimiza a través del uso de

20 un perfil de horneado leve diseñado para impedir que la composición de relleno hierva. Primero, las barras 10 se hornean a alrededor de 95°C, luego la temperatura se eleva un poco a entre alrededor de 210-220°C durante el tiempo de horneado, que puede ser de aproximadamente once minutos. El

25 contenido de humedad final de la barra 10 regularmente se

encuentra entre alrededor de 8% y 10% y el grosor final de la barra 10 es de preferencia menor que 7 mm.

Para minimizar la ruptura de las capas 1 y 3 de masas después del horneado, la barra 10 se enfría lentamente una vez que se ha retirado del horno. La barra puede enfriarse durante alrededor de 10 a 15 minutos en un túnel de enfriamiento, en el que la barra 10 entra en contacto con aire seco que tiene, por ejemplo, una temperatura de alrededor de 10°C a 15°C. Antes del embalaje, la barra 10 debe enfriarse a alrededor de 42°C a 47°C, después de lo cual, las barras 10 horneadas laminadas pueden embalarsen de manera individual en depósitos.

Una ventaja de las modalidades de la barra 10 laminada descrita en la presente es que logra un equilibrio de sabor y textura atractivo. Las capas de masa son delgadas y crujientes, similares a galletas saladas, mientras que el relleno permanece húmedo y lleno de sabor. El uso de una composición de relleno con una baja actividad de agua ayuda a retener la humedad dentro de la capa de relleno, lo que impide que las capas de masa crujientes absorban la humedad del relleno y se humedezcan.

Las variaciones y modificaciones que aparecen en lo anterior se encuentran dentro del alcance de la presente invención. Debe entenderse que la invención descrita y definida en la presente abarca todas las combinaciones

alternativas de dos o más de las características individuales mencionadas o evidentes a partir del texto y/o los dibujos. Todas estas combinaciones diferentes constituyen varios aspectos alternativos de la presente invención. Las 5 modalidades descritas en la presente explican los mejores modos conocidos para practicar la invención y permitirán que otras personas con experiencia en la técnica utilicen la invención. No debe interpretarse que las reivindicaciones incluyen modalidades alternativas en la medida de lo 10 permitido por la técnica anterior.

REIVINDICACIONES

1. Una barra horneada caracterizada porque comprende:

una primera capa de masa;

5 una segunda capa de masa, cada una de la primera y segunda capa de masa comprende harina de trigo, almidón modificado y enzimas; y

una capa de relleno que tiene una estabilidad de resistencia al calor mayor que alrededor de 90%, la capa de relleno se dispone entre la primera y segunda capa de masa y se extiende sustancialmente a todos los bordes de la primera y segunda capa de masa,

en donde cada una de la primera y segunda capa de masa tiene una textura similar a una galleta salada.

15 2. La barra horneada de conformidad con la reivindicación 1, caracterizada además porque comprende una composición de cobertura que comprende avena.

3. La barra horneada de conformidad con la reivindicación 1, caracterizada porque ninguna de la capa de relleno, primera capa de masa o segunda capa de masa contiene una reducción que incluya grasas transgénicas.

4. La barra horneada de conformidad con la reivindicación 1, caracterizada porque la barra tiene un contenido de humedad de entre alrededor de 8% y 10%.

25 5. La barra horneada de conformidad con la

reivindicación 1, caracterizada porque el grosor de la barra es menor que 7 milímetros.

6. La barra horneada de conformidad con la reivindicación 1, caracterizada porque la capa de relleno
5 comprende una actividad de agua de entre 0.56 y 0.65.

7. La barra horneada de conformidad con la reivindicación 1, caracterizada porque la capa de relleno comprende entre alrededor de 75% y 80% de sólidos.

8. Una composición de relleno para una barra
10 laminada caracterizada porque comprende:

por lo menos una fruta;

almidón modificado;

pectina; y

trozos de inclusión;

15 en donde la composición de relleno tiene un contenido de sólidos de por lo menos alrededor de 75% y una estabilidad de resistencia al calor de por lo menos 90%.

9. La composición de relleno de conformidad con la reivindicación 8, caracterizada porque la estabilidad de
20 resistencia al calor es mayor que alrededor de 97%.

10. La composición de relleno de conformidad con la reivindicación 8, caracterizada porque la composición de relleno tiene una actividad de agua de entre 0.56 y 0.65.

11. La composición de relleno de conformidad con la
25 reivindicación 8, caracterizada porque los trozos de

inclusión comprenden un material seleccionado del grupo que consiste de pasas, arándanos deshidratados, trozos de manzana deshidrata, trozos de tomate deshidratado y mezclas de los mismos.

- 5 **12.** La composición de relleno de conformidad con la reivindicación 8, caracterizada porque la fruta comprende fresa y/o manzana.

13. Un método para elaborar una barra horneada, caracterizado porque comprende:

- 10 proporcionar una primera capa de masa calibrada y una segunda capa de masa calibrada;

 depositar un relleno en la segunda capa de masa calibrada, el relleno comprende una estabilidad de resistencia al calor de por lo menos 90%;

- 15 colocar la primera capa de masa calibrada encima del relleno para formar una lámina;

 calibrar la lámina para reducir el grosor de la lámina a menos de 4 milímetros;

 cortar la lámina en barras; y

- 20 hornear las barras, la etapa de horneado comprende hornear las barras a una temperatura inicial de alrededor de 95%, seguido por un incremento lento de la temperatura a entre alrededor de 210-220°C;

- en donde el relleno es visible y se extiende de
25 manera sustancial a todos los bordes de la primera y segunda

capa de masa de las barras horneadas.

14. El método de conformidad con la reivindicación 13, caracterizado porque la barra horneada tiene un contenido de humedad de entre alrededor de 8% y 10%.

5 **15.** El método de conformidad con la reivindicación 13, caracterizado porque el relleno comprende fruta.

16. El método de conformidad con la reivindicación 13, caracterizado porque la primera capa de masa calibrada cubre el relleno de manera sustancialmente uniforme.

10 **17.** El método de conformidad con la reivindicación 13, caracterizado porque las barras se hornean durante un tiempo de aproximadamente 11 minutos.

18. El método de conformidad con la reivindicación 13, caracterizado además porque comprende la etapa de moldear
15 un diseño en la superficie de la lámina.

19. El método de conformidad con la reivindicación 13, caracterizado además porque comprende la etapa de realizar agujeros en la primera y segunda capa de masa calibrada.

20 **20.** El método de conformidad con la reivindicación 13, caracterizado porque cada una de la primera y segunda capa de masa tiene una textura similar a una galleta salada.

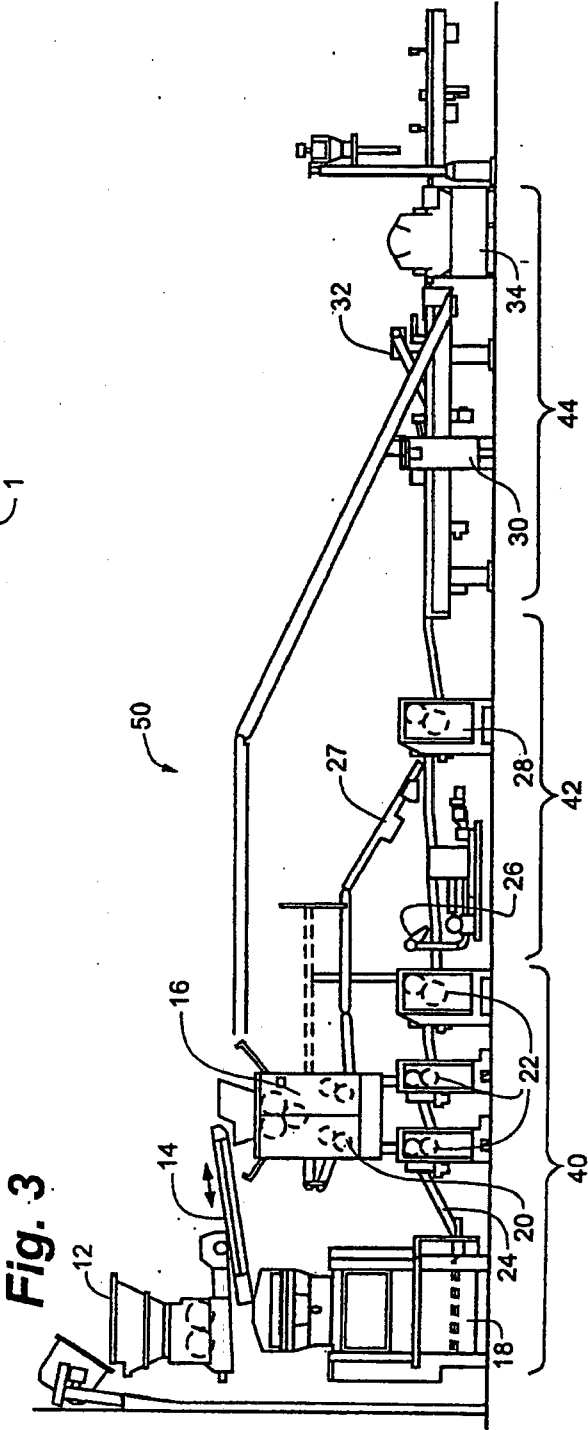
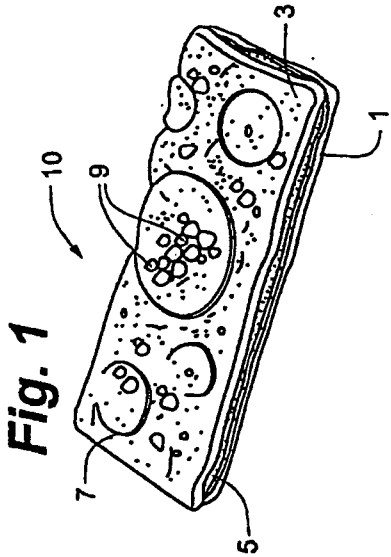


Fig. 2b

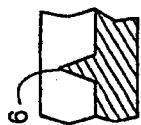


Fig. 2c



Fig. 2a

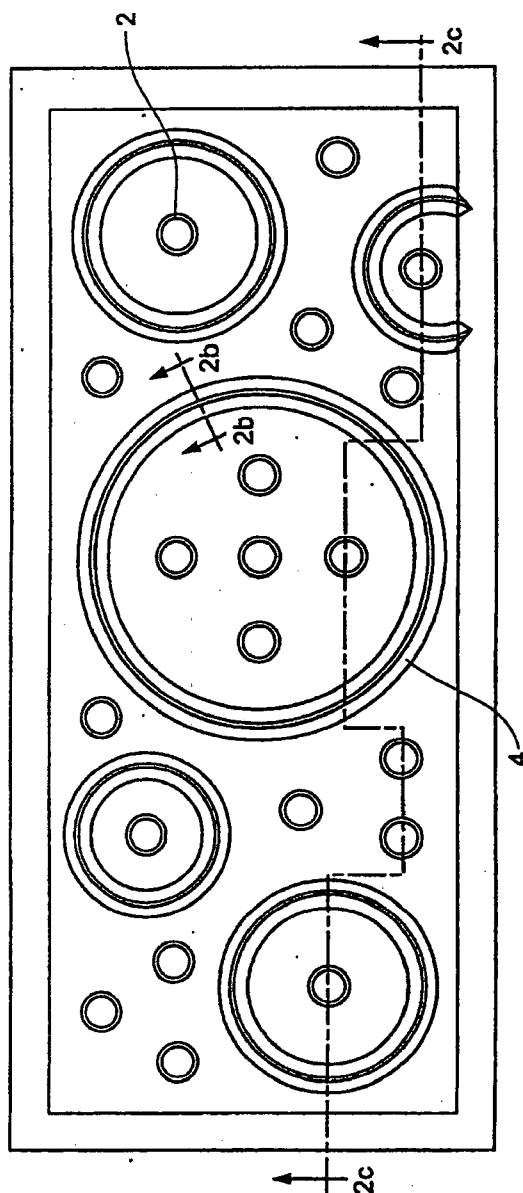


Fig. 4

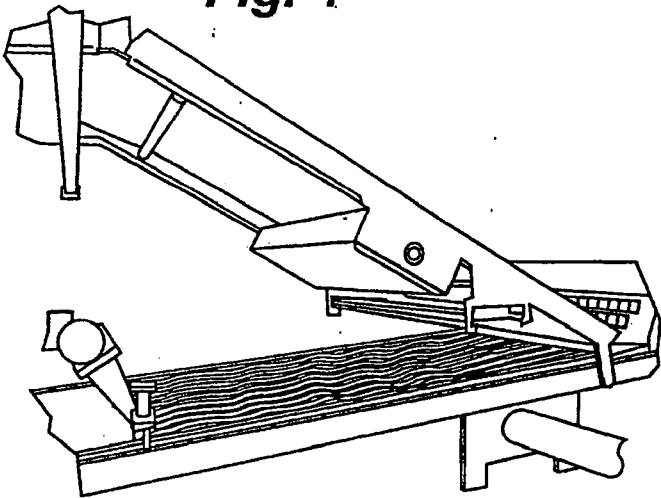
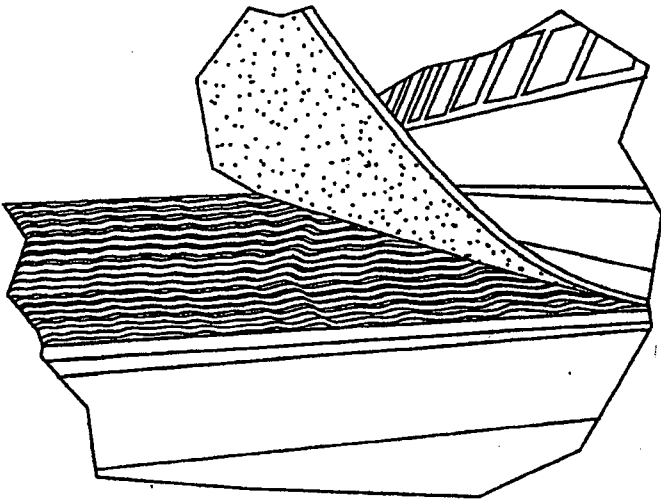


Fig. 5



006943.02502

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PCT REQUEST

Original (for SUBMISSION)

0	For receiving Office use only	
0-1	International Application No.	
0-2	International Filing Date	
0-3	Name of receiving Office and "PCT International Application"	
0-4	Form PCT/RO/101 PCT Request	
0-4-1	Prepared Using	PCT-SAFE [EASY mode] Version 3.51.026.201 MT/FOP 20080101/0.20.5.10
0-5	Petition The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	Receiving Office (specified by the applicant)	International Bureau of the World Intellectual Property Organization (RO/IB)
0-7	Applicant's or agent's file reference	006943.02502
I	Title of Invention	LAMINATED BAKED SNACK BAR
II	Applicant	
II-1	This person is	applicant only
II-2	Applicant for	all designated States except US
II-4	Name	CORPORATIVO INTERNACIONAL MEXICANO, S. DE R.L. DE C.V.
II-5	Address	Poniente 128, No. 606 Col. Industrial Vallejo 02300 D.F. Mexico Mexico
II-6	State of nationality	MX
II-7	State of residence	MX
III-1	Applicant and/or inventor	
III-1-1	This person is	applicant and inventor
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III-1-6	State of nationality	MX
III-1-7	State of residence	MX

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PCT REQUEST

Original (for SUBMISSION)

III-2	Applicant and/or inventor	
III-2-1	This person is	applicant and inventor
III-2-2	Applicant for	US only
III-2-4	Name (LAST, First)	GARCIA DE ALBA, Roberto
III-2-5	Address	Moralille #179 Pte. Col. Lomas des Valle San Pedro Garza Garcia N.L. CP 66256 Mexico Mexico
III-2-6	State of nationality	MX
III-2-7	State of residence	MX
III-3	Applicant and/or inventor	
III-3-1	This person is	applicant and inventor
III-3-2	Applicant for	US only
III-3-4	Name (LAST, First)	VILLANUEVA, Jesus
III-3-5	Address	Sierra de la Gabia #179 Co. Villa Montana CP 66230 Garza Garcia, NL Mexico
III-3-6	State of nationality	MX
III-3-7	State of residence	MX
IV-1	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
IV-1-1	Name (LAST, First)	ROKOS, Rebecca, P.
IV-1-2	Address	BANNER & WITCOFF, LTD. 10 South Wacker Drive Suite 3000 Chicago, Illinois 60606-7407 United States of America
IV-1-3	Telephone No.	312.463.5000
IV-1-4	Facsimile No.	312.463.5001
IV-1-5	e-mail	rrokos@bannerwitcoff.com
IV-1-6	Agent's registration No.	42,109
V	DESIGNATIONS	
V-1	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.	

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PCT REQUEST

Original (for SUBMISSION)

VI-1	Priority claim of earlier national application		
VI-1-1	Filing date	31 October 2007 (31.10.2007)	
VI-1-2	Number	11/932,111	
VI-1-3	Country	US	
VI-2	Incorporation by reference : where an element of the international application referred to in Article 11(1)(ii)(d) or (e) or a part of the description, claims or drawings referred to in Rule 20.5(a) is not otherwise contained in this international application but is completely contained in an earlier application whose priority is claimed on the date on which one or more elements referred to in Article 11(1)(ii) were first received by the receiving Office, that element or part is, subject to confirmation under Rule 20.6, incorporated by reference in this international application for the purposes of Rule 20.6.		
VII-1	International Searching Authority Chosen	European Patent Office (EPO) (ISA/EP)	
VIII	Declarations	Number of declarations	
VIII-1	Declaration as to the identity of the inventor	-	
VIII-2	Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent	-	
VIII-3	Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application	-	
VIII-4	Declaration of inventorship (only for the purposes of the designation of the United States of America)	-	
VIII-5	Declaration as to non-prejudicial disclosures or exceptions to lack of novelty	-	
IX	Check list	number of sheets	electronic file(s) attached
IX-1	Request (including declaration sheets)	4	✓
IX-2	Description	9	-
IX-3	Claims	3	-
IX-4	Abstract	1	✓
IX-5	Drawings	3	-
IX-7	TOTAL	20	

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PCT REQUEST

Original (for SUBMISSION)

	Accompanying Items	paper document(s) attached	electronic file(s) attached
IX-8	Fee calculation sheet	✓	-
IX-17	PCT-SAFE physical media	-	✓
IX-19	Figure of the drawings which should accompany the abstract		
IX-20	Language of filing of the international application	English	
X-1	Signature of applicant, agent or common representative	Aleksandr I. Pishko 57,800	
X-1-1	Name (LAST, First)	ROKOS, Rebecca, P.	
X-1-2	Name of signatory		
X-1-3	Capacity		

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10-1	Date of actual receipt of the purported international application	
10-2	Drawings:	
10-2-1	Received	
10-2-2	Not received	
10-3	Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application	
10-4	Date of timely receipt of the required corrections under PCT Article 11(2)	
10-5	International Searching Authority	ISA/EP
10-6	Transmittal of search copy delayed until search fee is paid	

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11-1	Date of receipt of the record copy by the International Bureau	
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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
7 May 2009 (07.05.2009)

PCT

(10) International Publication Number
WO 2009/056971 A2

(51) International Patent Classification: Not classified

(21) International Application Number:
PCT/IB2008/002933

(22) International Filing Date: 31 October 2008 (31.10.2008)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
11/932,111 31 October 2007 (31.10.2007) US

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— without international search report and to be republished upon receipt of that report

(54) Title: LAMINATED BAKED SNACK BAR

(57) Abstract: A laminated baked snack bar includes a layer of low moisture filling laminated between two thin layers of dough. The dough layers of the snack bar have a crunchy, cracker-like texture while the filling layer remains soft. The total thickness of the baked snack bar is preferably less than 7 millimeters. The snack bar is prepared by calibrating dough sheets to a thickness of less than 1 millimeter each, followed by depositing a filling composition having a high heat resistant stability on one of the calibrated dough sheets and placing a second calibrated dough sheet on top of the filling to form a laminate. The laminate is then calibrated, cut into bars and baked, using a mild baking profile. The snack bar may have a design molded on the top surface and/or a topping composition, preferably including oats, deposited on the laminate.



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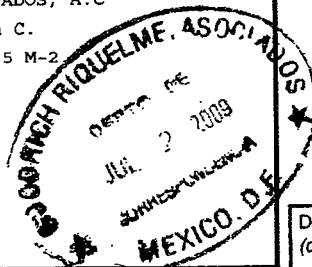
PATENT COOPERATION TREATY

PCT

From the INTERNATIONAL SEARCHING AUTHORITY

To:

GOODRICH, RIQUELME Y ASOCIADOS, A.C
Attn. Suarez Ramirez, Juan C.
Paseo de la Reforma No. 265 M-2
Col. y Del. Cuauhtémoc
06500 México, D.F.
MEXIQUE



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

Docketed 9/16/09

Attny: RPR/AUP/RTN

(PCT Rule 68) Ref: 006943.02502

Action: Art. 19 Amdt

Due Date: 8/30/09

Last Day: 8/30/09

By: [Signature]

Date of mailing
(day/month/year) 30/06/2009

Applicant's or agent's file reference
P08000WO0

FOR FURTHER ACTION

See paragraphs 1 and 4 below

International application No.
PCT/IB2008/002933

International filing date
(day/month/year) 31/10/2008

Applicant

CORPORATIVO INTERNACIONAL MEXICANO. S. DE R.L. ...

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) 338.82.70

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 International Searching Authority



European Patent Office, P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Eva Brell

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NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the *PCT Applicant's Guide*, a publication of WIPO.

In these Notes, "Article", "Rule", and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions, respectively.

INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report and the written opinion of the International Searching Authority, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only (see *PCT Applicant's Guide*, Volume I/A, Annexes B1 and B2).

The attention of the applicant is drawn to the fact that amendments to the claims under Article 19 are not allowed where the International Searching Authority has declared, under Article 17(2), that no international search report would be established (see *PCT Applicant's Guide*, Volume I/A, paragraph 296).

What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

When?

Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

How?

Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

What documents must/may accompany the amendments?

Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

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NOTES TO FORM PCT/ISA/220 (continued)

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped), whether

- (i) the claim is unchanged;
- (ii) the claim is cancelled;
- (iii) the claim is new;
- (iv) the claim replaces one or more claims as filed;
- (v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."
2. [Where originally there were 15 claims and after amendment of all claims there are 11]:
"Claims 1 to 15 replaced by amended claims 1 to 11."
3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."
4. [Where various kinds of amendments are made]:
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

"Statement under article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

It must be in the language in which the international application is to be published.

It must be brief, not exceeding 500 words if in English or if translated into English.

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

Consequence if a demand for international preliminary examination has already been filed

If, at the time of filing any amendments and any accompanying statement, under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the time of filing the amendments (and any statement) with the International Bureau, also file with the International Preliminary Examining Authority a copy of such amendments (and of any statement) and, where required, a translation of such amendments for the procedure before that Authority (see Rules 55.3(a) and 62.2, first sentence). For further information, see the Notes to the demand form (PCT/IPEA/401).

If a demand for international preliminary examination is made, the written opinion of the International Searching Authority will, except in certain cases where the International Preliminary Examining Authority did not act as International Searching Authority and where it has notified the International Bureau under Rule 66.1bis(b), be considered to be a written opinion of the International Preliminary Examining Authority. If a demand is made, the applicant may submit to the International Preliminary Examining Authority a reply to the written opinion 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 (Rule 43bis.1(c)).

Consequence with regard to translation of the international application for entry into the national phase

The applicant's attention is drawn to the fact that, upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see the *PCT Applicant's Guide*, Volume II.

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PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference P08000W00	FOR FURTHER ACTION see Form PCT/ISA/220 as well as, where applicable, item 5 below.	
International application No. PCT/IB2008/002933	International filing date (day/month/year) 31/10/2008	(Earliest) Priority Date (day/month/year) 31/10/2007
Applicant CORPORATIVO INTERNACIONAL MEXICANO. S. DE R.L. ...		

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 4 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
☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

b. ☐ This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6bis(a)).

c. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (See Box No. II)

3. ☐ **Unity of invention is lacking** (see Box No. III)

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 No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the **drawings**,

- a. the figure of the **drawings** to be published with the abstract is Figure No. _____
☐ as suggested by the applicant
☐ as selected by this Authority, because the applicant failed to suggest a figure
☐ as selected by this Authority, because this figure better characterizes the invention
b. ☒ none of the figures is to be published with the abstract

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INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2008/002933A. CLASSIFICATION OF SUBJECT MATTER
INV. A23L1/00 A21D13/00 A21D10/00

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)
A23L A21D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, FSTA

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/185158 A1 (MCHUGH EDWARD KEVIN [US] ET AL) 23 September 2004 (2004-09-23) the whole document	1-20
Y	-----	1-20
Y	US 6 299 916 B1 (DALLY VERNETTA L [US] ET AL) 9 October 2001 (2001-10-09) examples 1-3 claims 1-18	1-20
Y	-----	1-20
Y	JP 2002 051688 A (NITTO FLOUR MILLING) 19 February 2002 (2002-02-19) abstract	1-20
Y	-----	1-20
Y	US 2006/051482 A1 (THORPE ALAN [CA]) 9 March 2006 (2006-03-09) the whole document	1-20
	----- -/-	

☒ 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 document but 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 understand 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.

G document member of the same patent family

Date of the actual completion of the international search

5 June 2009

Date of mailing of the international search report

30/06/2009

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Korb, Margit

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LPO

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2008/002933

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2007/041679 A (ASHOURIAN JAMSHID [US]; KEELER LAURIE J [US]; SMITH DURWARD A [US]) 12 April 2007 (2007-04-12) page 1, paragraph 2 page 45, paragraph 2 claims 1-44	1-20
A	CHARLES, A.L. ET AL: "Role of intact starch granules and gluten on texture of Taiwanese flaky snack" JOURNAL OF TEXTURE STUDIES, vol. 35, no. 3, 2004, pages 311-323, XP002530797 the whole document	1-20
A	WEENA SRISAWAS AND JINDAL, V.K.: "Acoustic testing of snack food crispness using neural networks" JOURNAL OF TEXTURE STUDIES, vol. 34, 2003, pages 401-420, XP002530798 the whole document	1-20
A	VICKERS, Z.M. ET AL: "Relationships between sensory crispness and other sensory and instrumental parameters" JOURNAL OF TEXTURE STUDIES, vol. 11, 1980, pages 291-307, XP002530799	1-20
A	MAZUMDER ET AL: "Textural attributes of a model snack food at different moisture contents" JOURNAL OF FOOD ENGINEERING, BARKING, ESSEX, GB, vol. 79, no. 2, 1 March 2007 (2007-03-01), pages 511-516, XP005694739 ISSN: 0260-8774 the whole document	1-20
A	ROUDAUT G ET AL: "Crispness: a critical review on sensory and material science approaches" TRENDS IN FOOD SCIENCE AND TECHNOLOGY, ELSEVIER SCIENCE PUBLISHERS, GB, vol. 13, no. 6-7, 1 June 2002 (2002-06-01), pages 217-227, XP004394597 ISSN: 0924-2244 the whole document	1-20

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2008/002933

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2004185158 A1	23-09-2004	NONE	
US 6299916 B1	09-10-2001	NONE	
JP 2002051688 A	19-02-2002	JP 4165988 B2	15-10-2008
US 2006051482 A1	09-03-2006	CA 2435856 A1	31-01-2004
		US 2004022900 A1	05-02-2004
		US 2006013935 A1	19-01-2006
		US 2009110779 A1	30-04-2009
WO 2007041679 A	12-04-2007	AU 2006299381 A1	12-04-2007
		CA 2624753 A1	12-04-2007
		EP 1933639 A2	25-06-2008
		JP 2009509567 T	12-03-2009

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PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

PCT

To:

see form PCT/ISA/210
Docketed 9/16/09
Rept. AUP/PJN
Case Ref 006943.02050
Action Response to W.O.
Due Date 9/30/09
Last Day 9/30/09
By AC/H

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY
(PCT Rule 43bis.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.
PCT/IB2008/002933

International filing date (day/month/year)
31.10.2008

Priority date (day/month/year)
31.10.2007

International Patent Classification (IPC) or both national classification and IPC
INV. A23L1/00 A21D13/00 A21D10/00

Applicant
CORPORATIVO INTERNACIONAL MEXICANO. S. DE R.L. ...

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 usually 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:



European Patent Office
D-80298 Munich
Tel. +49 89 2399 - 0
Fax: +49 89 2399 - 4465

Date of completion of
this opinion

see form
PCT/ISA/210

Authorized Officer

Korb, Margit

Telephone No. +49 89 2399-8639



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WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/IB2008/002933

Box No. I Basis of the 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
 - ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).
2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43bis.1(a))
3. 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:
 - ☐ on paper
 - ☐ in electronic form
 - c. time of filing/furnishing:
 - ☐ contained in the international application as filed.
 - ☐ filed together with the international application in electronic form.
 - ☐ furnished subsequently to this Authority for the purposes of search.
4. ☐ 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.
5. Additional comments:

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.
PCT/IB2008/002933

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

1. Statement

Novelty (N)	Yes: Claims	<u>1-20</u>
	No: Claims	
Inventive step (IS)	Yes: Claims	
	No: Claims	<u>1-20</u>
Industrial applicability (IA)	Yes: Claims	<u>1-20</u>
	No: Claims	

2. Citations and explanations

see separate sheet

Re Item V.

1. Reference is made to the following documents:

- D1: US 2004/185158 A1 (MCHUGH EDWARD KEVIN [US] ET AL) 23 September 2004 (2004-09-23)
- D2: US-B1-6 299 916 (DALLY VERNETTA L [US] ET AL) 9 October 2001 (2001-10-09)
- D3: JP 2002 051688 A (NITTO FLOUR MILLING) 19 February 2002 (2002-02-19)
- D4: US 2006/051482 A1 (THORPE ALAN [CA]) 9 March 2006 (2006-03-09)
- D5: WO 2007/041679 A (ASHOURIAN JAMSHID [US]; KEELER LAURIE J [US]; SMITH DURWARD A [US]) 12 April 2007 (2007-04-12)

D1 (cf. claims 1-32) discloses a triple coextruded baked good (snack product) having a bar shape with a desired substantially smaller height than width and comprising concentric fillings which are visually apparent at opposing cut ends of the baked piece. Any conventional filler materials for a snack product may be used as a core or first filler and the middle or second filler (paragraph 0083). The casing material may be any conventional leavenable snack dough (paragraph 0084). A first and second dough layer comprising flour and modified starch and enzyme as stated in the claims is not disclosed in D1. D1 is concerned with the problem of avoiding visual smearing of one layer of filling into another (paragraph 0022).

D2 discloses snack bars comprising one dough layer as bottom layer and a filling layer as upper layer. The filling layer comprises modified starch and the dough layer comprises wheat flour but no modified starch and enzyme (cf. D2, examples 1-3) as stated in the present claims. D2 (cf. col.1, l.39-56) solves the problem of shelf-stability.

D3 (abstract) discloses a Japanese-fashioned baked snack produced from a dough composition comprising wheat flour, sparingly soluble granular powder and at least one component selected from different starches modified products thereof. However D3 (abstract) neither discloses a snack bar comprising a first and a second dough layer with a specifically disposed filling layer nor does D3 mention an enzyme comprised in the dough. D3 solves the problem of obtaining a dough composition which gives a crisp

feeling on the surface thereof, moist and creamy feelings of the inside.

D4 (cf. claims 1-27 and examples 1-7) discloses a batter composition for coating food pieces comprising modified starch. D4 (cf. paragraph 0016) solves the problem of retarding crispness of the food pieces. A snack bar as claimed is not mentioned in D4.

D5 (cf. p.1, paragraph 2, claims 1-44) discloses low-fat, fat-free or full-fat snack food products, in which the food pieces are treated with an enzyme. D5 (p.45, paragraph 2) mentions crisp and crunchy, snack products which crispness is evaluated by a specific Texture Analyzer (measurement for fracturing force) and Audio Envelope Detector (measurement for acoustic levels). A snack bar comprising a first and a second dough layer and a specifically deposited filling as claimed is not disclosed in D5.

2. Although the specific layers of the claimed snack bar and the calibrating feature of the dough layer stated in the process claims is not mentioned in any single document mentioned above, the claimed subject-matter is not considered to involve an inventive step for the following reason:

The problem to be solved of the claimed subject-matter is to provide a snack bar comprising a dough composition that exhibits a cracker-like texture and a filling that remains soft without causing the crunchy dough layers to become soggy (compare with e.g. p.2, paragraph 2). However the statement of the feature "wherein the first and second dough layers each have a cracker texture" in claim 1 is not clear since it is in contradiction with the description (cf. p.3, last paragraph to p.4, paragraph 1). According to the description the texture of the snack bar may be varied by additives. Thus it is not clear which texture should fall under the scope of claim 1 (from delicate and crispy to bold and crunchy texture or an "in-between" texture). Moreover the qualitative and quantitative measuring data for the cracker-like texture upon baking as described on page 5 (paragraph last but one) is considered to be incomplete (compare also with D5 (p.45, paragraph 2) which indicates specific analyzer and detector and specific measurement conditions). Hence the product claims 1-12 do not meet the requirements of Art. 6 PCT.

Furthermore the process claims do not define the components of the first and second dough layer as required for the claimed product but define the calibrating of the dough layers and baking conditions. Thus it is not clear which features are essential for the claimed subject-matter. In absence of a clear feature which defines the desired texture in the claims, and due to different essential features in the independent product claim

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING
AUTHORITY (SEPARATE SHEET)**

International application No.

PCT/IB2008/002933

and method claim, the claimed subject-matter does not meet the requirements of Art. 6 PCT and it is not considered to involve an inventive step. The layer compositions defined in claim 1 is considered obvious for a snack bar from D1, D2 and D3 (Art. 33(3) PCT and Art. 6 PCT). The calibrating process for the dough layer compositions and baking conditions stated in claim 13 are obvious for the skilled person from common knowledge and/or at least from D1 (Art. 6 PCT and Art. 33(3) PCT).

3. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1 to D5 is not mentioned in the description, nor are these documents identified therein.

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Possible steps after receipt of the international search report (ISR) and written opinion of the International Searching Authority (WO-ISA)

General information	For all international applications filed on or after 01/01/2004 the competent ISA will establish an ISR. It is accompanied by the WO-ISA. Unlike the former written opinion of the IPEA (Rule 66.2 PCT), the WO-ISA is not meant to be responded to, but to be taken into consideration for further procedural steps. This document explains about the possibilities.
Amending claims under Art. 19 PCT	Within 2 months after the date of mailing of the ISR and the WO-ISA the applicant may file amended claims under Art. 19 PCT directly with the International Bureau of WIPO. The PCT reform of 2004 did not change this procedure. For further information please see Rule 46 PCT as well as form PCT/ISA/220 and the corresponding Notes to form PCT/ISA/220.
Filing a demand for international preliminary examination	In principle, the WO-ISA will be considered as the written opinion of the IPEA. This should, in many cases, make it unnecessary to file a demand for international preliminary examination. If the applicant nevertheless wishes to file a demand this must be done before expiry of 3 months after the date of mailing of the ISR/ WO-ISA or 22 months after priority date, whichever expires later (Rule 54bis PCT). Amendments under Art. 34 PCT can be filed with the IPEA as before, normally at the same time as filing the demand (Rule 66.1 (b) PCT). If a demand for international preliminary examination is filed and no comments/amendments have been received the WO-ISA will be transformed by the IPEA into an IPRP (International Preliminary Report on Patentability) which would merely reflect the content of the WO-ISA. The demand can still be withdrawn (Art. 37 PCT).
Filing informal comments	After receipt of the ISR/WO-ISA the applicant may file informal comments on the WO-ISA directly with the International Bureau of WIPO. These will be communicated to the designated Offices together with the IPRP (International Preliminary Report on Patentability) at 30 months from the priority date. Please also refer to the next box.
End of the international phase	At the end of the international phase the International Bureau of WIPO will transform the WO-ISA or, if a demand was filed, the written opinion of the IPEA into the IPRP, which will then be transmitted together with possible informal comments to the designated Offices. The IPRP replaces the former IPER (international preliminary examination report).
Relevant PCT Rules and more information	Rule 43 PCT, Rule 43bis PCT, Rule 44 PCT, Rule 44bis PCT, PCT Newsletter 12/2003, OJ 11/2003, OJ 12/2003

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XS CPRTENFRDE

(19)日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11)特許出願公開番号
特開2002-51688
(P2002-51688A)

(43)公開日 平成14年2月19日(2002.2.19)

(51)Int.Cl. ⁷	識別記号	F I	テ-マ-ト*(参考)	
A 2 1 D	2/14	A 2 1 D	2/14	4 B 0 1 4
	2/16		2/16	4 B 0 3 2
	2/18		2/18	4 B 0 3 6
	2/34		2/34	
	2/36		2/36	

審査請求 未請求 請求項の数 8 O L (全 8 頁) 最終頁に続く

(21)出願番号 特願2000-244315(P2000-244315)

(22)出願日 平成12年8月11日(2000.8.11)

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(54)【発明の名称】 和風スナック用生地組成物及びそれを用いた和風スナックの製造方法

(57)【要約】

【課題】 焼成した際に、生地がパリパリとしており、中身はしっとり感・クリーミー感があり、かつこの食感の経時的変化が少なく、特に冷蔵・冷凍保存後に電子レンジなどで再加熱しても食感の劣化の少ない和風スナック用生地組成物及びそれを用いた和風スナックの製造方法を提供する。

【解決手段】 和風スナック用生地組成物に、小麦粉と、10～80メッシュの難溶性粒状粉体と、タピオカ澱粉、馬鈴薯澱粉、米粉及びそれらの化工品からなる群から選ばれた1種以上を含有させる。この和風スナック用生地は乳化剤を含むことが好ましく、前記乳化剤がHLB7～15であることが好ましい。そして、上記和風スナック用生地組成物を用いて調製したバターに具材を添加して焼成して和風スナックを得る。この和風スナックは冷蔵又は冷凍することが好ましい。また冷蔵又は冷凍した和風スナックは、電子レンジで加熱、あるいは電子レンジで加熱後、油ちょうすることが好ましい。

【特許請求の範囲】

【請求項1】 小麦粉と、10～80メッシュの難溶性粒状粉体と、タピオカ澱粉、馬鈴薯澱粉、米粉及びそれらの化工品からなる群より選ばれた1種以上を含有することを特徴とする和風スナック用生地組成物。

【請求項2】 乳化剤を含む請求項1に記載の和風スナック用生地組成物。

【請求項3】 前記乳化剤が、HLB7～15である請求項2に記載の和風スナック用生地組成物。

【請求項4】 タピオカ澱粉、馬鈴薯澱粉、米粉及びそれらの化工品からなる群より選ばれた2種以上を含む、請求項1～3のいずれか一つに記載の和風スナック用生地組成物。

【請求項5】 請求項1～4のいずれか一つに記載の和風スナック用生地組成物を用いて調製したバターに具材を添加して焼成することを特徴とする和風スナックの製造方法。

【請求項6】 前記焼成して得られた和風スナックを冷蔵又は冷凍する請求項5に記載の和風スナックの製造方法。

【請求項7】 前記冷蔵又は冷凍した和風スナックを電子レンジで加熱する請求項6に記載の和風スナックの製造方法。

【請求項8】 前記冷凍した和風スナックを電子レンジで加熱した後、さらに油ちょうする請求項7に記載の和風スナックの製造方法。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、焼成した際に、生地表面（皮）がパリパリとしており、中身はしっとり感・クリーミー感のある、皮と中身の食感が異なる和風スナック用生地組成物及びそれを用いた和風スナックの製造方法に関する。

【0002】

【従来の技術】鯛焼き、大判焼き、タコ焼き、お好み焼きなど（以下、和風スナックという）は、小麦粉を主成分とした生地組成物に水、卵を加えて調製したバターに所定の具材を加えて焼成して作られる。例えば、タコ焼きはバターにキャベツ、紅しょうが、天かす等の具材を添加して調製した生地をタコ焼きの型に流し込み、おつ切りにしたタコを加えて焼成して得られる。

【0003】近年のソフト化志向を反映して、特にタコ焼きなどは内部がクリーミーで皮がパリパリとした、いわゆる関西風のタコ焼きが好まれる傾向にある。

【0004】和風スナックは、焼成後すぐに食するのが最も美味しく、焼成後の時間が経過するに伴って、具材や内部の水分が皮に移行して、パリパリとした食感が失われて水っぽくなり、型くずれを生じてしまう。特に、焼成済みの和風スナックを冷蔵又は冷凍保存した後、電子レンジで再加熱して食する場合に上記劣化が顕著に起こる。

る。

【0005】そのため、冷蔵・冷凍保存時における和風スナックの生地の劣化、再加熱した際の食感を改善するために、例えば以下のような技術が開示されている。特開平6-62813号公報には、小麦粉、油脂及び澱粉エーテルの混合物を主原料としたことを特徴とするタコ焼き用ミックスが開示されている。

【0006】特開平9-299069号公報には、

(a)小麦粉から主としてなる穀粉類、(b)アセチル化ワキシー澱粉、架橋処理ワキシー澱粉、アセチル化し且つ架橋処理したワキシー澱粉、アセチル化タピオカ澱粉、架橋処理タピオカ澱粉及びアセチル化し且つ架橋処理したタピオカ澱粉から選ばれる1種又は2種以上の澱粉、並びに(c)キサンタンガムを含有することを特徴とするお好み焼き類用又はタコ焼き類用の組成物が開示されている。

【0007】特開平10-150957号公報には、小麦粉100質量部と可溶性澱粉3～20質量部とからなるタコ焼き用粉が開示されている。

【0008】特開平6-277011号公報には、小麦粉とヒドロキシプロピル化デンプンを含有するプレミックスが開示されている。

【0009】特開平6-86658号公報には、澱粉100質量部に対して、大豆蛋白粉10～50質量部、グルコノデルタラクトン1～10質量部が原料中に配合されていることを特徴とする明石風タコ焼きが開示されている。

【0010】特開平8-317780号公報には、調理加熱時に水分や油分のドリップが流出しやすい食品に乾燥マッシュポテト又は／及びジェランガムゲルを配合することを特徴とする冷凍食品の製造方法が開示されている。

【0011】

【発明が解決しようとする課題】このように、和風スナックの食感を改善するため、生地組成物に関する数多くの技術が提案されているが、焼成後に時間が経過した場合や、冷蔵・冷凍保存後に電子レンジなどで再加熱した場合における食感の劣化防止に対して、十分に満足できる技術は未だ見出されていないのが現状である。

【0012】したがって、本発明の目的は、焼成した際に、生地表面（皮）がパリパリとしており、中身はしっとり感・クリーミー感があり、かつこの食感の経時的変化が少なく、特に冷蔵・冷凍保存後に電子レンジなどで再加熱しても食感の劣化の少ない和風スナック用生地組成物及びそれを用いた和風スナックの製造方法を提供することにある。

【0013】

【課題を解決するための手段】上記目的を達成するため、本発明の和風スナック用生地組成物は、小麦粉と、10～80メッシュの難溶性粒状粉体と、タピオカ澱

粉、馬鈴薯澱粉、米粉及びそれらの化工品からなる群より選ばれた1種以上を含有することを特徴とする。

【0014】この和風スナック用生地はさらに乳化剤を含むことが好ましく、前記乳化剤がHLB7~15であることが好ましい。また、タピオカ澱粉、馬鈴薯澱粉、米粉及びそれらの化工品からなる群より選ばれた2種以上を含むことが好ましい。

【0015】本発明の和風スナックの製造方法は、前記和風スナック用生地組成物を用いて調製したバターに具材を添加して焼成することを特徴とする。

【0016】この和風スナックの製造方法においては、前記焼成して得られた和風スナックを冷蔵又は冷凍することが好ましい。また、前記冷蔵又は冷凍した和風スナックを電子レンジで加熱することが好ましい。さらに、前記冷凍した和風スナックを電子レンジで加熱した後、さらに油ちようすることが好ましい。

【0017】本発明によれば、和風スナック用生地組成物に、小麦粉と、10~80メッシュの難溶性粒状粉体と、タピオカ澱粉、馬鈴薯澱粉、米粉及びそれらの化工品からなる群より選ばれた1種以上を含有させたことにより、焼成した際に、生地表面(皮)がパリパリとしており、中身はしっとり感・クリーミー感があり、かつこの食感の経時的変化が少なく、特に冷蔵・冷凍保存後に電子レンジなどで再加熱しても食感の劣化を顕著に低減させることができる。

【0018】また、この和風スナック用生地組成物を用いて調製したバターに具材を添加して焼成することにより、上記の良好な食感を有し、かつこの食感の経時的変化が少なく、特に冷蔵・冷凍保存後に電子レンジなどで再加熱しても食感の劣化の少ない和風スナックを得ることができる。

【0019】

【発明の実施の形態】本発明の和風スナック用生地組成物は、小麦粉を主成分とし、10~80メッシュの難溶性粒状粉体と、タピオカ澱粉、馬鈴薯澱粉、米粉及びそれらの化工品からなる群より選ばれた1種以上を含有する。本発明においては、少なくとも特定の粒度範囲にある難溶性粒状粉体と特定の澱粉類及び/又は米粉類(以下、澱粉類等という。)の2成分を併用することが重要であり、いずれかが欠けても目的とする生地が得られない。

【0020】本発明において難溶性粒状粉体とは、水に分散させたときに、その表面の一部が溶けることがあっても、内部まで完全に溶けることのない可食性の粒状粉体を意味する。具体的には、①小麦粉、コーンスターチなどの澱粉、化工澱粉、コーンフラワー、大豆粉などを造粒したもの、②小麦セモリナ、コーングリッツ、ドライパン粉を粉砕あるいは整粒したもの、③穀類、豆類をバフ処理したもの等が挙げられる。本発明においては小麦セモリナが好ましく、特にデュラム小麦セモリナが好

ましい。

【0021】また、難溶性粒状粉体は、その粒度が10~80メッシュが好ましく、特に20~60メッシュが好ましい。粒径が10メッシュより大きいと口溶けが悪く、食した際に口の中に残ってしまいざらついた食感になる。また、バターを調製する際の作業性も悪くなる。一方、粒度が80メッシュより小さいと焼成した際に生地表面(皮)がパリパリとした食感にならない。

【0022】上記範囲内の粒度を有する難水溶性粒状粉体は、公知の手段により粉砕又は整粒するか、グアガムやキサンタンガム等のガム溶液をバインダーとして用いて流動槽造粒機などにより造粒して得ることができる。

【0023】上記澱粉類等としては、タピオカ澱粉、馬鈴薯澱粉、米粉及びそれらの化工品からなる群より選ばれた1種以上が好ましく用いられる。化工処理は、 α 化処理、酸処理、エーテル化処理、エステル化処理、架橋処理等が挙げられる。

【0024】上記特定の澱粉類等を用いることにより、焼成した生地が程よくソフトになり、口溶けがよく、また保形性も維持され、型崩れしにくくなる。しかし、例えばワキシー澱粉を用いた場合、生地が柔らかくなりすぎてしまい、コーンスターチを用いた場合は生地が固くなりすぎてしまう。

【0025】本発明の和風スナック用生地組成物は、第3の成分として乳化剤を含有することが好ましい。乳化剤を用いることにより生地をソフトにすることができる。

【0026】乳化剤としては、例えばショ糖脂肪酸エステル、グリセリン脂肪酸エステルやレシチンなどが挙げられる。本発明においては、ショ糖脂肪酸エステルが好ましく用いられる。また、HLB7~15が好ましく、より好ましくはHLB9~13である。HLBが7未満であると、中身のしっとり感・クリーミー感が弱くなることがあり、HLBが15超であると生地が柔らかくなりすぎてしまうことがある。

【0027】本発明の和風スナック用生地組成物には、上記の他に、前記米粉類以外のライ麦粉やコーンフラワーなどの穀粉類又はそれらの化工品や、前記澱粉類以外の各種澱粉又はそれらの化工澱粉や、大豆粉、大豆蛋白質、えんどう蛋白質、小麦グルテン、卵粉末、脱脂粉乳等の蛋白質や、大豆油、菜種油、オリーブ油、パーム油などの植物油脂ならびにヘット、ラードなどの動物油脂およびこれらの油脂を使用したショートニング、粉末油脂などの加工油脂等の油脂類や、山芋粉、食物繊維、膨脹剤、調味料、塩、砂糖、調味料、ビタミン類、ミネラル類を適宜添加してもよい。

【0028】本発明の和風スナック用生地組成物は、例えば銅焼きや大判焼き用生地組成物では、小麦粉50~80質量%、上記難溶性粒状粉体1~10質量%、上記澱粉類等5~20質量%、上記乳化剤0.05~1質

量%を含有することが好ましい。

【0029】そして、この生地組成物100質量部に対して、水100～120質量部、全卵5～40質量部を加えて混合し、バターを調製する。このバターを型に流し込み、後は常法にしたがって、餡を入れて焼成すればよい。

【0030】また、タコ焼きやお好み焼き用地組成物では、小麦粉50～80質量%、上記難溶性粒状粉体5～30質量%、上記澱粉類等5～30質量%、上記乳化剤0.5～2質量%を含有することが好ましい。

【0031】そして、この生地組成物100質量部に対して、水100～300質量部、全卵5～100質量部を加えて混合し、バターを調製する。このバターにキャベツ、紅しょうが、天かす、桜エビ等の具材を適宜添加して生地を調製し、常法にしたがって、タコ焼きにおいてはぶつ切りのタコを加え、お好み焼きにおいては豚肉、イカ、エビ等を加えて焼成すればよい。

【0032】本発明においては、上記のようにして焼成して得られた和風スナックを冷蔵してチルド食品としてもよく、冷凍して冷凍食品としてもよい。また、冷蔵又は冷凍した和風スナックは、そのまま電子レンジで加熱するだけで、焼成直後の良好な食感を有する和風スナックとなる。また、冷蔵又は冷凍した和風スナックをそのまま160～190℃の油中で油ちょうしてもよい。

【0033】

【実施例】以下、実施例を挙げて本発明を具体的に説明する。

試験例1 (タコ焼き)

表1に示す各種の和風スナック用地組成物100質量部に、水275質量部及び全卵10質量部を加えてバターを調製し、さらに具材として刻んだキャベツ25質量部、天かす15質量部、紅しょうが2質量部を加えて、タコ焼き用地を得た。なお、難溶性粒状粉体として60メッシュの造粒したコーンスターチ、澱粉類等としてタピオカ澱粉及び米粉、乳化剤としてHLB10のグリセリン脂肪酸エステルを用いた。

【0034】この生地をタコ焼きの焼き型に流し込み、ぶつ切りのタコを入れて190℃、10分間焼成してタコ焼きを製造した。

【0035】これらのタコ焼きを、①焼成直後の状態、及び②焼成してから24時間冷蔵した後電子レンジで加熱した状態で、10名のパネラーに試食させて、食感（皮のパリパリ感、中身のクリーミー感）を評価した。評価は、非常に良いものを10とし、逆に非常に悪いものを1として10段階で行い、10名のパネラーの平均値で表した（以下の試験例において同じ）。この結果を表1に示す。

【0036】

【表1】

生地の配合組成		実施例1	実施例2	比較例1	比較例2
小麦粉		60	70	75	70
コーンスターチ		10	10	—	—
タピオカ澱粉		10	—	—	10
米粉		10	10	15	10
乳化剤 (HLB10)		1	1	1	1
コーンフラワー		5	5	5	5
増粘多糖類		1	1	1	1
塩		2	2	2	2
グルタミン酸ソーダ		1	1	1	1
合計		100	100	100	100
全卵		10	10	10	10
水		275	275	275	275
食感	①	9.0	8.5	3.9	4.5
	②	7.6	7.0	2.8	3.6

【0037】表1に示されるように、本発明で規定する範囲の粒度を有する難溶性粒状粉体、特定の澱粉類等及び乳化剤を併用した実施例1、2は、焼成直後の状態でも、焼成後24時間冷蔵保存して電子レンジで加熱した状態でも良好な食感を有することが分かる。特に澱粉類等を2種類使用した実施例1は、より食感がよいことが分かる。

【0038】これに対して、難溶性粒状粉体を使用しな

い比較例1、2は、焼成直後の状態でも、焼成後24時間冷蔵保存して電子レンジで加熱した状態でも食感が劣ることが分かる。

【0039】試験例2 (大判焼き)

表2に示す各種の和風スナック用地組成物100質量部に、水115質量部及び全卵15質量部を加えてバターを調製し、大判焼き用地を得た。なお、難溶性粒状粉体として20メッシュの小麦セモリナ、澱粉類等と

して馬鈴薯澱粉及び米粉、乳化剤としてHLB4又は10のショ糖脂肪酸エステルを用いた。

【0040】この生地を、大判焼きの焼き型に流し込み、170℃、5分間焼成して餡を入れ、別途同様にして生地のみを焼成したもので挟んで、さらに約5分間焼成して大判焼きを製造した。

【0041】これらの大判焼きを、焼成してから6時間室温に放置した後電子レンジで加熱した状態で、10名のパネラーに試食させて、試験例1と同様にして食感を評価した。この結果を表2に示す。

【0042】

【表2】

生地の配合組成	実施例3	実施例4	比較例3	比較例4
小麦粉	60	60	60	80
小麦セモリナ	2	2	—	2
馬鈴薯澱粉	12	12	12	—
米粉	8	8	10	—
乳化剤 (HLB4)	0.2	—	—	—
乳化剤 (HLB10)	—	0.2	0.2	0.2
コーンフラワー	9	9	9	9
膨張剤	1.8	1.8	1.8	1.8
増粘多糖類	1	1	1	1
グルコース	6	6	6	6
合計	100	100	100	100
全卵	15	15	15	15
水	115	115	115	115
食感	7.7	9.5	2.7	2.3

【0043】表2に示されるように、本発明で規定する範囲の粒度を有する難溶性粒状粉体、特定の澱粉類等及び乳化剤を併用した実施例3及び4は、焼成してから6時間室温に放置した後電子レンジで加熱した状態でも良好な食感を有することが分かる。特にHLB10の乳化剤を用いた実施例4は、より食感がよいことが分かる。

【0044】これに対して、難溶性粒状粉体を使用しない比較例3、澱粉類等を使用しない比較例4は、焼成してから6時間室温に放置した後電子レンジで加熱した状態での食感が劣ることが分かる。

【0045】試験例3（鯛焼き）

表3に示す各種の和風スナック用生地組成物100質量部に、表に示す配合割合で水及び全卵を加えてバター

を調製し、鯛焼き用生地を得た。なお、難溶性粒状粉体として50メッシュのコーングリッツ、澱粉類としてエーテル化タピオカ澱粉、酸処理馬鈴薯澱粉及び米粉、乳化剤としてHLB10のショ糖脂肪酸エステルを用いた。

【0046】この生地を、鯛焼きの焼き型に流し込み、試験例2と同様にして焼成して鯛焼きを製造した。

【0047】これらの鯛焼きを、焼成してから1ヶ月間冷凍保存した後電子レンジで加熱した状態で、10名のパネラーに試食させて、試験例1と同様にして食感を評価した。この結果を表3に示す。

【0048】

【表3】

生地的配合組成	実施例5	実施例6	比較例5	比較例6
小麦粉	70	70	70	80
コーングリッツ	5	5	—	10
タピオカ澱粉 (エーテル処理)	15	—	5	—
馬鈴薯澱粉 (酸処理)	—	5	5	—
米粉	—	10	10	—
乳化剤 (HLB10)	0.2	0.2	0.2	0.2
膨張剤	1.8	1.8	1.8	1.8
α化澱粉	3	3	3	3
増粘多糖類	1	1	1	1
トレハオース	4	4	4	4
合計	100	100	100	100
全卵	25	25	25	25
水	160	155	160	155
食感	8.8	8.9	2.6	2.0

【0049】表3に示されるように、本発明で規定する範囲の粒度を有する難溶性粒状粉体、特定の澱粉類等及び乳化剤を併用した実施例5及び6は、冷凍保存した後電子レンジで加熱した状態でも良好な食感を有することが分かる。

【0050】これに対して、難溶性粒状粉体を使用しない比較例5、澱粉類等を使用しない比較例6は、冷凍保存した後電子レンジで加熱した状態での食感が劣ることが分かる。

【0051】試験例4（お好み焼き）
表4に示す各種の和風スナック用生地組成物100質量部に、水120質量部、全卵80質量部及びサラダ油5質量部を加えてバッターを調製し、さらに具材として刻んだキャベツ150質量部、天かす15質量部、すりおろした山芋5質量部、紅しょうが5質量部、桜エビ3質量部を加えて、お好み焼き用生地を得た。なお、難溶性粒状粉体として30メッシュのドライパン粉、澱粉類等として酸処理タピオカ澱粉及び米粉、乳化剤としてHLB10のグリセリン脂肪酸エステルを用いた。

【0052】この生地を、ホットプレートで180℃、約10分間両面を焼成してお好み焼きを製造した。

【0053】これらのお好み焼きを、①焼成後1ヶ月間冷凍保存してから電子レンジで解凍した後、175℃のサラダ油で5分間油ちょうした直後の状態、及び②にして油ちょうした後、1時間経過した状態で試験例1と同様にして食感を評価した。この結果、試験例5及び6は、試験例1と同様に食感を評価した。この結果、試験例5及び6は、試験例1と同様に食感を評価した。

【0054】

【表4】

生地的配合組成	実施例7	比較例7	比較例8	比較例9
小麦粉	60	70	75	90
ドライパン粉	15	—	15	—
タピオカ澱粉 (酸処理)	10	10	—	—
米粉	5	10	—	—
乳化剤 (HLB10)	1	1	1	1
コーンフラワー	5	5	5	5
増粘多糖類	1	1	1	1
塩	2	2	2	2
グルタミン酸ソーダ	1	1	1	1
合計	100	100	100	100
全卵	80	80	80	80
サラダ油	5	5	5	5
水	120	120	120	120
食感				
①	9.5	4.0	2.9	3.2
②	9.2	2.1	1.9	2.2

【0055】表4に示されるように、本発明で規定する範囲の粒度を有する難溶性粒状粉体、特定の澱粉類等及び乳化剤を併用した実施例7は、冷凍保存後、解凍して油ちょうした直後の状態でも、油ちょう後1時間経過した状態でも良好な食感を有することが分かる。

【0056】これに対して、難溶性粒状粉体を使用しない比較例7、澱粉類等を使用しない比較例8、難溶性粒状粉体及び澱粉類等を使用しない比較例9は、冷凍保存後、解凍して油ちょうした直後の状態でも、油ちょう後1時間経過した状態でも食感が劣ることが分かる。

【0057】試験例5（タコ焼き）

表5に示す各種の和風スナック用生地組成物100質量部に、水270質量部及び全卵10質量部を加えてバターを調製し、さらに具材として刻んだキャベツ25質

量部、天かす15質量部、紅しょうが2質量部を加えて、タコ焼き用生地を得た。なお、難溶性粒状粉体として50メッシュのコーングリッツ、澱粉類等としてタピオカ澱粉、馬鈴薯澱粉及び米粉、乳化剤としてHLB11のショ糖脂肪酸エステルを用いた。

【0058】この生地を、タコ焼きの焼き型に流し込み、ぶつ切りのタコを入れて180℃、11分間焼成してタコ焼きを製造した。

【0059】これらのタコ焼きを、焼成後10分間経過した状態で、試験例1と同様にして食感を評価した。この結果を表5に示す。

【0060】

【表5】

生地の配合組成	実施例8	実施例9	実施例10	実施例11	実施例12	比較例10
小麦粉	77.9	77.9	78.0	77.9	78.0	77.9
コーングリッツ	10	10	10	10	10	10
タピオカ澱粉	10	—	—	5	5	—
馬鈴薯澱粉	—	10	—	5	5	—
米粉	—	—	10	—	—	—
乳化剤 (HLB11)	0.1	0.1	—	0.1	—	0.1
増粘多糖類	1	1	1	1	1	1
塩	1	1	1	1	1	1
合計	100	100	100	100	100	100
全卵	10	10	10	10	10	10
水	270	270	270	270	270	270
食感	8.0	8.3	7.9	9.3	7.0	2.3

【0061】表5に示されるように、本発明で規定する範囲の粒度を有する難溶性粒状粉体、特定の澱粉類等及び乳化剤を併用した実施例8、9、11、本発明で規定する範囲の粒度を有する難溶性粒状粉体及び特定の澱粉類を併用した実施例10、12は、焼成後10分間経過した状態でも良好な食感を有することが分かる。特に難溶性粒状粉体、澱粉類等及び乳化剤の3成分を併用した実施例8、9、11はより食感がよいことが分かる。

【0062】これに対して、特定の澱粉類を使用しない比較例10は、焼成後10分間経過した状態での食感が劣ることが分かる。

【0063】

【発明の効果】以上説明したように、本発明によれば、和風スナック用生地組成物に、小麦粉と、10～80メ

ッシュの難溶性粒状粉体と、タピオカ澱粉、馬鈴薯澱粉、米粉及びそれらの化工品からなる群より選ばれた1種以上を含有させることにより、焼成した際に、生地が表面がバリバリとしており、中身はしっとり感・クリーミー感がある食感が得られ、かつこの食感の経時的変化が少なく、特に冷蔵・冷凍保存後に電子レンジなどで再加熱してもこの食感の劣化を顕著に低減させることができる。

【0064】また、この和風スナック用生地組成物を用いて調製したバターに具材を添加して焼成することにより、上記の良好な食感を有し、かつこの食感の経時的変化が少なく、特に冷蔵・冷凍保存後に電子レンジなどで再加熱しても食感の劣化の少ない和風スナックを得ることができる。

フロントページの続き

(51)Int. Cl.⁷

識別記号

FI

ターワード (参考)

A21D 10/04

A21D 10/04

A23G 3/00

102

A23G 3/00

102

A23L 1/48

A23L 1/48

57

(8) 開2002-51688 (P2002-52AA)

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Fターム(参考) 4B014 GE03 GG02 GG03 GG04 GK07
GK09 GL06 GL11 GP01 GP12
GP15
4B032 DB33 DB40 DE06 DG02 DG07
DG08 DK10 DK13 DK15 DK17
DK30 DK39 DL01 DL03 DL08
DL20 DP73
4B036 LC04 LF14 LH08 LH11 LH12
LH22 LH29 LH30 LH37 LK02
LK03 LP02 LP17

EUROPEAN PATENT OFFICE

Patent Abstracts of Japan

PUBLICATION NUMBER : 2002051688
PUBLICATION DATE : 19-02-02

APPLICATION DATE : 11-08-00
APPLICATION NUMBER : 2000244315

APPLICANT : NITTO SEIFUN KK;

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INT.CL. : A21D 2/14 A21D 2/16 A21D 2/18 A21D 2/34 A21D 2/36 A21D 10/04 A23G 3/00
A23L 1/48

TITLE : DOUGH COMPOSITION FOR JAPANESE-FASHIONED SNACK AND METHOD FOR
PRODUCING JAPANESE-FASHIONED SNACK USING THE SAME

ABSTRACT : PROBLEM TO BE SOLVED: To obtain a dough composition for Japanese-fashioned snack, giving a crisp feeling of the surface thereof, moist and creamy feelings of the inside with a slight change in the palate filling with time when baked, and the baked composition in particular has slight deterioration of its palate feeling even if heated again in an microwave oven or the like after preserved under refrigeration/freezing, and to provide a method for producing Japanese-fashioned snack using the above composition.

SOLUTION: This dough composition is obtained by incorporating a dough composition for Japanese-fashioned snack with wheat flour, 10 to 80-mesh springly soluble granular powder and at least one component selected from the group consisting of tapioca starch, potato starch, rice flour and modified products thereof and preferably including an emulsifier preferably with an HLB of 7-15. The other objective Japanese- fashioned snack is obtained by incorporating ingredient(s) in a batter prepared using the above dough composition followed by baking. A preferable version of this snack is obtained by refrigerating or freezing of the above snack. The preferable other version of this snack is obtained by heating in a microwave oven (and then deep-frying) the thus refrigerated or frozen Japanese-fashioned snack.

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Textural attributes of a model snack food at different moisture contents

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Received 16 December 2005; received in revised form 8 February 2006; accepted 13 February 2006

Available online 29 March 2006

Abstract

Moisture content plays a significant role on the texture of ready-to-eat (RTE) snacks as it directly affects the crispness that is a key factor for their acceptance. The popular low-density RTE snacks such as corn balls has been selected as a model system to assess the detailed textural attributes when the moisture content was varied between 2% and 10%. The compression curve (force offered by the sample at different time of compression) apparently shows three prominent zones. The slope of the curve is high in the first and last zones but marginally increases in between these two zones when most of the fractures occur.

Good indices to judge the texture of a snack are firmness, Young's modulus and number of peaks; the latter has been defined as a drop in force of magnitude ≥ 1 N. Critical moisture content for corn ball is 4% above which these three indices is markedly affected and product approaches unacceptable domain. The microstructure of corn balls shows the presence of air cells with thin walls and vacuoles. Deformed/damaged cells, fracture(s) in the cell walls and line of fracture for compressed samples have been observed.

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Keywords: Model snack; Moisture content; Fracture; Young's modulus

1. Introduction

Snack foods are designed to be less perishable, more durable and more appealing than natural foods. Different types of snack foods are available of which the new generation snacks fall into several categories such as low fat, baked but not fried, high fiber products made from rice/wheat bran and coated snacks, etc.

The acceptance of snacks is critical because of the specific quality attributes that attract people. The various sensory quality attributes of snack foods are appearance, texture, taste, colour and flavour. Among them, texture is one of the most important one and it is particularly true for snack foods (Bourne, 2002). Crispness is perceived through a combination of tactile, kinesthetic, visual and auditory sensations and represents the key texture attributes of dry snack products Heidenreich, Jaros, Rohm, and Ziems (2004). Crispness is also associated with rapid drop of force during mastication process that, in turn, is based on fracture propagation in brittle materials (Vincent, 1998). When force is applied to brittle snacks, rupture of the cellular structure occurs and, in line with some deformation, generates a typical sound contributing to crispness sensation (Vickers & Bourne, 1976). The crisp materials usually generates irregular force–deformation curve.

The ready-to-eat (RTE) snacks are usually low moisture foods and a change in moisture content directly affects texture, and consequently, the less crispy snacks are not acceptable. The moisture-dependent behaviour of snacks with particular reference to texture and fracture behaviour are scarce. Further, texture of snacks also depends on the microstructure as they are inter-related.

Compression is the most common method to determine the texture of foods, and it has been applied on snacks (Vincent, 1998), semi-solid foods such as gels (Doublier, 1992), doughs (Bhattacharya, Narasimha, & Bhattacharya,

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2003), etc. It is desirable to obtain a good resolution during testing particularly for firm foods than for soft foods as the change in height due to the application of force for firm food is much lower than soft foods. Extruded corn balls, fried low moisture snacks and puffed rice are typical firm food products in contrast to soft foods like gels.

Crispness of cereals has been related to their water content or the water activity by Martinez-Navarraete, Moragu, Talens, and Chiralt (2004), Heidenreich et al. (2004) and by Katz and Labuza (1981). Heidenreich et al. (2004) studied the texture parameters of extruded rice crisps which were adjusted to water activities in the range of 0.05 and 0.65. The general conclusions that can be derived from these studies are that the crispness is affected when the sample exceeds a critical water activity value which has been reported to be above 0.5.

Hence, scope exists to study the texture of snacks as a function of moisture content. The usefulness of such results lies in quality control, packaging, storage and transportation of such snacks. It is worth mentioning here that measurement of crispness of a snack is yet to be a well established procedure.

The objectives of the present research are to study the effect of moisture content on texture of a model snack food such as extruded corn balls under compression, and examination of microstructure of the samples with an intention to relate it with texture of snack and fracture behaviour.

2. Materials and methods

2.1. Corn balls

Corn grits were procured from Tagir Private Ltd., Mumbai, India, and had particles ranging from 0.41 to 0.64 mm with an average particle size of 0.56 mm. The proximate composition, as determined by employing AOAC (1984), are 9.6% moisture, 7.2% protein ($N \times 6.25$), fat 0.9%, ash 1.2% and carbohydrate 81.1% (by difference). Corn grits were extruded using a single screw cooking extruder (collet type extruder, barrel bore 75 mm), available at Fun Snacks, New Delhi, having a capacity of producing about 60 kg of corn balls per hour (Agarwal & Bhattacharya, 2004). Feed in the form of wet corn grit was provided to the extruder cooker through a twin-screw feeder. The screw speed of the extruder shaft was 195 ± 7 rpm and was operated by a 20 HP three phase motor. The length-to-diameter (L/D) ratio of the extruder was 8. The die head was provided with six circular die openings of 4 mm diameter each. The moisture content of the feed prior to extrusion was $17 \pm 1\%$ and the melt temperature at die during extrusion cooking was $135 \pm 5^\circ\text{C}$. Rotary cutters were mounted on the die head to cut the expanded extruded rods into near spherical shapes. The extrudates were dried at an air temperature of about 70°C for 15 min in a tray drier.

The average diameter of individual ten extruded balls was determined by using a dial type caliper with a least

count of 0.01 mm. Density was obtained by dividing the mass of individual corn balls by its respective volumes. The moisture content of corn balls was determined in triplicate by employing the AOAC (1984) method. The diameter, density and moisture content of corn balls were 17.6 ± 1.4 mm, $87.3 \pm 7.6 \text{ kg m}^{-3}$ and $5.1 \pm 0.1\%$, respectively.

2.2. Uniaxial compression

The individual samples were compressed at a crosshead speed of 0.1 mm s^{-1} up to a strain level of 0.8 employing a texture measuring instrument (Model # TAHD_i, Stable Microsystems, Surrey, UK). The sample was compressed between two parallel plates of diameter 100 mm each, and 25 individual samples were tested for texture measurement. All texture measurements were repeated twice.

The parameters, determined from the force-deformation curves, were maximum force, energy for compression (till maximum force), number of major peaks, and initial slope of the linear portion of curve (Murthy & Bhattacharya, 1998). A drop of $\geq 1 \text{ N}$ force during compression was considered as a major fracture. The maximum force is the peak force offered by the sample during compression or at failure, whichever was higher. Firmness is primarily the deformation modulus (equivalent to elasticity) of the material under test and was obtained from the slope of the initial linear portion of the force-deformation curve (Szczesniak, 1983). Engineering stress and strain, and true stress and strain were determined (Bhattacharya et al., 2003) to calculate Young's modulus by using cylindrical samples of height 10 mm, according to theory mentioned in the subsequent section.

Axial compression of a sample between parallel plates causes the specimen height to decrease and its diameter to increase. Thus, the commonly used engineering or apparent compressive strain (ϵ_E) can be calculated (Hsieh & Regenstein, 1993) by using Eq. (1) as

$$\epsilon_E = \frac{\Delta h}{h_0} \quad (1)$$

where h_0 is the initial height of the sample and Δh is the change in height due to compression. The true, natural, or Hencky's compressive strain (ϵ_T) is given by Eq. (2)

$$\epsilon_T = \ln \left(\frac{h_0}{h_0 - \Delta h(t)} \right) \quad (2)$$

The engineering or apparent compressive stress (σ_E) can be calculated from the force-time plot and by knowing the cross-sectional area of the sample prior to compression (Eq. (3)). True stress (Hsieh & Regenstein, 1993) is given by Eq. (4)

$$\sigma_E = \frac{F(t)}{A_0} \quad (3)$$

$$\sigma_T = \frac{F(t)}{A(t)} = \frac{F(t)(h_0 - \Delta h(t))}{A_0} \quad (4)$$

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The Young's modulus is equal to the ratio of true stress and strain (up to elastic limit), and can be expressed (Mohsenin, 1986) as

$$\gamma = \frac{\sigma_T}{\varepsilon_T} \quad (5)$$

2.3. Microstructure

The samples were dehydrated, mounted on aluminium stubs with conductive adhesive, coated with gold in a sputter coater and were examined with a scanning electron microscope (Model 435 VP, Leo Electron Microscopy Ltd., Cambridge, UK) as mentioned earlier (Bhat & Bhattacharya, 2001). The samples were examined at a voltage of 15 kV and a low magnification of 15× was used to examine the samples. The size of cells and the thickness of the cell walls were obtained by placing the cursors to appropriate locations during examination. Representative and repeatable photomicrographs have been presented.

3. Results and discussion

3.1. Compression characteristics

Corn balls show characteristic compression curves depicting different magnitudes of forces as a function of strain. The sample compression curve for corn balls (Fig. 1(A)) apparently indicates the presence of three zones. In the first zone, there is a sharp rise in force with time or deformation, which may be attributed to the toughness of the product. In the second zone, multiple fractures occur as evidenced by several ups and downs in the curve but show a marginal increasing trend. The third zone is characterised by a sharp increase in force with an increase in the extent of compression while showing fractures.

Dry cellular expanded extruded products such as corn balls consists of brittle walls surrounding air-filled cavities (Heidenreich et al., 2004). Initially, at a low strain, the air cells are deformed elastically to offer low resistive force (usually <15 N) showing the first zone of compression. This initial slope (equal to force/distance), conventionally called firmness (Murthy & Bhattacharya, 1998; Szczesniak, 1983), results out of the resistance offered by the air cells along with the cell walls. Once these thin cell walls undergo fracture, the second zone starts showing multiple damage to several air cells. The number of fractures increases with increasing strain as more and more air cells are damaged. The average force during this zone increases marginally. Once all or most of the cells are affected at a high strain, the density of the sample increases markedly, and hence, the sample acts as a compacted cohesive mass offering a high force. The slope of this zone may also be termed as firmness, and to differentiate from the earlier slope of first zone, it may be called as final firmness. Development of fracture lines, and even failures are also the characteristics of this third zone.

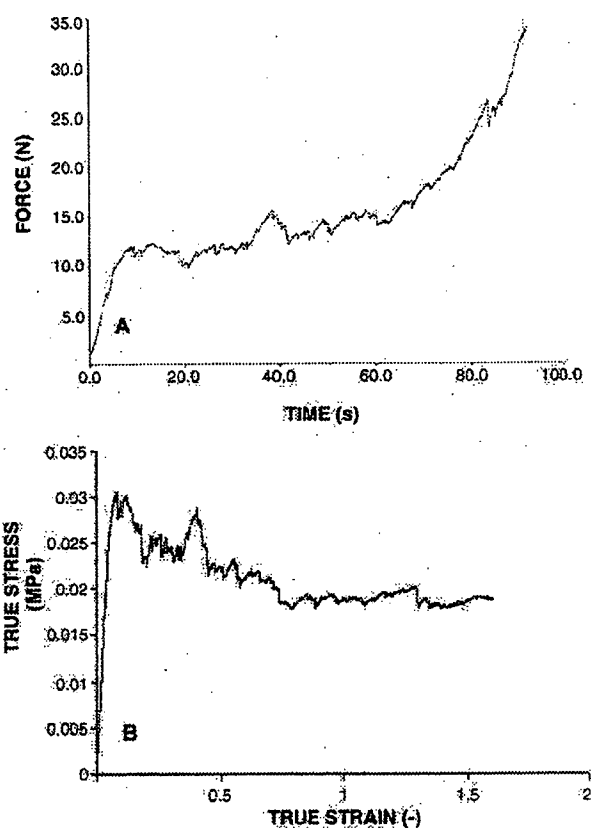


Fig. 1. Sample compression curves for corn ball at a moisture content of 9.2% showing (A) force-time and (B) true stress-true strain plots at a crosshead speed of 0.1 mm s⁻¹.

On replotting the graphs (Fig. 1(B)) in terms of true stress and true strain, these three zones are once again prominent. On a general estimate, the first zone ends before a true strain of 0.1 while the last zone is beyond 0.75. However, the patterns of the curves including the magnitudes of these zones change appreciably as the moisture content of snack varies, and as expected, it is also a function of the property of the material under test.

3.2. Effect of moisture content

The textural parameters such as maximum force, number of major peaks, energy for compression, Young's modulus and firmness are shown as a function of moisture content (Figs. 2–6). The maximum force is an indication of the peak resistance offered by corn ball during compression; an increase in moisture content increases maximum force (Fig. 2). The number of major peaks (Fig. 3) show a decreasing trend with increasing moisture content. It indicates that at a high moisture content, the same snack would not appear to be brittle or crisp. This happens as the number of major peaks approaches zero at a moisture content of about 10%, which indicates that the product lost all its

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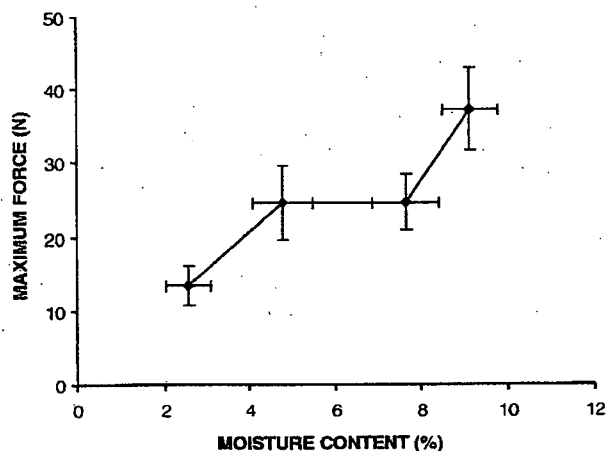


Fig. 2. Effect of moisture content on maximum force.

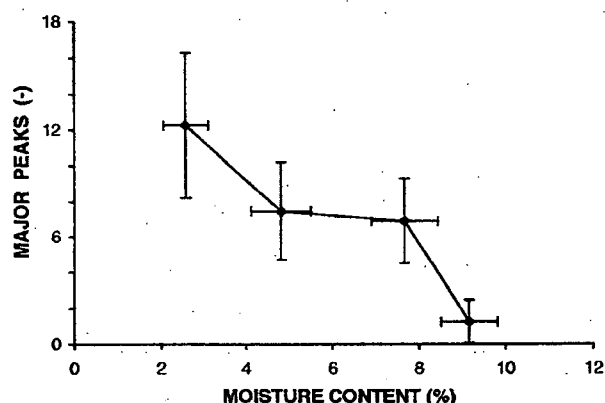


Fig. 3. Effect of moisture content on number of major peaks during compression.

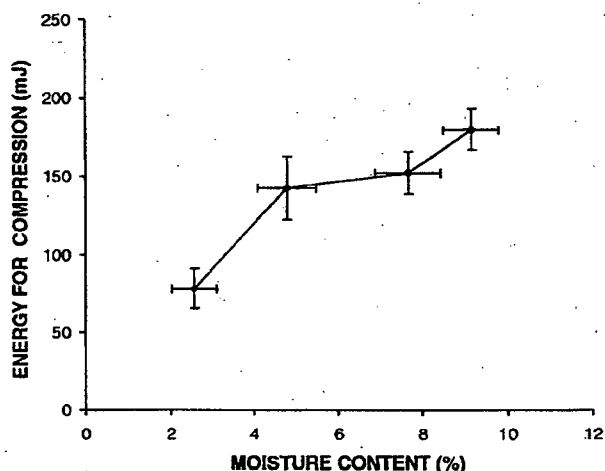


Fig. 4. Effect of moisture content on compression energy.

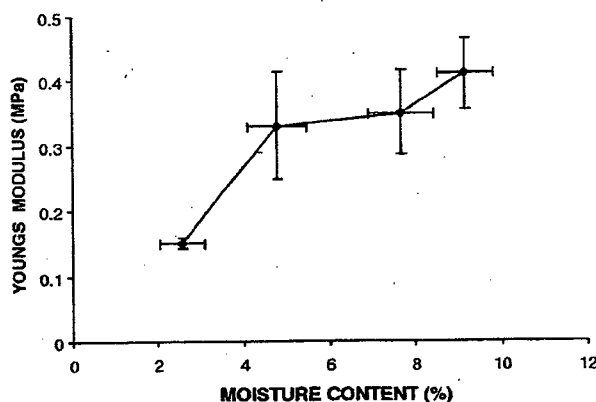


Fig. 5. Effect of moisture content on Young's modulus.

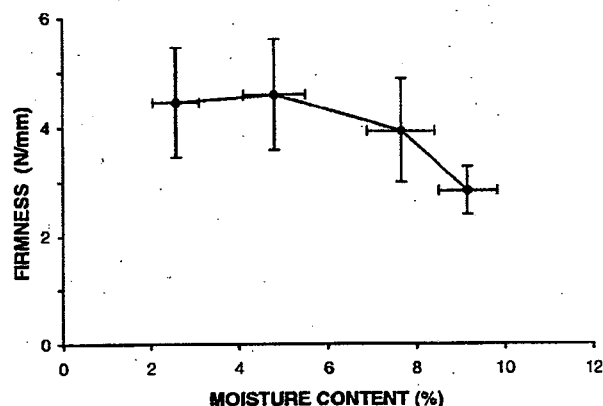


Fig. 6. Effect of moisture content on firmness.

characteristic crispness. Water leads to plasticization and softening of the starch–protein matrix and thus alters the strength of the product (Martinez-Navarraete et al., 2004).

The energy for compression and Young's modulus (Figs. 4 and 5) show an increasing trend with moisture content. These results indicate that a snack having high moisture content needs more energy to bite and/or chew as its elastic limit increases. These phenomena may be explained by the plasticization effect of moisture on food materials which makes the snack to behave like a semi-solid mass rather than a brittle solid; this behaviour is common in several viscoelastic materials including food doughs (Bhattacharya et al., 2003). Hence, snacks with high moisture content show enhanced level of strain tolerance during compression with delayed fracture or even absence of fracture or failure.

A decreasing trend in firmness of corn balls has been observed (Fig. 6) above a moisture content of 4.5%, and marked decrease occurs beyond 7%. The results of sensory assessment of corn ball indicate that the characteristic crisp texture is retained up to a moisture content of about 4%. Samples with $\geq 4.5\%$ moisture content appear to be crisp

in first bite, and the panelists felt them to be soft in subsequent bites. Corn balls above 6% moisture content appear to be not crisp, and hence, are not acceptable by the panelist. Considering 4% as the critical moisture content that decides the textural acceptability of corn balls, the values for Young's modulus, firmness and number of major peaks are 0.25 MPa, 4.5 N mm⁻¹ and 8, respectively.

Texture of snack foods can be denoted by several sensory terms such as crisp, crunchy and crumbly. On the other hand, objective quantification of texture has been conducted by determining the slope of the line joining the origin and the peak force has been termed as stiffness by Vincent (1998) whereas Szczesniak (1983) considered the slope of the initial straight-line portion as elastic modulus that may be considered as a measure of firmness. Murthy and Bhattacharya (1998) considered it as deformability for black pepper. In addition to firmness, the number of major peaks and Young's modulus are also suitable for quantifying the texture of snack foods.

3.3. Microstructure

Microstructure of uncompressed and compressed at different strains were examined to understand the changes in cellular structure and pattern of fracture/failure. The cross-sectional view of uncompressed corn ball (Fig. 7) shows air cells with varying dimensions. The largest dimension or diameters of such air cells are approximately between 0.5 and 3 mm that are separated by a thin cell wall having a thickness of 20–50 μ . These structural features can account for the low density (about 87 kg m⁻³), and crisp texture which melts easily in the mouth. When force is applied to brittle snacks, rupture of the cellular structure occurs and, in line with some deformation, generates a typical sound contributing to crispness sensation (Vickers & Bourne, 1976).

The compressed corn ball (Fig. 8) shows damages to air cell and cell walls. Deformed cells and broken cell walls are

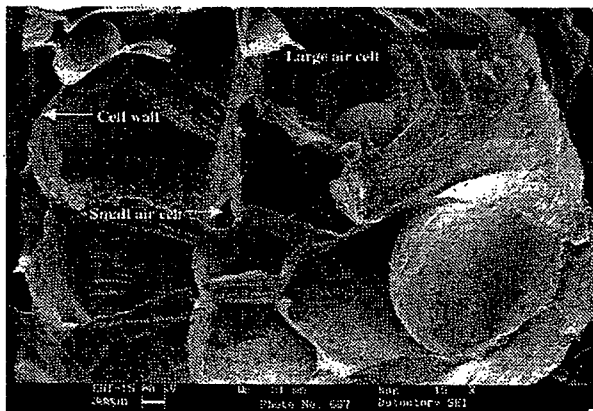


Fig. 7. Microstructure (15x) of the cross-section of corn ball prior to compression.

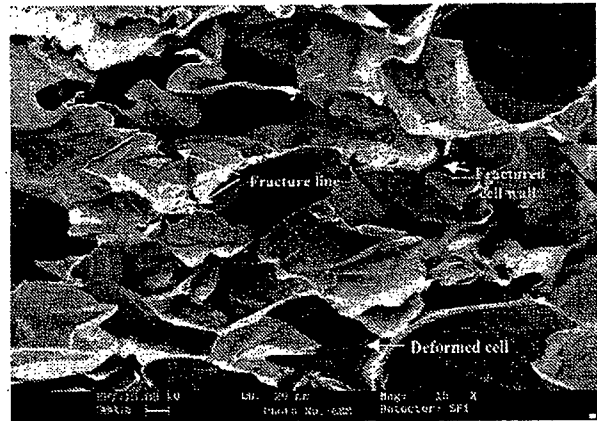


Fig. 8. Microstructure (15x) of corn ball after compression at a moisture content of 9.2%.

visible along with fracture lines; the latter item propagates leading to failure into several pieces.

4. Conclusions

Moisture content plays a significant role on the texture of ready-to-eat snacks as it directly affects the crisp behaviour, the key factor related to their acceptance. Uniaxial compression testing was performed on a popular low-density RTE snack, such as corn balls, as a model snack; it shows characteristic force–time curves depicting different magnitudes of forces offered by the samples as a function of strain, and apparently indicates the presence of three zones. Good indices to judge the crisp behaviour are firmness, Young's modulus and the number of major peaks; these indices are sensitive to moisture content of sample particularly when it is more than 4%. Microstructural observations indicate the presence of air cells of size ranging between 0.5 and 3 mm that are separated by thin cell walls having a thickness of 20–50 μ . Application of compressive load shows deformed cells with fractured cell walls and fracture lines.

Acknowledgements

The authors wish to thank Mr. K.K. Bhat, Head, Sensory Science Department, CFRTI, Mysore for the sensory assessment of corn balls.

References

- Agarwal, K., & Bhattacharya, S. (2004). Uptake of sucrose solution by extruded corn balls and effect on the textural characteristics. *Journal of Food Process Engineering*, 28, 154–165.
- AOAC (1984). *Official methods of analysis* (14th ed.). Arlington, VA: Association of Official Analytical Chemists.
- Bhat, K. K., & Bhattacharya, S. (2001). Deep fat frying characteristics of chickpea flour suspensions. *International Journal of Food Science and Technology*, 35, 499–507.

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- Bhattacharya, S., Narasimha, H. V., & Bhattacharya, S. (2003). Effect of gum Arabic on the rheology of corn flour doughs and fried product quality. *Journal of Texture Studies*, 34, 421–436.
- Bourne, M. C. (2002). *Food texture and viscosity: concept and measurement*, 2nd ed., New York State Agricultural Experiment Station and Institute of Food Science. Cornell University, Geneva, New York, pp. 171–189.
- Doublier, J. L. (1992). Viscoelastic properties of food gels. In M. A. Rao & J. F. Steffe (Eds.), *Viscoelastic properties of foods* (pp. 371–433). London: Elsevier Applied Science.
- Heidenreich, S., Jaros, D., Rohm, R., & Ziem, A. (2004). Relationship between water activity and crispness of extruded rice crisps. *Journal of Texture Studies*, 35, 621–633.
- Hsieh, Y. L., & Regenstein, J. M. (1993). Failure deformation and stress relaxation of heated egg white gels. *Journal of Food Science*, 58, 113–123.
- Katz, E. E., & Labuza, T. P. (1981). Effect of water activity on the sensory crispness and mechanical deformation of snack products. *Journal of Food Science*, 46, 403–409.
- Martinez-Navarraete, N., Moragu, G., Talens, P., & Chiralt, A. (2004). Water sorption and the plasticization effect in wafers. *International Journal of Food Science and Technology*, 39, 555–562.
- Mohsenin, N. N. (1986). *Physical properties of plant and animal materials* (2nd ed.). New York: Gordon and Breach Science Publishers, pp. 128–175.
- Murthy, C. T., & Bhattacharya, S. (1998). Moisture dependant physical and uniaxial compression properties of black pepper. *Journal of Food Engineering*, 37, 193–205.
- Szczesniak, A. S. (1983). Physical properties of foods: what they are and their relation to other food properties. In M. Peleg & E. B. Bagley (Eds.), *Physical properties of foods* (pp. 1–41). Westport, Connecticut, USA: AVI Publ. Co.
- Vickers, Z. M., & Bourne, M. C. (1976). A psychoacoustical theory of crispness. *Journal of Food Science*, 41, 1158–1164.
- Vincent, J. F. V. (1998). The quantification of crispness. *Journal of Science of Food and Agriculture*, 78, 162–168.



Review

Crispness: a critical review on sensory and material science approaches

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Many texture studies have been published on crispness because of the great interest of consumers towards crispy foods. This work reviews the existing literature on the topic, and especially the different approaches, instrumental and sensory, applied to study crispness. These studies result in a wide range of data but, because crispness is not a clearly defined sensory attribute, the conclusions that can be drawn from these studies should be carefully examined. The physical basis for crispness are discussed and the role of structure, hydration and ingredients on crispness and its stability are presented.

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Introduction

Living in a society of large choice of quality food, the consumers' appreciation has become one of the main criteria in their food choice, as well as nutrition and

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PII: S0924-2244(02)00139-5

safety. The contribution of texture to the consumers' appreciation of a food product has been studied for nearly 40 years. In the early studies on the awareness of food texture, the importance of crispness was highlighted. For instance, word association tests, in which consumers were asked to generate attributes related to a list of specific foods, showed that the term "crisp" was mentioned more often than any other attribute (Rohm, 1990; Szczesniak, 1971; Szczesniak & Kleyn, 1963).

In 1972, Iles and Elson (1972) showed that products were ranked in the same order for crispness and consumers' preference. This result was later replicated by Katz and Labuza (1981) emphasizing the importance of crispness in food acceptability. Thus, the food industry has considered the necessity to control this characteristic both during production and storage. To achieve such an objective requires the knowledge of intrinsic parameters (physical, chemical, product-related) responsible for crispness. But crispness, like any other textural attribute, depends not only on *ad hoc* rheological/mechanical characteristics exhibited by a product, but also on the consumers who identify the sensations perceived upon eating, as relevant to crispness. Thus, to understand both the mechanisms underlying crispness perception and the meaning, consumers give to the term 'crispy', is relevant to this issue. This paper will then be structured as follows. In the first section, the sensory works on crispness and especially the strategies implemented to evaluate crispness are reviewed. In the second section, the instrumental approaches developed to study crispness are presented. In the final section, the key parameters for crispness control are reviewed.

Crispness: sensory approaches

Although texture researches cannot ignore sensory approach, there are only few studies dealing with methodological aspect of crispness assessment. Different approaches have been reported in the literature on crispness evaluation. In the 1970's and early 1980's, the magnitude estimation method was commonly used (Brennan, Jowitt, & Williams, 1974; Christensen & Vickers, 1981; Edmister & Vickers, 1985; Katz & Labuza, 1981; Mohamed, Jowitt, & Brennan, 1982; Vickers, 1981; Vickers & Wasserman, 1979). In this technique, one product is chosen as a reference and is given an arbitrary score. The assessors are asked to score the samples proportionally to this reference.

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Usually, these evaluations are carried out with a large number (20–50) of untrained assessors. In the 1980's, the descriptive analysis became popular and was acknowledged as a reliable technique to measure sensory properties. It became the reference technique for crispness measurement and profoundly changed the experimental protocols: ratio scales were abandoned in favour of interval scales (structured or unstructured linear scales) and assessments were performed with small group of trained panellists (about 10 people).

On the training stage of descriptive analysis, the objective is to reach a consensus among panellists on the meaning of every attribute. To achieve this, it is recommended in handbooks to provide assessors with a definition. Thus, in some studies, a verbal definition was given to the attribute 'crispy' (Barrett, Cardello, Leshner, & Taub, 1994; Dacremont, 1992; Duizer, Campanella, & Barnes, 1998; Onwulata & Heymann, 1994; Seymour & Hamann, 1988). The examination of these definitions (Table 1, including two earlier studies) shows a large diversity of meaning. The definitions provide varying explanations on which sensations assessors should focus to evaluate crispness. Five aspects have been quoted: structure of the intact product, sounds emitted at fracture, force needed to crush the sample, how the product collapses at fracture and how do the pieces appear after

fracture. As shown in Table 2, there is at best only a moderate amount of agreement among definitions. Depending on the definition, some characteristics are stressed with more or less details, or omitted. Usually, definitions include a description of exploratory procedures, i.e. the way the sample should be manipulated. These procedures may also vary. In some studies, assessors are instructed to crush the samples either with their molars or their incisors. In other studies, the panel evaluates crispness by crushing or snapping the sample with the fingers (Onwulata & Heymann, 1994; Wai-chungo, Heymann, & Heldman, 2000).

These definitions probably do not reflect an unique sensory concept, as indicated by the outcome of the experiments in which they were used:

- the definition of Seymour and Hamman (1988) only referred to high-pitched crushing sounds and a good correlation between crispness and energy in the high frequencies of eating sounds was found;
- the definitions of Jeon, Breene, and Munson (1975) and Barrett, Cardello *et al.* (1994) emphasised the importance of the force required to bite through the sample and, in both cases, a close relationship between crispness and hardness was found;

Table 1. Definitions of crispness

Reference	Attribute used	Location of the panel	Definition
Barrett <i>et al.</i> , 1994	Crispy	USA	The perceived horizontal force with which the product separates into two or more distinct pieces during a single bite with the incisors. An abrupt and complete failure of the product is required.
Brennan <i>et al.</i> , 1973	Crispy	UK	Place a small piece between the molars and bite down slowly and evenly until a sudden and continuous breakdown of the biscuit structure occurs. Assess the rate at which this breakdown into small fragments occurs using as near as possible the same biting rate.
Dacremont, 1992	Croustillant	France	Noisy at biting, aerated, light and that crumble. The fracture is progressive during biting (translation from French).
Duizer <i>et al.</i> , 1998	Crispy	New Zealand	A combination of the noise produced and the breakdown of the product as it is bitten entirely through with the back molars.
Jeon <i>et al.</i> , 1975	Crispy	USA	Relative force required to bite through [the sample].
Onwulata and Heymann, 1994	Crispy	USA	The perceived relative force used by crunching [the product] in the mouth.
Seymour and Hamman, 1988	Crispy	USA	First bite: Place sample between incisors, bite through and evaluate the level of higher pitched noise.

Table 2. Stimuli cited for the definition of the attribute crispy

References	Noise	Force	Fracture	Particle	Structure
Barrett <i>et al.</i> , 1994		Horizontal force	Abrupt and complete	Two or more pieces	
Brennan <i>et al.</i> , 1973			Sudden and continuous	Small fragments	
Dacremont, 1992	Noisy		Progressive	Crumble	Aerated and light
Duizer <i>et al.</i> , 1998	Noise		Breakdown		
Jeon <i>et al.</i> , 1975		Relative force			
Onwulata and Heymann, 1994		Relative force			
Seymour and Hamman, 1988	High pitched				

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- the definition of Dacremont (1992) referred to the structure of the product and a correlation was found between crispness, aeration and crumbliness.

One wonders whether these results are the cause or the consequence of the definitions. If the verbal definition of crispness is relevant, there is no need for further investigation on the meaning of crispness. If the definition is not relevant, then, at best, the definition is ineffective and, at worst, it leads assessors to evaluate some other sensory concepts. Aware of this shortcoming, some panel leaders did not provide panellists with a verbal definition but allowed them to reach a consensus at the training step, by discussing together when tasting products (Brown, Langley, & Braxton, 1998; Lee, Schweitzer, Morgan, & Shepherd, 1990; Liu & Tan, 2000; Piazza & Masi, 1997; Roudaut, Dacremont, & Le Meste, 1998; Sauvageot & Blond, 1991). However, the problem remains because there is no guarantee that two groups, independently trained, would reach a consensus on the same meaning. Thus, trained assessors provide reliable responses but, the validity of responses, i.e. the ability to provide reproducible results between independently trained groups, might be jeopardized by the training itself.

In many studies, untrained assessors were used (Christensen & Vickers, 1981; Edmister & Vickers, 1985; Katz & Labuza, 1981; Mohamed, Jowitt, & Brennan, 1982; Vickers, 1981; Vickers & Wasserman, 1979; Dacremont, 1995; Norton, Mitchell, & Blanshard, 1998; Sherman & Deghaidy, 1978; Suwonsichon & Peleg, 1998; Vickers, 1984, 1985, 1987, 1988; Vickers & Christensen, 1980), though this methodological choice has been rarely justified. Working with untrained assessors might have been a way to avoid the adulteration of the crispy concept due to training in laboratory conditions. Such a method requires to work with a larger number of assessors, to compensate the possibility that their concepts were not aligned initially. The question of whether or not untrained assessors are able to quantify their perceptions in a reliable way is still under debate (Dugle, 1997; Hough, 1998; Moskowitz, 1996, 1997, 1998). However, it is obvious that protocols developed for descriptive analysis cannot be directly transposed to untrained assessors. Some authors used specific protocols, such as ranking task (Norton *et al.*, 1998; Sherman & Deghaidy, 1978) or categorisation task (Dacremont, 1995), which are more adapted to untrained assessors than the rating task.

Vallés Pàmies, Roudaut, Dacremont, Le Meste, and Mitchell (2000) proposed an alternative approach to overcome the difficulty. First, the consensual 'crispy' concept is measured in the population of interest. This can be achieved, for instance, by asking consumers to categorise a large range of products as 'crispy', 'not

crispy' or 'borderline'. Then, prototypical products are identified and used as a perceptive (as opposed to verbal) definition to train a conventional descriptive panel. At the end of training, the efficiency of the learning stage is tested, to check that panellists' concepts are aligned. Afterwards, the familiar procedure of descriptive analysis is carried out. In this way, the ecological validity of the measure and its reliability are both achieved.

The measurement of crispness by sensory mean is not a straightforward process. The difference between a sensory concept (i.e., the collection of perceptions identified as relevant to the same class) and its label (i.e., the word used by a community to refer to it) should be acknowledged. Thus, the use of the same label in different studies, especially with trained panellists, is not a guarantee that the same sensory concept is measured. On the opposite, different labels might have been used to refer to the same concept. For instance, 'crunchy' is used to characterize some products described as 'crispy' by other panels (Brown *et al.*, 1998; Guraya & Toledo, 1996; Segnini, Dejmek, & Oste, 1999). The question whether crispy and crunchy refer to the same sensory concept is quite difficult to answer. The strong positive correlation observed in studies where crispness and crunchiness were estimated by the same panel, on the same products (Barrett, Cardello *et al.*, 1994; Seymour & Hamann, 1988; Suwonsichon & Peleg, 1998; Vickers, 1981, 1985) favours the hypothesis of two labels for an unique concept. However, other works (Dacremont, 1995, 1996) suggest that crispy and crunchy refer to different concepts. The question is still open.

Moreover, studies on crispness were conducted in several countries, which adds difficulties to compare results due to the inherent distortion of meaning in translation (see Zannoni (1997) for a review on translation in descriptive analysis). For instance, Table 3, extracted from the polyglot list of textural terms published by Drake (1989), outlines that crispness can have more than one equivalent term in other languages. But, even if one equivalent word exists in two languages, they may not have exactly the same meaning. For example in France, neither fruits nor vegetables are considered 'croustillant' (translation of crisp) (Dacremont, 1992), as opposed to the United States (Szczeniak, 1988). The consensual meaning of a word is culture-dependent, i.e. it

Table 3. Translations of the terms crispy and crunchy from Drake (1989)

English	Crispy	Crunchy
French	Croustillant	Croquant
Italian	<Crocante>	
Iceland	<->	
Japanese	Baribari Boriori Karikari	Karikarisuru Pariparisuru

depends on the language but also on other cultural facts such as food habits, for instance.

Outcomes of sensory studies are often difficult to compare because of the confusion between concept and label, the lack of homogeneity in the procedures implemented for sensory assessments and the difficulties inherent to multi-cultural studies in the perception field. Therefore, this might explain some contradictory results reported in the crispness literature, especially in studies dealing with relationships between instrumental and sensory data.

Crispness: instrumental approaches

Although sensory analysis gives a more complete description of the texture of tested products, there has been a great interest in developing instrumental techniques to assess crispness. Instrumental techniques present some advantages, especially in industrial environments where quick and easy-to-use methods are in great demand and economically more profitable. Crispness being described as a concept with kinesthetic and auditory components, it is not surprising that the instrumental methods developed to evaluate it, have focused on the measurements of these properties singularly or in combination. Although a recent analysis of crispy bread has been performed by a complex instrumental set up considering at the same time flavours, mechanical and acoustic properties (Winqvist, Wide, Eklov, Hjort, & Lundstrom, 1999), the measurements are generally performed separately.

Mechanical measurements

Crispness 'measurements' are performed on instruments originally, developed for material science, providing physical parameters with fundamental significance in terms of rheological properties. These parameters cannot give straightforward crispness measurement, if any, but can be used as indicators, provided they are validated by sensory data.

Considering the perception of crispness upon eating, large deformation and fracture tests seem to be the most suitable instrumental tests. However, small deformation data, such as those acquired in dynamic rheology (George & Smith, 1996; Kalichevsky, Blanshard, & Mash, 1993; Le Meste, Roudaut, & Davidou, 1996; Nikolaidis & Labuza, 1996; Roudaut et al., 1998) or prior to fracture at larger deformation (such as for apparent Young's modulus measurement) (Fontanet, Davidou, Dacremont, & Le Meste, 1997; Hutchinson, Mantle, & Smith, 1989; Nicholls, Appelqvist, Davies, Ingman, & Lillford, 1995), may provide information not directly related to crispness, but to the molecular basis of this attribute.

Examples of measurements of rheological behaviour are numerous in the literature. Independently of the probe type or of the method used, they are all based on

recording the force when a deformation is applied to the product. Although constant loading rate tests have been suggested to provide more information (Jowitt & Mohamed, 1980), in most cases, tests are performed at constant deformation rate. Some authors also suggested the use of a high impact test (Hayter & Smith, 1988; Hayter, Smith, & Richmond, 1986; Hutchinson et al., 1989) to overcome the limitations of the testing deformation speeds used (i.e. $< 16.6 \text{ mm s}^{-1}$ for an Instron Universal Testing Machine) compared to the high speed of mastication (between 20 and 50 mm s^{-1}); nevertheless, this type of test is not used.

The most commonly used tests can be categorized into three groups: flexure (Andersson et al., 1973; Attenburrow, Davies, Goodband, & Ingman, 1992; Van Hecke, Allaf, & Bouvier, 1995; Vickers & Christensen, 1980), shear (Bhattacharya & Hanna, 1987; Faubion & Hosney, 1982) and compression tests. The latter are probably the most commonly employed because of their similarities with the mastication process. In these tests, the specimen is compressed either between two parallel plates (Moskowitz, Segars, Kapsalis, & Kluter, 1974) or by a plunger compressing the sample held in a cylinder (Andersson et al., 1973). Samples can be tested individually or as bulk when contained in a cell (Nixon & Peleg, 1995). Puncture tests have been extensively used as well (Georget, Parker, & Smith, 1995; Hayter & Smith, 1988; Hutchinson, Sdiolak, & Smith, 1987; Li, Kloeppel, & Hsieh, 1998; Van Hecke, Allaf, & Bouvier, 1998) for they simulate the incisors impact at biting. In this case, a cylindrical or conical probe of small diameter plunges in the specimen at constant and rather low speed. This test has specially been employed for the characterization of foamed products, and the probe is expected to fracture separately the different cell walls constituting the product. The force-deformation pattern is characterised by series of sharp force peaks corresponding to the rupture of individual cell walls (Fig. 1). Rheological studies differ in the way the force-deformation plots have been analysed, either by extracting some parameters, or by considering the signal as a whole.

First, the data analysis of compression tests was considered based on a fundamental approach in terms of rheological parameters, providing Young's modulus and fracture stress values (Brennan et al., 1974; Fontanet et al., 1997; Hutchinson et al., 1987; Katz & Labuza, 1981; Nicholls et al., 1995; Roudaut et al., 1998; Sauvageot & Blond, 1991; Seymour & Hamann, 1988). These analyses concentrate only on the linear region of the force-deformation plot, and reflect the mechanical properties with a material science approach. Such parameters, when corrected for the sample dimensions, are suitable for comparisons between specimens.

Another approach is to collect information from the jagged part of the force-deformation curves. For some

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authors (Barrett, Normand, Peleg, & Ross, 1992; Rohde, Normand, & Peleg, 1993), the overall force–deformation plot would be better analyzed by the description of its irregularities than by the extraction of some parameters. Three main analyses have been developed: extracting parameters from each force peak, calculating the power spectrum and determining the fractal dimension of the signal.

Barrett, Rosenberg, and Ross (1994) and Vincent (1998) described quantitatively the distribution of fracture forces occurring during compression, or bending of brittle foods. Using puncture tests, Van Hecke *et al.* (1998) and Vallés Pàmies *et al.* (2000) calculated the average of the so-called puncturing force (integral of force–time), the Number of Spatial Ruptures (NSR, ratio of the total number of peaks to the distance of puncturing), the average specific force of structural ruptures (ratio of the sum of force drops per peak to the number of peaks) and the ‘crispness’ work (ratio of the average puncturing force to the NSR). NSR and puncturing force were found to correlate with crispness and hardness (sensory data) respectively (Vallés Pàmies *et al.*, 2000). This is in agreement with Guraya and Toledo (1996) who claims that compressive force alone is insufficient to describe accurately the texture of crispy products.

In the last 10 years, with faster computers and thus the possibility of acquiring digital data from mechanical tests, novel methods for measuring crispness throughout the jagged plateau of the force–deformation pattern have been developed. Many authors (Barrett *et al.*, 1992; Barrett, Cardello *et al.*, 1994; Barrett, Rosenberg *et al.*, 1994; Harris & Peleg, 1996; Peleg, 1997; Rohde *et al.*, 1993) and references therein, suggest the determination of the power spectrum using Fast Fourier Transform (FFT) analysis. Indeed, relations between average power of the spectrum, and sensory attributes such as fracturability and crispness have been shown (Barrett, Cardello *et al.*, 1994; Barrett, Rosenberg *et al.*, 1994).

Finally, fractal techniques have become popular for analyzing multi-peak pattern from force–deformation curves (Nixon & Peleg, 1995; Norton *et al.*, 1998; Nuebel & Peleg, 1993; Peleg, 1997; Suwonsichon & Peleg, 1998; Vallés Pàmies *et al.*, 2000). The approach consists in considering the force–deformation plot in its whole complexity and jaggedness. However, this idea is debated: Vincent (1998) has indicated that the study of jaggedness is not appropriate because it does not account for forces and energies. The fractal analysis is based on the determination of the fractal dimension. Among the available algorithms, the Kolmogorov algorithm is one of the most used. It is based on a box-counting method. The signal is surrounded by a grid, and the number of boxes occupied by the signal is counted. Of course, decreasing the grid size increases the number of boxes occupied. The log (number of occupied boxes) is plotted

versus log (relative box size) and the apparent fractal dimension of the signal is the slope of the obtained line. Barrett *et al.* (1992) suggest a relation between fractal dimension and crispness when observing a sigmoidal effect of water for both of them. However, this suggestion does not appear relevant for Suwonsichon and Peleg [33] for they found that the critical water content for the sensory crispness and fractal dimension of puffed cereals did not coincide.

Mitchell and collaborators (Norton *et al.*, 1998; Vallés Pàmies *et al.*, 2000) applied the fractal analysis following a slightly different approach, based on the measurement of the curve dimension as a function of the sampling frequency. This plot has a sigmoidal shape, and the inflexion point provides information on the mean width of the force–deformation plot, whereas the slope at this point describes the distribution of the peaks: The smaller the slope, the greater the dispersion of the peaks. Comparisons with sensory data showed the crispier the products, the lower the average width of the peaks. As an example, for the crispier product of their study, the average peak width is around 200 μm , that is about five fractures per mm. Van Hecke *et al.* (1998) obtained a similar value for similar products, when counting the peaks of the force–deformation curves. Crispy products break through numerous and neighbouring fractures; when crispness decreases (after rehydration for example), the number of fractures decreases which increases the width of the peaks on the force–deformation plot.

Acoustic measurements

As described in Table 1, crispness has an auditory component. It is therefore not surprising that some methods, developed to study crispness, have focused on the sounds generated at fracture, the sound being recorded during instrumental crushing or during mastication. The instrumental approach (using a texture analyser, for instance) is favoured because all aspects of fracture are then controlled. However, the sounds recorded during mastication are more representative of the auditory stimuli related to crispness, especially when bone- and air-conducted vibrations are recorded and analysed together. As a matter of fact, bone conduction was reported as very important to identify crispness from other auditory-related texture attributes, such as crunchiness and crackle (Dacremont, 1995; Dacremont, Colas, & Sauvageot, 1991). A very interesting and comprehensive review on the acoustic research applied to the study of crispy, crunchy and crackly textures has recently been published by Duizer (2001).

Two main approaches have been used to study fracture sounds, analysing either the amplitude–time plot of the acoustic signal (Dacremont, 1992; Duizer *et al.*, 1998; Lee *et al.*, 1990; Nussinovitch, Corradini, Normand, & Peleg, 2000; Vickers, 1987) or the amplitude–

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frequency plot, the latter being derived from the former via a FFT (Fast Fourier Transform) (Dacremont, 1995; Duizer *et al.*, 1998; Lee, Deibel, Glemblin, & Munday, 1988; Roudaut *et al.*, 1998; Seymour & Hamann, 1988; Winquist *et al.*, 1999).

Combining these approaches, sonograms are a 3-D (amplitude–time–frequency) graphical representation of acoustic signals. As emphasized by Brochetti, Penfield, and Burchfield (1992), it is a very powerful tool for sound analysis. It is widely used in the field of speech analysis but, despite some early attempts (Drake, 1963; Vickers & Boume, 1976), it has been rarely used for eating-sounds analysis. The main reason is that a sonogram represents a huge amount of data, from which pertinent information are difficult to extract. Liu and Tan (2000) overcame this difficulty recently, using artificial neural networks and thus succeeded in predicting sensory scores for crispness of 10 food products from their sonograms. This might be one of the most promising approaches for analysing eating sounds.

Bio-rheology

Another promising field is the in-mouth measurement of texture which permits to follow the textural changes of products during the whole mastication process. This temporal aspect is especially important for dry crisp products due to their hydration by saliva.

Kohyama and Nishi (1997) used a multiple-point pressure sensor method to display the distribution of forces on the biting surface. Textural differences of products and their changes during biting were thus discriminated.

Electromyography has also been used to understand texture through structural breakdown during eating (Brown & Braxton, 2000; Brown *et al.*, 1998). The activity of the jaw muscles is recorded non invasively during mastication, reflecting the eating activity in usual consumption conditions. Brown and Braxton (2000) identified different groups of consumers exhibiting specific mastication patterns, clearly related to the perceived texture of crisp biscuits.

Parameters controlling crispness of dry crisp products

Process and structure

Process parameters and macrostructure are difficult to separate, since the latter often results from the former.

Most cereal-based crispy products are brittle material characterized by a cellular, lamellar or puffed structure (Barrett, Cardello *et al.*, 1994). More precisely, their structure has been defined (Taranto, 1983) as on the one hand, a discontinuous phase (gaseous) made of air bubbles formed upon fermentation and vaporization of water upon baking and on the other hand, a continuous solid phase supporting the sample weight. This structure is often described as a solid foam or sponge and com-

monly characterized by microscopy (Faubion & Hose-ney, 1982; Guraya & Toledo, 1996). The parameters controlling the mechanical properties of cellular material (Gibson & Ashby, 1988; Smith, 1989) such as density, cell wall thickness, cell size and cell number are expected to predict the product crispness (Desrumaux, Bouvier, & Burr, 1999; Guraya & Toledo, 1996; Hutchinson *et al.*, 1989). Barrett, Cardello *et al.* (1994) suggest a relationship describing crispness (through fractal dimension) with a combination of cell area (A) and bulk density (ρ) expressed as follow:

$$\text{Fractal Dimension} : 1.37 - 0.0112A + 1.93 \rho$$

The relations between process and crispness have been studied considering different processing conditions. But most of the studies are based on extrusion cooking works, investigating the role of water content, screw speed, torque, pressure and temperature. These parameters interact to a large extent and therefore, depending on the combination chosen, their action on texture may be variable. For example, the amount of water required in extrusion-cooking for an optimal crispness lays between the low values, inhibiting expansion, and higher ones leading to a dough viscosity too low for cells formation. Furthermore, decreasing water content during extrusion increases the Specific Mechanical Energy (SME), favouring starch conversion and overall macromolecular degradation, thus giving rise to a more fragile structure and a greater fracturability. Temperature is also among the most effective parameters for crispness control. Simultaneous high shear and high temperature give rise to lower crispness (Omwulata & Heymann, 1994).

The key role of the process was confirmed by the experiment of Guraya and Toledo (1996) comparing half products (pellets) prepared by drum-drying and cold extrusion. The half product preparation was proven to be more determining for the texture than the subsequent puffing methods.

The crispness development during the process has been investigated for frying, baking and toasting. Upon frying, crispness of chips increases as porosity increases and moisture decreases (Kawas & Moreira, 2001). When considered upon baking, crispness is shown to develop with the setting of the sponge structure at the latest stages of the baking (Piazza & Masi, 1997). Drake (1963) showed that crispness increased with toasting time.

Ingredients and hydration

Most low moisture baked or extruded products such as breakfast cereals, wafers, biscuits and snacks have a crispy texture. If the moisture content of these products increases, due to water sorption from the atmosphere or by mass transport from neighbouring components or

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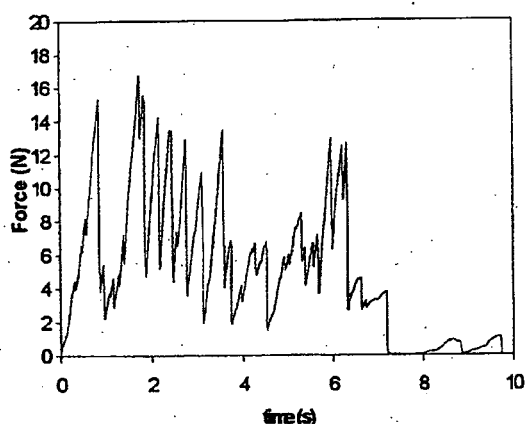


Fig. 1. Characteristic jagged force-deformation plot of a crispy product.

phases, a loss of crispness is observed (Nicholls *et al.*, 1995). A great number of studies has been published on this topic (Harris & Peleg, 1996; Peleg, 1993, 1994, 1998, 1999; Wolny & Peleg, 1994) with a view to characterizing and predicting the effects of water on crispness or to suggest the physical basis for such effects. The effect of hydration on crispness is illustrated in Fig. 2 (from Peleg, 1994); it can be described by a Fermi equation expressed as :

$$Y = Y_0 / \{1 + \exp[(a_w - a_{wc})/b]\}$$

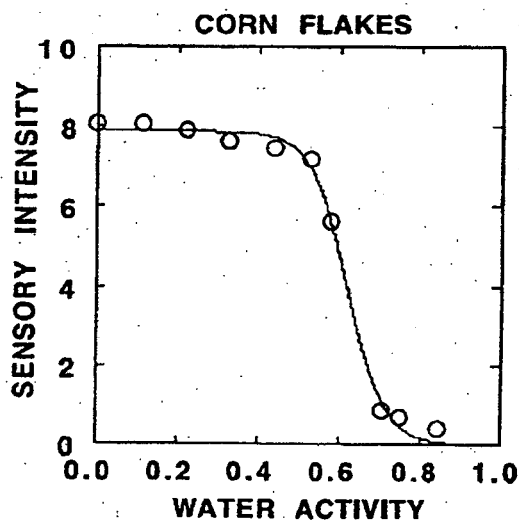


Fig. 2. Sensory crispness of corn flakes as a function of water activity. Open circles are experimental data published by Sauva-geot and Blond (1991), and solid line the Fermi fit (Peleg, 1994).

where Y is crispness, Y_0 crispness in the dry state, a_{wc} the critical water activity corresponding to $Y = Y_0/2$ and b a constant that expresses the transition range.

The pioneering work on the effect of water on crispness was presented by Brennan *et al.* in 1974, followed by Katz and Labuza (1981), in studies presenting sensory crispness and mechanical data of snacks equilibrated at different water activities.

The baking and extrusion-cooking processes of starch-based material lead to the major loss of the materials crystallinity (Le Meste *et al.*, 1996). Thus, crispness has been associated with the amorphous state, and the change from crispy (brittle, noisy) to deformable (ductile, silent) following rehydration was attributed to the occurrence of the glass transition of the product at room temperature (Ablett, Attenburrow, & Lillford, 1986; Slade & Levine, 1993). The critical effect of moisture was associated to a plasticization mechanism consisting in a free volume increase through the addition of low molecular weight molecules (water), resulting in a greater mobility and increased flexibility of the macromolecules in the dynamically constrained glass (Ferry, 1980; Sears & Darby, 1982). The plasticization causes a decrease of the glass transition temperature (T_g) below ambient temperature, and thus a decrease of the rigidity of the hydrated product (Ablett *et al.*, 1996; Hutchinson *et al.*, 1989).

However, several authors report that crispness of cereal-based products could be affected by hydration (Attenburrow *et al.*, 1992; Fontanet *et al.*, 1997; Hutchinson *et al.*, 1989; Kaletung & Breslauer, 1993; Le Meste *et al.*, 1996; Li *et al.*, 1998; Nicholls *et al.*, 1995; Roudaut *et al.*, 1998) at temperatures well below their T_g or the T_g measured for hydrated wheat starch (Zeleznek & Hosney, 1987). Studying crackers, Nikolaidis and Labuza (1996) attributed hydration-induced texture changes to the glass transition of gluten. It could be argued that the studied products contain not only gluten but also other ingredients (starch, sugars) which might affect T_g of the complex product. Moreover, due to the complexity of the products, the existence of a unique glass transition and the role of the transition in the texture change are questioned. Several authors (Kalichevsky *et al.*, 1993; Slade & Levine, 1993) have stressed out that due to their complexity and heterogeneity, products may contain multiple phases with different T_g 's. The textural changes could thus be caused by the glass transition of a minor phase, which may not be visible on DSC thermograms. However, such a point may not be valid, for single component sample. For Peleg (1999), the contribution of the glass transition to the texture changes might not be relevant, since all properties may not change in unison as predicted by the glass transition theory. Indeed, different crispness-associated properties can be observed to vary within a wide range of water contents and thus may not result from a

single event (Peleg, 1993; Tesch, Norman, & Peleg, 1996).

While the contribution of the glass transition to texture changes is questioned, the importance of sub- T_g motions is given attention. Indeed, localized movements preceding the α relaxation (onset of large amplitude cooperative movements) could participate in texture changes of glassy polymers (Fontanet *et al.*, 1997; Le Meste *et al.*, 1996; Roudaut, Maglione, & Le Meste, 1999; Wu, 1992). Below 15% water content, starchy products are glassy at ambient temperature; however, between 0 and 10% of water, they exhibit a decrease of crispness concomitant to an increase of hardness (observed by instrumental and sensory measurements) upon rehydration (Harris & Peleg, 1996; Roudaut *et al.*, 1998; Suwonsichon & Peleg, 1998; Vallés Pàmies *et al.*, 2000; Waichungo *et al.*, 2000). An antiplasticizing mechanism was suggested to interpret such a phenomenon, the increasing hydration being possibly responsible for both a molecular densification of the product (decreasing free volume) (Benczedi, 1999; Seow, Cheah, & Chang, 1999; Vrentas, Duda & Ling, 1988), and additional interactions between water and the biopolymer matrix. This stiffening has also been attributed to a molecular rearrangement facilitated by an initial increased mobility due to the water uptake (Fontanet *et al.*, 1997). Above 9–10% of water, the plasticization phenomenon would become dominant, and the hardness would decrease (Roudaut *et al.*, 1998) (Figure 3).

Since ingredients affect the structural organisation of products, they are likely to control their mechanical properties (Barrett *et al.*, 1994; Desrumaux *et al.*, 1999; Faubion & Hosney, 1982; Mohamed, Abd Hamid, & Abdul Hamid, 1998; Moore, Sanei, Van Hecke, & Bouvier, 1990; Onwulata, Smith, Konstance, & Hol-

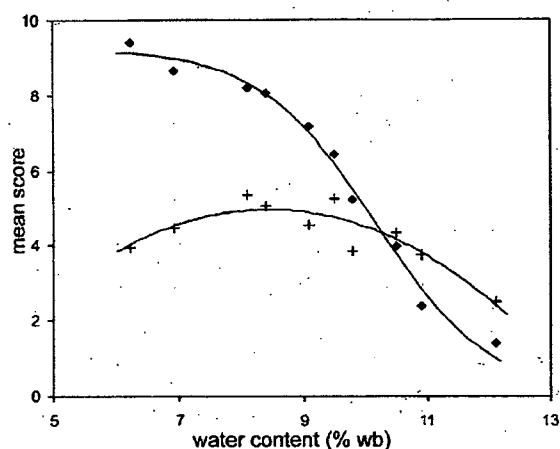


Fig. 3. Influence of water content on crispness (♦) and hardness (+) for extruded flat bread.

singer, 2001; Van Hecke *et al.*, 1998) and most expectedly their crispness. Literature does not offer a large number of studies on the influence of formulation on crispness. It is likely that industrial trials are actually run on the matter, however, faced with a competition issue, their results remain confidential. In most studies, the role of ingredients on crispness is extrapolated from their role on mechanical or structure properties, and rarely on their effects on the perceived crispness. However, a few studies report sensory data (Desrumaux *et al.*, 1999; Ferriola & Stone, 1998; Mohamed *et al.*, 1998; Roudaut, Dacremont, Vallés Pàmies, Mitchell, & Le Meste, 2001; Thakur & Saxena, 2000; Van Hecke *et al.*, 1995, 1998). Based on the assumption that texture of snack foods is controlled by ingredients providing enough viscosity and retaining texture and shape, Thakur and Saxena (2000) have studied the influence of different types of flour (corn, gram) and gums (xanthan, guar, arabic gum, carboxymethylcellulose). However, because the measured sensory attributes are not clearly defined, and because large interactions between the effects of the ingredients exist, it is quite difficult to draw a clear conclusion on the individual role of the tested ingredients. Mohammed *et al.* (1998) have investigated the effects of pregelatinized rice flour, tapioca starch, proteins (egg yolk, gluten, skimmed milk, whey and ovalbumin), emulsifiers and calcium chloride on the crispness of frying batters. Adding pregelatinized rice flour, increasing amylose content and adding calcium chloride up to an optimum level improved crispness. These results remain ambiguous for the crispness evaluation is unclear (hardness and crispness attributes are used undistinctively). The interactions between proteins, polysaccharides and water have been suggested to play a role in the crispness of some products (Mohamed *et al.*, 1998; Van Hecke *et al.*, 1995). Proteins and fibers have generally a deleterious effect on crispness (Moore *et al.*, 1990; Sotillo & Hettiarachy, 1994). Fatty acids and emulsifiers may control crispness through the formation of complexes with starch (Desrumaux *et al.*, 1999; Mohamed *et al.*, 1998; Van Hecke *et al.*, 1998); when used at low concentrations (0.5%), they provide maize grits with optimal crispness (Desrumaux *et al.*, 1999).

The effect of sucrose on crispness has been investigated in various ways. Nussinovitch *et al.* (2000) observed that, for freeze-dried agar prepared with or without infused sucrose, sucrose increased brittleness (and thus expectedly crispness), although the interpretation was ambiguous for sucrose affected the density of the material. Sucrose exhibits a crispness protecting action against hydration, shifting for sucrose-rich extruded starch the critical hydration towards values higher than for pure extruded starch (Roudaut *et al.*, 2001; Vallés Pàmies *et al.*, 2000).

Finally, the influence of secondary sweeteners (coating) on the 'bowl life' of crispness was considered by

Ferriola and Stone (1998), with a significant 'wet' crispness stabilization by honey.

Conclusions

Crispness is a complex attribute resulting on the one hand from multiple sensations and on the other hand from multiple physical parameters, combining molecular, structural and manufacturing processes, as well as storage conditions.

In general, research works should better merge sensory and instrumental approaches. Indeed instrumental related information such as sonograms or electromyographies data would enable a better understanding of the mental representation of texture through modelling cognitive activities from stimuli characteristics. In turns, sensory aspects should be considered in physical studies and take into account aspects such as, for example, the mastication dynamics induced by changes in both temperature and moisture content due to saliva.

Moreover, further studies should consider the role of ingredients to control and preserve crispness, as well as standardization of the sensory tests to ensure consistency in the outcomes of the studies, especially in an international research context.

References

- Ablett, S., Attenburrow, G. E., & Lillford, P. J. (1986). The significance of water in the baking process. In J. M. V. Blanshard, P. J. Frazier, & T. Galliers (Eds.), *Chemistry and physics of baking: material, process and products* (pp. 30–41). London: Royal Society of Chemistry.
- Andersson, Y., Drake, B., Granquist, A., Halldin, L., Johansson, B., Pangborn, R. M., & Akesson, C. (1973). Fracture force, hardness and brittleness in crisp bread, with a generalized regression analysis approach to instrumental-sensory comparisons. *Journal of Texture Studies*, 4, 119–144.
- Attenburrow, G. E., Davies, A. P., Goodband, R. M., & Ingman, S. J. (1992). The fracture behaviour of starch and gluten in the glassy state. *Journal of Cereal Science*, 16, 1–12.
- Barrett, A. H., Cardello, A. V., Leshner, L. L., & Taub, I. A. (1994). Cellularity, mechanical failure, and textural perception of corn meal extrudates. *Journal of Texture Studies*, 25, 77–95.
- Barrett, A. H., Rosenberg, S., & Ross, E. W. (1994). Fracture intensity distributions during compression of puffed corn meal extrudates: method for quantifying fracturability. *Journal of Food Science*, 59, 617–620.
- Barrett, A. M., Normand, M. D., Peleg, M., & Ross, Y. (1992). Characterization of the jagged stress-strain relationships of puffed extrudates using the fast Fourier transform and fractal analysis. *Journal of Food Science*, 57, 227–235.
- Benczedi, D. (1999). Estimation of the free volume of starch-water barriers. *Trends in Food Science & Technology*, 10, 21–24.
- Bhattacharya, M., & Hanna, M. A. (1987). Textural properties of extrusion-cooked corn starch. *Lebensmittel-Wissenschaft und -Technologie, Food Science and Technology*, 20, 195–201.
- Brennan, J. G., Jowitt, R., & Williams, A. (1974). Sensory and instrumental measurement of 'brittleness' and 'crispness' in biscuits. *In Proc. 4th International congress in food science & technology* (Vol. II, pp. 130–143), Madrid, Spain, 22–27 September.
- Brochetti, D., Penfield, M. P., & Burchfield, S. B. (1992). Speech analysis techniques: a potential model for the study of mastication sounds. *Journal of Texture Studies*, 23, 111–138.
- Brown, W. E., & Braxton, D. (2000). Dynamics of food breakdown during eating in relation to perceptions of texture and preference: a study on biscuits. *Food Quality and Preference*, 11, 259–267.
- Brown, W. E., Langley, K. R., & Braxton, D. (1998). Insight into consumers' assessments of biscuit texture based on mastication analysis—hardness versus crunchiness. *Journal of Texture Studies*, 29, 481–497.
- Christensen, C. M., & Vickers, Z. M. (1981). Relationships of chewing sounds to judgments of food crispness. *Journal of Food Science*, 46, 574–578.
- Dacremont, C. (1992). *Contribution à la caractérisation de trois descripteurs de texture : croustillant, craquant et croquant par des approches acoustiques et sensorielles* PhD thesis, ENSBANA, Université de Bourgogne, Dijon, France.
- Dacremont, C. (1995). Spectral composition of eating sounds generated by crispy, crunchy and crackly foods. *Journal of Texture Studies*, 26, 27–43.
- Dacremont, C. (1996). Croustillant, craquant, croquant : trois sensations différentes? In *Le goût, 3ème colloque transfrontalier* (pp. 365–373), Dijon, 12–13 September 1996.
- Dacremont, C., Colas, B., & Sauvageot, F. (1991). Contribution of air- and bone-conduction to the creation of sounds perceived during sensory evaluation of foods. *Journal of Texture Studies*, 22, 443–456.
- Desrumaux, A., Bouvier, J. M., & Burri, J. (1999). Effect of free fatty acids addition on corn grits extrusion cooking. *Cereal Chemistry*, 76, 699–704.
- Drake, B. K. (1963). Food crushing sounds. An introductory study. *Journal of Food Science*, 28, 233–241.
- Drake, B. K. (1989). Sensory textural/rheological properties—a polyglot list. *Journal of Texture Studies*, 20, 1–27.
- Dugle, J. (1997). Note on "Expert versus consumers: a comparison". *Journal of Sensory Studies*, 12, 147–153.
- Duizer, L. (2001). A review of acoustic research for studying the sensory perception of crisp, crunchy and crackly textures. *Trends in Food Science & Technology*, 12, 17–24.
- Duizer, L. M., Campanella, O. H., & Barnes, G. R. G. (1998). Sensory, instrumental and acoustic characteristics of extruded snack food products. *Journal of Texture Studies*, 29, 397–411.
- Edmister, J. A., & Vickers, Z. M. (1985). Instrumental acoustical measures of crispness in foods. *Journal of Texture Studies*, 16, 153–167.
- Faubion, J. M., & Hosenev, R. C. (1982). High-temperature short-time extrusion-cooking of wheat starch and flour. II. Effect of protein and lipid on extrudate properties. *Cereal Chemistry*, 59, 533–537.
- Ferriola, D., & Stone, M. (1998). Sweetener effects on flaked millet breakfast cereals. *Journal of Food Science*, 63, 726–729.
- Ferry, J. D. (1980). *Viscoelastic properties of polymers*. New York: John Wiley & Sons.
- Fontanet, I., Davidou, S., Dacremont, C., & Le Meste, M. (1997). Effect of water on the mechanical behaviour of extruded flat bread. *Journal of Cereal Science*, 25, 303–311.
- Georget, D. M. R., & Smith, A. C. (1996). The effects of sugars on the mechanical properties of processed cereals. *Journal of Thermal Analysis*, 47, 1377–1389.

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- Georget, D. M. R., Parker, R., & Smith, A. C. (1995). Assessment of a pin deformation test for measurement of mechanical properties of breakfast cereal flakes. *Journal of Texture Studies*, 26, 161–174.
- Gibson, L. J., & Ashby, M. F. (1988). *Cellular solids: structure and properties*. Oxford: Pergamon Press.
- Guraya, H. S., & Toledo, R. T. (1996). Microstructural characteristics and compression resistance as indices of sensory texture in a crunchy snack product. *Journal of Texture Studies*, 27, 687–701.
- Harris, M., & Peleg, M. (1996). Patterns of textural changes in brittle cellular foods caused by moisture sorption. *Journal of Texture Studies*, 27, 225–231.
- Hayter, A. L., & Smith, A. C. (1988). The mechanical properties of extruded food foams. *Journal of Materials Science*, 23, 736–743.
- Hayter, A. L., Smith, A. C., & Richmond, P. (1986). The physical properties of extruded foods foams. *Journal of Materials Science*, 21, 3729–3736.
- Hough, G. (1998). Expert versus consumers: a critique. *Journal of Sensory Studies*, 13, 285–289.
- Hutchinson, R. J., Mantle, S. A., & Smith, A. C. (1989). The effect of moisture content in the mechanical properties of extruded food foams. *Journal of Materials Science*, 24, 3249–3253.
- Hutchinson, R. J., Sdiolak, G. D. E., & Smith, A. C. (1987). Influence of processing variables on the mechanical properties of extruded maize. *Journal of Materials Science*, 22, 3956–3962.
- Iles, B. C., & Elson, C. R. (1972). [cited by Vickers, Z. M. (1988)]. Crispness of cereal. In Pomeranz, Y. (Ed.), *Advances in cereal science and technology*. (pp. 1–19)
- Jeon, I. J., Breene, W. M., & Munson, S. T. (1975). Texture of fresh-pack whole cucumber pickles: correlation of instrumental and sensory measurements. *Journal of Texture Studies*, 5, 399–409.
- Jowitt, R., & Mohamed, A. A. A. (1980). An improved instrument for studying crispness in foods. In P. Linko, Y. Malkki, J. Olkku, & J. Larinkari (Eds.), *Food process engineering* (pp. 292–300). London, UK: Applied Science.
- Kaletung, G., & Breslauer, K. J. (1993). Glass transition of extrudates: relationship with processing-induced fragmentation and end-product attributes. *Cereal Chemistry*, 70, 548–552.
- Kalichevsky, M. T., Blanshard, J. M. V., & Mash, R. D. L. (1993). Applications of mechanical spectroscopy to the study of glassy biopolymers and related systems. In J. M. V. Blanshard, & P. J. Lillford (Eds.), *The glassy state in foods* (pp. 133–156). Nottingham, UK: Nottingham University Press.
- Katz, E. E., & Labuza, T. P. (1981). Effect of water activity on the sensory crispness and mechanical deformation of snack food products. *Journal of Food Science*, 46, 403–409.
- Kawas, M.-L., & Moreira, R. G. (2001). Characterization of product quality attributes of tortilla chips during the frying process. *Journal of Food Engineering*, 47, 97–107.
- Kohyama, K., & Nishi, M. (1997). Direct measurement of biting pressures for cracker using a multiple point sheet sensor. *Journal of Texture Studies*, 28, 605–617.
- Le Meste, M., Roudaut, G., & Davidou, S. (1996). Thermo-mechanical properties of glassy cereal foods. *Journal of Thermal Analysis*, 47, 1361–1376.
- Lee, W. E. III, Deibel, A. E., Glembin, C. T., & Munday, E. G. (1988). Analysis of food crushing sounds during mastication: frequency-time study. *Journal of Texture Studies*, 21, 165–178.
- Lee, W. E. III, Schweitzer, M. A., Morgan, G. M., & Shepherd, D. C. (1990). Analysis of food crushing sounds during mastication: total sound level studies. *Journal of Texture Studies*, 21, 165–178.
- Li, Y., Kloeppel, K. M., & Hsieh, F. (1998). Texture of glassy corn cakes as function of moisture content. *Journal of Food Science*, 63, 869–872.
- Liu, X., & Tan, J. (2000). Acoustic wave analysis for food crispness evaluation. *Journal of Texture Studies*, 30, 397–408.
- Mohamed, A. A. A., Jowitt, R., & Brennan, J. G. (1982). Instrumental and sensory evaluation of crispness: I. In friable foods. *Journal of Food Engineering*, 1, 55–75.
- Mohamed, S., Abd Hamid, N., & Abdul Hamid, M. (1998). Food components affecting the oil absorption and crispness of fried batter. *Journal of the Science of Food and Agriculture*, 78, 39–45.
- Moore, D., Saneil, A., van Hecke, E., & Bouvier, J. M. (1990). Effect of ingredients on physical/structural properties of extrudates. *Journal of Food Science*, 55, 1383–1387 1402.
- Moskowitz, H. R. (1996). Expert versus consumers: a comparison. *Journal of Sensory Studies*, 11, 19–37.
- Moskowitz, H. R. (1997). A reply "Note on expert versus consumers: a comparison". *Journal of Sensory Studies*, 12, 155–168.
- Moskowitz, H. R. (1998). Consumers versus expert in the light of psychophysics. *Journal of Sensory Studies*, 13, 291–298.
- Moskowitz, H. R., Segars, R. A., Kapsalis, J. G., & Kluter, R. A. (1974). Sensory ratio scales relating hardness and crunchiness to mechanical properties of space cubes. *Journal of Food Science*, 39, 200–202.
- Nicholls, R. J., Appelqvist, I. A. M., Davies, A. P., Ingman, S. J., & Lillford, P. J. (1995). Glass transitions and fracture behaviour of gluten and starches within the glassy state. *Journal of Cereal Science*, 21, 25–36.
- Nikolaidis, A., & Labuza, T. P. (1996). Glass transition state diagram of a baked cracker and its relationships to gluten. *Journal of Food Science*, 61, 803–806.
- Nixon, R., & Peleg, M. (1995). Effect of sample volume on the compressive force-deformation curves of corn flakes tested in bulk. *Journal of Texture Studies*, 26, 59–69.
- Norton, C. R. T., Mitchell, J. R., & Blanshard, J. M. V. (1998). Fractal determination of crisp or crackly textures. *Journal of Texture Studies*, 29, 239–253.
- Nuebel, C., & Peleg, M. (1993). Compressive stress-strain relationships of two puffed cereals in bulk. *Journal of Food Science*, 58, 1356–1360 1374.
- Nussinovitch, A., Corradini, M. G., Normand, M. D., & Peleg, M. (2000). Effect of sucrose on the mechanical and acoustic properties of freeze dried agar, κ carrageenan and gellan gels. *Journal of Texture Studies*, 31, 205–223.
- Onwulata, C., & Heymann, H. (1994). Sensory properties of extruded corn meal related to the spatial distribution of process conditions. *Journal of Sensory Studies*, 9, 101–112.
- Onwulata, C. I., Smith, P. W., Konstance, R. P., & Holsinger, V. H. (2001). Incorporation of whey products in extruded corn, potato or rice snacks. *Food Research International*, 34, 679–687.
- Peleg, M. (1993). Mapping the stiffness-temperature-moisture relationship of solid biomaterials at and around their glass transition. *Rheologica Acta*, 32, 575–580.
- Peleg, M. (1994). A mathematical model of crunchiness / crispness loss in breakfast cereals. *Journal of Texture Studies*, 25, 403–410.
- Peleg, M. (1997). Measures of line jaggedness and their use in foods textural evaluation. *Critical Reviews in Food Science and Nutrition*, 37, 491–518.
- Peleg, M. (1998). Instrumental and sensory detection of simultaneous brittleness loss and moisture toughening in three puffed. *Journal of Texture Studies*, 29, 255–274.

- Peleg, M. (1999). Phase transitions and the mechanical properties of food biopolymers. In P. Colonna, & S. Guilbert (Eds.), *Biopolymer science: food and non food applications* (pp. 271–282). Paris: INRA Editions.
- Piazza, L., & Masi, P. (1997). Development of crispness in cookies during baking in an industrial oven. *Cereal Chemistry*, 74, 135–140.
- Rohde, F., Normand, M. D., & Peleg, M. (1993). Characterization of the power spectrum of force-deformation relationships of crumbly. *Journal of Texture Studies*, 24, 45–62.
- Rohm, H. (1990). Consumer awareness of food texture in Austria. *Journal of Texture Studies*, 21, 363–373.
- Roudaut, G., Dacremont, C., & Le Meste, M. (1998). Influence of water on the crispness of cereal based foods acoustic, mechanical, and sensory studies. *Journal of Texture Studies*, 29, 199–213.
- Roudaut, G., Dacremont, C., Vallés Pàmies, B., Mitchell, J., & Le Meste, M. (in press). Rehydration of crispy cereal products: a tentative explanation of texture changes. In *ACS Symposium Series*.
- Roudaut, G., Maglione, M., & Le Meste, M. (1999). Sub-Tg relaxations in cereal-based systems. *Cereal Chemistry*, 76, 78–81.
- Sauvageot, F., & Blond, G. (1991). Effect of water activity on crispness and mechanical deformation of snack food products. *Journal of Texture Studies*, 22, 423–442.
- Sears, J. K., & Darby, J. R. (1982). Mechanism of plasticizer action. In *The technology of plasticizer* (pp. 35–77). New York: Wiley Inter-science Publisher.
- Segnini, S., Dejmek, P., & Oste, R. (1999). Relationships between instrumental and sensory analysis of texture and color of potato chips. *Journal of Texture Studies*, 30, 677–690.
- Seow, C. C., Cheah, P. B., & Chang, Y. P. (1999). Antiplasticization by water in reduced-moisture food systems. *Journal of Food Science*, 64, 576–581.
- Seymour, S. K., & Hamann, D. D. (1988). Crispness and crunchiness of selected low moisture foods. *Journal of Texture Studies*, 19, 79–95.
- Sherman, P., & Deghaidy, F. S. (1978). Force-deformation conditions associated with the evaluation of brittleness and crispness in selected food. *Journal of Texture Studies*, 9, 437–459.
- Slade, L., & Levine, H. (1993). The glassy state phenomenon in food molecules. In J. M. V. Blanshard, & P. J. Lillford (Eds.), *The glassy state in foods* (pp. 35–102). Nottingham, UK: Nottingham University Press.
- Smith, A. C. (1989). Solid foams. *Food Colloids*, 75, 56–73.
- Sotillo, E., & Hettiarachy, N. S. (1994). Corn meal-sunflower meal extrudates and their physicochemical properties. *Journal of Food Science*, 59, 432–435.
- Suwonsichon, T., & Peleg, M. (1998). Instrumental and sensory detection of simultaneous brittleness loss and moisture toughening in three puffed cereals. *Journal of Texture Studies*, 29, 255–274.
- Szczesniak, A. S. (1971). Consumer awareness of texture and of other food attributes. *Journal of Texture Studies*, 2, 196–206.
- Szczesniak, A. S. (1988). The meaning of textural characteristics—crispness list. *Journal of Texture Studies*, 19, 51–59.
- Szczesniak, A. S., & Kleyn, D. H. (1963). Consumer awareness of texture and other food attributes. *Food Technology*, 63, 74–77.
- Taranto, M. V. (1983). Structural and textural characteristics of baked goods. In M. Peleg, & E. B. Bagley (Eds.), *Physical properties of foods* (pp. 229–265). Westport, CT: The AVI Publishing Company.
- Tesch, R., Normand, M. D., & Peleg, M. (1996). Comparison of the acoustic and mechanical signatures of two cellular crunchy cereal foods at various water activities levels. *Journal of the Science of Food and Agriculture*, 70, 347–354.
- Thakur, S., & Saxena, D. C. (2000). Formulation of extruded snack food (gum based cereal-pulse blend): optimisation of ingredients levels using response surface analysis. *Lebensmittel-Wissenschaft und -Technologie, Food Science and Technology*, 33, 354–361.
- Vallés Pàmies, B., Roudaut, G., Dacremont, C., Le Meste, M., & Mitchell, R. (2000). Understanding the texture of low moisture cereal products: part I mechanical and sensory measurements of crispness. *Journal of the Science of Food and Agriculture*, 80, 1679–1685.
- Van Hecke, E., Allaf, K., & Bouvier, J.-M. (1995). Texture and structure of crispy-puffed food products I: mechanical properties. *Journal of Texture Studies*, 26, 11–25.
- Van Hecke, E., Allaf, K., & Bouvier, J.-M. (1998). Texture and structure of crispy-puffed food products II: mechanical properties in puncture. *Journal of Texture Studies*, 29, 617–632.
- Vickers, Z. M. (1981). Relationships of chewing sounds to judgments of crispness, crunchiness and hardness. *Journal of Food Science*, 47, 121–124.
- Vickers, Z. M. (1984). Crispness and crunchiness. A difference in pitch? *Journal of Texture Studies*, 15, 157–163.
- Vickers, Z. M. (1985). The relationships of pitch, loudness and eating technique to judgements of the crispness and crunchiness of food sounds. *Journal of Texture Studies*, 16, 85–95.
- Vickers, Z. M. (1987). Sensory, acoustical, and force-deformation measurements of potato chip crispness. *Journal of Food Science*, 52, 138–140.
- Vickers, Z. M. (1988). Instrumental measures of crispness and their correlation with sensory assessment. *Journal of Texture Studies*, 19, 1–14.
- Vickers, Z. M., & Bourne, M. C. (1976). A psychoacoustical theory of crispness. *Journal of Food Science*, 41, 1158–1164.
- Vickers, Z. M., & Christensen, C. M. (1980). Relationships between sensory crispness and other sensory and instrumental parameters' studies. *Journal of Texture Studies*, 11, 291–307.
- Vickers, Z. M., & Wasserman, S. S. (1979). Sensory qualities of food sounds based on individual perceptions. *Journal of Texture Studies*, 10, 319–332.
- Vincent, J. F. V. (1998). The quantification of crispness. *Journal of the Science of Food and Agriculture*, 78, 162–168.
- Vrentas, J. S., Duda, J. L., & Ling, H. C. (1988). Antiplasticization and volumetric behavior in glassy polymers. *Macromolecules*, 21, 1470–1475.
- Waichungo, W. W., Heymann, H., & Heldman, D. R. (2000). Using descriptive analysis to characterize the effects of moisture sorption on the texture of low moisture foods. *Journal of Texture Studies*, 15, 35–46.
- Winquist, F., Wide, P., Eklov, T., Hjort, C., & Lundstrom, L. (1999). Crisp bread quality evaluation based on fusion of information from the sensor analogies to the human olfactory, auditory, and tactile senses. *Journal of Food Process Engineering*, 22, 337–358.
- Wollny, M., & Peleg, M. (1994). A model of moisture-induced plasticization of crunchy snacks based on Fermi's distribution function. *Journal of the Science of Food and Agriculture*, 64, 467–473.
- Wu, S. (1992). Secondary relaxation, brittle-ductile transition temperature and chain structure. *Journal of Applied Polymer Science*, 46, 619–624.
- Zannoni, M. (1997). Approaches to translation problems of sensory descriptors. *Journal of Sensory Studies*, 12, 239–253.
- Zelezniak, K. J., & Hoseney, R. C. (1987). The glass transition in starch. *Cereal Chemistry*, 64, 121–124.

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XP-002530799

**RELATIONSHIPS BETWEEN SENSORY CRISPNESS AND
OTHER SENSORY AND INSTRUMENTAL PARAMETERS¹**

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(Manuscript received July 17, 1980; in final form September 15, 1980)

ABSTRACT

Twenty subjects judged the crispness, loudness, and firmness of sixteen food samples by both biting and chewing and by only biting the foods. These subjects also scored the foods for thirteen textural qualities. Instrumental measures of slope, peak force, and deformation to fracture were obtained for the sixteen foods from a snap test at four deformation rates. Whether a subject judged an attribute by the bite or the bite and chew technique made little or no difference in the sensory judgments. Crispness appeared to be very closely related to loudness and less closely related to firmness. Loudness of the chewing sounds was more closely related to crispness than to firmness. Of the sensory qualities studied, loud, snap, and crackly were the three most closely related to crispness. Of the instrumental parameters Young's Modulus generally had the highest correlation with the crispness of all foods and peak force generally had the highest correlation with firmness. Deformation rate had minimal effects on measures of flexure or peak force, but its effects on Young's Modulus were frequently large and irregular. A vibrotactile-acoustical hypothesis for crispness is proposed.

¹ Paper No. 11321, Scientific Journal Series Minnesota Agricultural Experiment Station, St. Paul, Minnesota

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INTRODUCTION

Since Vickers and Bourne (1976b) suggested that crispness in foods might be an acoustical sensation, research on crispness has broadened to encompass the sounds produced when a food is bitten or crushed (Vickers 1979; Jowitt and Mohamad 1979; Sherman and Deghaidy 1978; Vickers and Wasserman 1980). Vickers and Bourne (1976b) suggested that the loudness of the sounds produced when biting a crisp food was very important for quantifying the sensation of crispness. A study of food sounds by Vickers and Wasserman (1980) also provided evidence for a close relationship between loudness and crispness.

Crushing sounds, however, are not the only sensations involved in the perception of crispness. Christensen and Vickers (1981) have shown that judgments of crispness do not change when auditory sensations are blocked, indicating that chewing sounds are not essential for judgments of food crispness. Oral tactile sensations apparently provide much of the information needed for sensory judgments of crispness. Brennan *et al.* (1970) found that sensory firmness and crispness in apples are highly correlated but easily distinguished. Jeon *et al.* (1975) defined sensory crispness of a cucumber pickle as the force required to bite through it, indicating that they considered crispness as equivalent to firmness or hardness.

One objective of this research was to study the relationships between sensory measures of crispness, loudness, and firmness for a wide range of crisp foods to test the earlier speculations that the sensations of crispness are closely related to acoustical sensations of loudness and/or tactile sensations of firmness.

We also examined the relationship between two techniques for judging the three sensory attributes: a "bite only" technique and a "bite and chew" technique. Vickers and Bourne (1976a) reported that subjects stated they could best judge crispness while biting the foods. This contrasts with Sherman and Deghaidy's (1978) observation that subjects in their study used information from both biting and chewing the foods to judge crispness.

A second objective of this study was to compare the sensory measures of crispness, loudness, and firmness with instrumental measures of stiffness, flexure, and breaking force determined from a triple beam snap test at four deformation rates. Vickers and Bourne (1976a) reviewed the literature on crispness in foods and identified two instrumental textural measures derived from a snap test, bend deformation to fracture and stiffness (the slope of a force-deformation curve or Young's Modulus), that have been shown to have large correlations with sensory crispness over a variety of different foods. Extensive studies by Iles and Elson (1972), Brennan *et al.* (1974), and Vickers (1975) contributed substantially to this con-

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clusion. Many other instrumental tests have shown an agreement with sensory crispness for a single product; however, most of these other measurements do not predict the crispness of more than a single food.

Sherman and Deghaidy (1978) have further pursued the study of crispness in food and provided additional evidence for the relationship between crispness and stiffness measured from a snap test. Their work also indicates that the rate of deformation may be an important factor for the instrumental testing.

A third objective of this study was to examine a broad set of textural descriptors to determine their relation to the sensory quality of crispness and to the instrumental parameters studied. These other descriptors might provide additional clues to the oral tactile nature of the crispness sensation.

MATERIALS AND METHODS

Samples

Nine different food samples, purchased in local supermarkets, were used in this study. From these foods sixteen different samples, some with altered crispness, were prepared for testing (Table 1). The foods were cut into rectangular shapes. (Celery was an exception. Each rib was cut in half longitudinally. Measures of height and width thus correspond to the nonrectangular half-rib sections.) These foods were chosen because they represent a broad range of crispness and have dissimilar textures.

To alter the level of crispness the water activities of the dry crisp foods were adjusted to approximately those shown in Table 1 by placing them in desiccators containing one of the following saturated salt solutions: LiCl ($a_w = .11$), MgCl ($a_w = .32$), K_2CO_3 ($a_w = .44$), and NaCl ($a_w = .75$). The samples remained in the desiccators for at least one week. They were then wrapped individually in Saran and stored in airtight containers until tested. The crispness of the wet crisp foods was adjusted by blanching them in boiling water for the length of time indicated in Table 1. Wet crisp foods were refrigerated in water until the day of testing.

Subjects

Twenty U. of Pennsylvania students, 12 males and 8 females, served as subjects. They were solicited by an advertisement in the campus newspaper. Subjects were chosen in order of inquiry and were paid for their participation.

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Table 1

Product	Dimensions ^a in mm	
	Height	Width
Celery, fresh	9.7	16.7
Celery, blanched 45 s	8.3	15.0
Celery, blanched 3 min	7.9	14.8
Turnips, fresh	11.7	12.1
Turnips, blanched 30 s	10.6	11.1
White radish, fresh	5.9	12.5
White radish, blanched 60 s	5.2	10.6
Gingersnap (Nabisco), $a_w = .11$	6.6	21.0
Gingersnap (Nabisco), $a_w = .32$	6.6	21.0
Triscuit (Nabisco), $a_w = .32$	5.0	19.4
Triscuit (Nabisco), $a_w = .44$	5.0	19.4
Triscuit (Nabisco), $a_w = .75$	5.0	19.4
Waverly Wafer (Nabisco), $a_w = .11$	4.8	36.0
Ry Krisp (Ralston Purina), $a_w = .32$	5.7	30.7
Lorna Doone (Nabisco), $a_w = .75$	9.5	20.6
Saltine (Nabisco), $a_w = .44$	4.0	25.0

^aDimensions are averages of all samples used for instrumental testing

Sensory Testing

Each subject was tested separately by an experimenter who was present throughout the test. The experimenter gave directions, distributed the samples and answered procedural questions. Each subject participated in two 45 min sessions. Subjects used magnitude estimation (modulus-free) to judge the loudness, crispness, and firmness of the food samples. Before testing began, the subjects practiced using magnitude estimation by assigning numbers to different sizes of circles.

In both test sessions the subjects judged three separate and sequential sets of the 16 food samples, one set for crispness, one set for firmness, and one for loudness. Half of the subjects were instructed to make their judgments by only biting the foods during the first session and by biting and chewing the foods during the second session. The other half used the bite and chew method in the first session and the bite only method in the second session. (The bite only technique involved biting the food with the incisors and immediately expectorating. The bite and chew technique involved biting the food with the incisors and chewing at least twice with the molars.)

After judging each sample set, subjects assigned numbers to verbal concepts using the same numerical scales they had used to evaluate the foods. This scoring was intended to anchor the magnitude estimation results to the following five terms arranged in order of intensity: least crisp (loud, firm) food imaginable, slightly, moderately, and extremely crisp (loud,

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firm) and most crisp (loud, firm) food imaginable. The order in which the attributes were judged and the order of the food samples within a set were randomized.

After completing the magnitude estimation judgments in the second session, subjects were presented with another set of the 16 foods and asked to score each of the samples for the following attributes (which were not defined for the subjects): brittleness, toughness, snappiness, firmness, gumminess, flakiness, loudness, stiffness, crispness, smoothness, crackliness, elasticity, and hardness. Subjects scored each food for each attribute by category scaling. (See Fig. 1.)

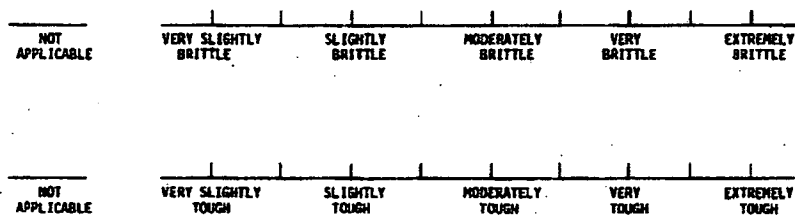


FIG. 1. RESPONSE FORM USED FOR SCORING THE FOODS ON THE THIRTEEN SENSORY ATTRIBUTES

Instrumental Testing

A table model Instron Universal Testing Machine (Model 1132) was equipped with a triple beam snap test cell modeled from the one described by Bruns and Bourne (1976). The test involved supporting a rectangular bar of food across the two lower bars (always set 3 cm apart) and fracturing it at the center by the downward motion of the upper blade. Ten samples of each product were tested at crosshead speeds of 5, 10, 20, and 25 cm/min. The latter was the Instron's fastest deformation rate. The following parameters were measured: peak force, slope — the slope was measured at the steepest part of the force-deformation curve, and deformation to fracture.

DATA ANALYSIS

Instrumental

Arithmetic means of the peak force (F), slope (S), and deformation to fracture (D) were used to calculate the following parameters for each

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food and each deformation rate:

F/D — a second indicator of slope

$\frac{F/D}{S}$ — an index of curvature (For a purely elastic food this ratio would equal 1.)

E = Young's modulus of elasticity calculated as follows:

$$E = \frac{SL^3}{4bh}$$

where:

L = effective length of sample (30 mm)

b = sample width

h = sample height

(The width and height of the celery samples were multiplied by $\sqrt{2/3}$ before entering them in this equation because the cross sectional area of the celery was 2/3 of that determined by multiplying its width by its height.)

D/h — flexure corrected for sample height

Sensory

The magnitude estimation data were first normalized using geometric means (Engen 1971) to equate the moduli of the different subjects. Normalization procedures were performed separately for the three sensory attributes and for the bite only and bite and chew techniques (a total of six separate normalizations).

Regression lines and correlation coefficients for relationships between the bite and the bite and chew techniques and between the different sensory parameters were computed using mean normalized data. Input for the regression analyses for the relationships between sensory and instrumental parameters consisted of the mean values for the instrumental parameters and all normalized subject's values for the sensory parameters.

Mean data from the category scaling of the 16 foods on the 13 attributes were used to determine the dependence of the quality crispness on the remaining attributes. Multiple regression analysis was used to evaluate the contribution of the eleven other variables to the sensation of crispness (Nie *et al.* 1975). Principal component analysis (Varimax rotation) was used to determine which of the thirteen attributes appeared most closely related to crispness (Nie *et al.* 1975).

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RESULTS

Sensory

Whether a sensory attribute was judged by the bite or the bite and chew technique made little difference in the subjects' scores. Sample correlation coefficients between the two judging techniques were +.97 for crispness, +.95 for loudness, and +.98 for firmness. The estimated slope of the regression equation relating the geometric means of crispness bite to the geometric means of crispness bite and chew is 1.00, indicating a one-to-one relationship between them. The estimated slope of the line relating loudness bite to loudness bite and chew was 0.91, and the estimated slope of the line relating firmness bite to firmness bite and chew was 0.97. These estimates are not significantly different from 1.00, and accordingly, further analyses used only the bite and chew data.

The highest sample correlation between any two of the three sensory attributes was between loudness and crispness ($r = +.97$). Sample correlations between loudness and firmness ($r = +.84$) and between firmness and crispness ($r = +.83$) were somewhat lower.

Multiple regression analysis of the category scale data indicated that snap, loud, and crackly were the three terms most closely associated with crispness.

$$(\text{Crisp} = .32 \text{ snap} + .31 \text{ loud} + .26 \text{ crackly} \dots)$$

When the data for wet crisp foods were analyzed separately, firmness replaced crackly as one of the most closely associated terms with crispness. Multiple regression analysis for only the dry-crisp foods yielded similar results to the analysis of all foods.

Loud and snap were also the terms most closely associated with crispness in the principal component analysis results. The plot of the first two factors is shown in Fig. 2. Loadings and Eigenvalues for the factors are listed in Table 2. In this plot brittleness appears to be less related to crispness than it is to crackliness. The close positioning of crackly and brittle was likely responsible for crackly masking brittleness in the multiple regression analysis. Separate principal component analyses of both wet and dry crisp foods were similar to the analysis of all foods except the terms crackly, loud, firm, snap, hard, stiff, and brittle appeared to cluster more closely around crispness when only the dry crisp foods were analyzed, and tended to spread farther apart when only the wet crisp foods were analyzed. In all cases the characteristics gummy, flaky, smooth, and elastic were not positioned close to crispness.

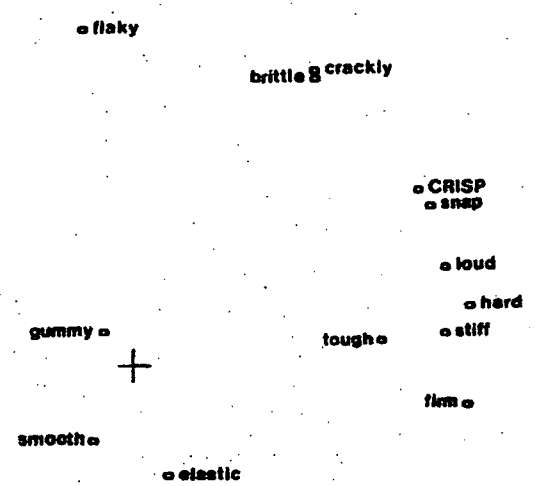


FIG. 2. RESULTS OF PRINCIPAL COMPONENTS ANALYSIS ON ALL FOODS

Origin is indicated by +. The abscissa represents factor 1; the ordinate represents factor 2.

Table 2. Principal components analysis results

Variable	Factor 1	Factor 2	Factor 3
Brittle	.46	.75	-.07
Tough	.62	.06	.36
Snap	.75	.41	-.10
Firm	.84	-.11	-.03
Gummy	-.08	.09	.86
Flaky	-.12	.88	-.18
Loud	.79	.26	-.14
Stiff	.78	.09	-.01
Crisp	.72	.45	-.19
Smooth	-.11	-.19	.80
Crackly	.46	.76	-.09
Elastic	.08	.28	.78
Hard	.85	.16	-.08
Eigenvalue	5.55	2.46	1.36
Percent of Variation	42.70	18.90	10.50

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Instrumental

Deformation rate influenced the parameters of peak force, flexure, slope, and Young's Modulus, but no consistent pattern was observed between foods. Effects on flexure and peak force were minimal. Fresh turnips were an exception; peak force increased dramatically with increasing crosshead speed. Table 3 gives the peak force data at the four crosshead speeds. Peak force readings at higher crosshead speeds tend to be slightly depressed for dry crisp foods. The effects of crosshead speed on Young's Modulus were irregular and large for the dry crisp foods (Fig. 3) and minimal for wet crisp foods (Table 4). Figure 3 illustrates that not only do the actual values of Young's Modulus vary considerably for a single product with changes in crosshead speed, but the relationship of that food to other foods in the sample set can change dramatically. For example, Ry Krisp at a crosshead speed of 5 cm/min has the third highest value of Young's Modulus (3.71). However, at a crosshead speed of 25 cm/min it has the seventh highest value (2.53). The slower crosshead speed, 5 cm/min, produced the highest correlations between all three sensory qualities (crispness, firmness, and loudness) of all foods and both peak force and Young's Modulus. These correlations are listed in the upper portion of Table 5.

Instrumental — Sensory

Only the instrumental parameters peak force, slope, F/D, and Young's Modulus showed reasonably high correlations ($r > +.40$) with the three sensory attributes of loudness, crispness, and firmness. Since slope, F/D, and Young's Modulus are so closely related and Young's Modulus had the best correlations with crispness, only the values for Young's Modulus will be detailed.

Of the instrumental measures, Young's Modulus generally correlated most highly with the crispness of *all* foods. The correlations between Young's Modulus and crispness remained rather stable at the four different deformation rates (Table 5) in spite of the variability shown in Fig. 3. The relationship between Young's Modulus and crispness is shown in Fig. 4. The crispness of dry crisp foods appears to have a different relationship to Young's Modulus than does the crispness of wet crisp foods.

The highest correlations for any instrumental-sensory pair occurred between peak force and firmness for dry crisp foods (Table 5). Peak force generally appears to be better than Young's Modulus as an indicator of firmness.

Correlations between peak force and loudness tend to diminish as deformation rates increased for wet crisp foods but not for dry crisp foods.

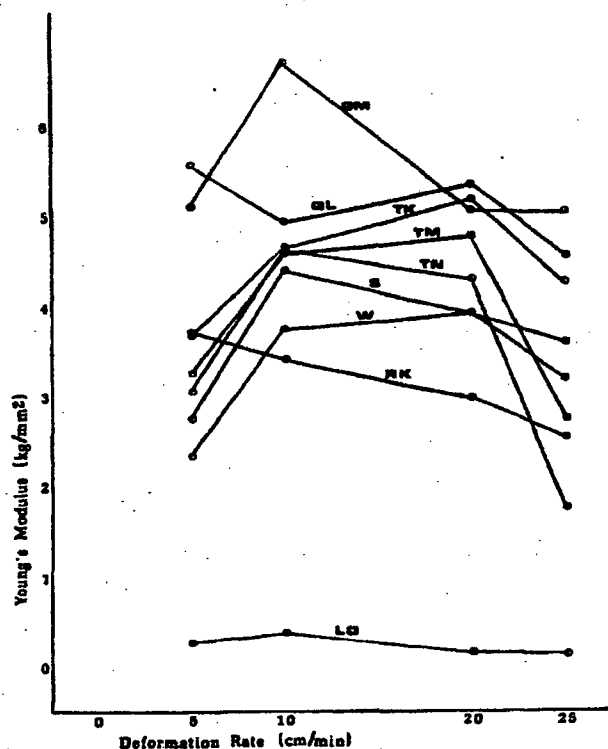


FIG. 3. RELATIONSHIPS BETWEEN DEFORMATION RATE AND YOUNG'S MODULUS FOR THE DRY CRISP FOODS

GM (gingersnap MgCl), GL (gingersnap LiCl), TK (Triscuit K_2CO_3), TM (Triscuit MgCl), TN (Triscuit NaCl), S (saltine K_2CO_3), W (Waverly Wafer LiCl), RK (Ry Krisp MgCl).

Correlations between Young's Modulus and loudness, however, remain relatively stable at increasing deformation rate.

DISCUSSION

The high correlations and one-to-one relationships between the bite only and the bite and chew techniques suggest that the sensory information required to determine food crispness, loudness, and firmness is

Table 3. Peak force in kilograms for 16 different food samples at four deformation rates

Food	Deformation Rate — cm/min			
	5	10	20	25
Celery, fresh	3.23	2.82	2.68	2.42
Celery, blanched 45 s ^a	1.17	1.12	1.07	1.20
Celery, blanched 3 min ^a	.93	.81	.93	1.02
Turnips, fresh	2.35	2.91	3.30	4.52
Turnips, blanched 30 s ^a	.91	.92	1.17	1.28
White radish, fresh	.53	.54	.57	.55
White radish, blanched 60 s ^a	.11	.14	.18	.16
Gingersnap, LiCl	2.66	2.16	1.83	1.75
Gingersnap, MgCl	2.75	2.51	2.37	1.90
Triscuit, MgCl	1.40	1.29	1.29	1.04
Triscuit, K ₂ CO ₃	1.38	1.42	1.55	1.20
Triscuit, NaCl	1.55	1.62	1.51	1.40
Waverly Wafer, LiCl	1.51	1.38	.91 ^b	.71 ^b
Ry Krisp, MgCl	1.42	1.27	1.34	1.18
Lorna Doone, NaCl	.67	.57	.24	.23
Saltine, K ₂ CO ₃	.79	.65	.61	.64

^aBlanched vegetables often did not break
^bKeebler Club crackers were substituted for these two tests due to unavailability of Waverly Wafers

Table 4. Young's Modulus in kg mm⁻² for the wet crisp food samples at four deformation rates

Food	Deformation Rate — cm/min			
	5	10	20	25
Celery, fresh	.68	.71	.80	.70
Celery, cooked 45 s	.29	.29	.31	.36
Celery, cooked 3 min	.27	.23	.25	.33
Turnips, fresh	.21	.25	.35	.52
Turnips, cooked 30 s	.05	.05	.06	.08
White radish, fresh	.58	.63	.68	.56
White radish, cooked 60 s	.07	.10	.11	.11

present in the initial bite. These data contrast with Sherman and Deghaidy's (1978) findings that subjects reported using both biting and chewing sounds for judgments of crispness. Information obtained during chewing may be useful, but it does not appear to be essential for judgments of crispness.

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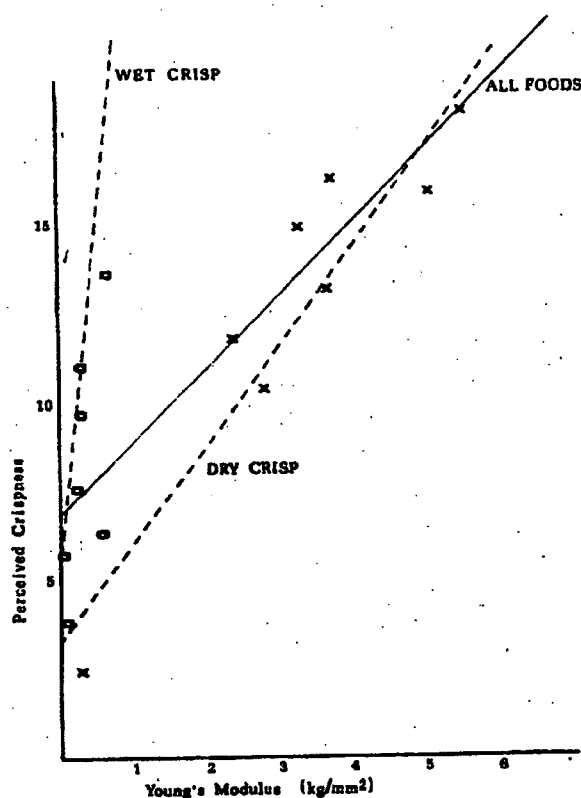


FIG. 4. RELATIONSHIPS BETWEEN SENSORY CRISPNESS AND YOUNG'S MODULUS

The deformation rate is 5 cm/min. X's represent dry crisp foods; O's represent wet crisp foods.

Relationships between the sensory attributes of crispness, loudness, and firmness demonstrate that crispness judgments are more highly correlated to the auditory sensation of loudness than to the tactile sensation of firmness. Firmness may be a poor choice of a tactile sensation involved in crispness. Recent research (Christensen and Vickers 1981) has demonstrated that crispness judgments can easily be made in the absence of any auditory feedback from biting and chewing sounds. Thus an oral tactile crispness sensation must exist.

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Table 5. Correlation coefficients between the sensory attributes crispness, loudness, and firmness and the Instron parameters, peak force, and Young's Modulus

Instron Parameter	Crisp								Loud								Firm			
	Deformation Rate cm/min																			
	5	10	20	25	5	10	20	25	5	10	20	25	5	10	20	25				
<u>All Foods</u>																				
Peak force	.52	.45	.38	.25	.55	.47	.39	.26	.58	.55	.52	.41								
Young's Modulus	.55	.52	.53	.53	.50	.45	.46	.46	.46	.39	.39	.39								
<u>Dry Crisp Foods</u>																				
Peak force	.49	.47	.54	.55	.51	.48	.52	.55	.69	.70	.72	.75								
Young's Modulus	.59	.58	.57	.54	.59	.51	.52	.48	.73	.65	.62	.56								
<u>Wet Crisp Foods</u>																				
Peak force	.54	.48	.39	.33	.59	.51	.40	.32	.49	.48	.44	.40								
Young's Modulus	.44	.42	.44	.52	.47	.44	.46	.53	.25	.23	.26	.36								

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Results of the principal components analyses showed that crispness had a high loading on factor (1), a moderated loading on factor (2), and a negative loading on factor (3). The first factor appears to describe a hardness dimension since hardness and firmness load vary highly on the factor. Flaky, brittle, and crackly load highly on factor 2. This dimension appears to represent the fracturability of the food. The descriptors gummy, smooth, and elastic characterize factor 3. From these analyses crispness would appear to contain independent elements of both hardness and fracturability.

Figure 2 shows that the descriptors most closely associated with crispness are snap, crackly, brittle, and loud. Vickers and Wasserman (1980) found that snap, crackly, and brittle were descriptors with an auditory component. These terms, along with loudness, were found to be similar to crispness in their multidimensional scaling study of food sounds.

Although the effects of crosshead speed on peak force were minimal (Table 3) correlations of peak force with the crispness of all foods diminished markedly with increasing deformation rate (Table 5). Two factors may help account for these changes. The first of these is the marked increase in peak force with increasing deformation rate shown by the fresh turnip. At a deformation rate of 25 cm/min the fresh turnip has a peak force nearly twice as high as any other food. Fresh turnips, however, are scored relatively low for crispness. The second factor might be that the peak force readings for dry crisp foods tend to be slightly lower at the higher crosshead speeds. (This tendency is also apparent in the results of Sherman and Deghaidy (1978)). Although correlations between peak force and crispness for dry crisp foods alone tend to increase with increasing crosshead speed, when these data are combined with that of wet crisp foods the overall correlation is diminished.

Peak force is a better indicator of the tactile sensation of firmness whereas Young's Modulus tends to be a better indicator of the sensation of crispness. The observation that Young's Modulus generally correlated most highly with the crispness of all foods supports observations of earlier investigators (Brennan *et al.* 1970; Iles and Elson 1971; Vickers 1975; Sherman and Deghaidy 1978). This study differed from these above in that it examined a wider variety of food textures and a broader range of crispness. It is not possible to conclude that Young's Modulus correlated more highly with sensations of an acoustical nature whereas peak force correlates more highly with tactile sensations, because both instrumental parameters are about equally well correlated to loudness.

Vickers and Bourne (1976b) speculated that stiffness correlated with crispness because the stiffness contributed to the loudness of the sound produced when the food was bitten. (Young's Modulus of elasticity is

proportional to the amplitude of vibration (Mohsenin 1970)). However, Young's Modulus tends to correlate more highly with crispness than with loudness. These data suggest that the contribution of stiffness to the sensation of crispness involves more than just loudness.

The correlation coefficients between the sensory attributes closely related to crispness and the instrumental parameters peak force and Young's Modulus are shown in Table 6. Young's Modulus correlates more highly with descriptors that load highly on factor 2 of the principal components analysis. Peak force tends to correlate more highly with descriptors that have high loadings on factor 1. If crispness does contain independent elements of both hardness and fracturability, as suggested by the principal components analysis, peak force, and Young's Modulus may be indicators of these components.

Table 6. Correlation coefficients between peak force, Young's Modulus, and sensory attributes closely related to crispness

Sensory Parameter ¹	Instrumental Parameter ²	
	Peak Force	Young's Modulus
Brittle	.35	.67
Snappy	.48	.55
Firm	.48	.32
Loud	.55	.50
Crisp	.49	.57
Crackly	.33	.64

¹ From category scaling data
² Deformation rate = 5 cm/min

Together the sensory and the instrumental data indicate that crispness is a complex sensation having both auditory and oral tactile components. The repeated breaking or repeated fracturing of food samples during biting and chewing has been implicated in the generation of the characteristic sounds produced by crisp foods (Vickers and Bourne 1976b). This repeated breaking may produce the quality of fracturability associated with factor 2 of the principal components analysis whereas the forces associated with the repeated breaking may be related to factor 1. Vibrations from this fracturing likely contribute substantially to the tactile sensation of crispness. These tactile vibrations would then be enhanced by any accompanying auditory sensations.

The results of this study together with those of Christensen and Vickers (1981) support a hypothesis that vibratory stimuli produced by the repeated fracturing of a food underlie crispness. Vibratory stimuli

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would be expected to produce both tactile and auditory sensations of crispness. This hypothesis would also accommodate the earlier studies of Vickers and Bourne (1976b) as well as the more recent studies of Sherman and Deghaidy (1978) and Vickers and Wasserman (1980). This hypothesis explains why food crushing sounds provide information on crispness and why crispness judgments can be made in the absence of these auditory cues. It also allows for the lack of an excellent correspondence between the sensation of crispness and any single force-deformation parameter obtained from Instron testing.

If crispness is a vibrotactile-acoustical sensation, future instrumental tests should address these qualities. Studies of vibration amplitude and the vibratory patterns produced when a food is crushed should be promising avenues for future research on instrumental measures of crispness.

SUMMARY

Sensory analysis indicates that crispness is more closely related to acoustical qualities such as loud, snap, and crackly than to oral tactile qualities such as firmness. Young's Modulus, an instrumental parameter obtained from an Instron snap test, shows the closest relationships to sensory crispness. These relationships are fairly stable at deformation rates of 5–25 cm/min. The hypothesis that crispness is a vibrotactile-acoustical sensation provides a satisfactory explanation for the close relationship of crispness to other acoustical sensations, the ease of making crispness judgments in the absence of acoustical sensations, and the relative inadequacy of Young's Modulus as a measure of the stimulus.

ACKNOWLEDGMENT

This work was supported in part by the Minnesota Agricultural Experiment Station and by the Monell Chemical Senses Center. Thanks are due to Lisa Casper for her technical assistance and to Campbell Soup Company for the use of their Instron.

REFERENCES

- BRENNAN, J. G., JOWITT, R. and MUGHSI, O. A. 1970. Some experiences with the General Foods Texturometer. *J. Texture Studies* 1, 167.

- BRENNAN, J. G., JOWITT, R. and WILLIAMS, A. 1974. Sensory and instrumental measurement of brittleness and crispness. *Proc. 4th Intl. Congr. Food Sci. Technol.*, Madrid, Spain, Vol. II, 130-143.
- BRUNS, A. J. and BOURNE, M. C. 1976. Effect of sample dimensions on the snapping force of crisp foods. *J. Texture Studies* 6, 445-458.
- CHRISTENSEN, C. M. and VICKERS, Z. M. 1981. Relationships of chewing sounds to judgments of food crispness. *J. Food Sci.* 46, 576-578.
- ENGEL, T. 1971. *Psychophysics: II. Scaling Methods*. Woodworth and Schlosberg's *Experimental Psychology*, (J. W. Kling and L. A. Riggs, eds.), Holt, Rhinehart, and Winston, New York.
- ILES, B. C. and ELSON, C. R. 1972. Crispness. BFMIRA Research Reports, No. 190.
- JEON, I. J., BREENE, W. M. and MUNSON, S. T. 1973. Texture of cucumbers, correlation of instrumental and sensory measurements. *J. Food Sci.* 38, 334-337.
- JEON, I. J., BREENE, W. M. and MUNSON, S. T. 1975. Texture of fresh-pack whole cucumber pickles: Correlation of instrumental and sensory measurements. *J. Texture Studies* 5, 399-410.
- JOWITT, R. and MOHAMED, A. A. A. 1979. An improved instrument for studying crispness in foods. Presented at the 2nd Intl. Congress on Engineering and Food, August, Helsinki, Finland.
- MOHSENIN, N. N. 1970. *Physical Properties of Plant and Animal Materials*. Volume 1. Structural, Physical Characteristics, and Mechanical Properties. Gordon and Breach Science Publishers, New York.
- NIE, N. H., HULL, C. H., JENKINS, J. G., STEINBRENNER, K. and BENT, D. H. 1975. *Statistical Packages for the Social Sciences*, 2nd ed, McGraw-Hill, New York.
- SHERMAN, P. and DEGHADY, F. S. 1978. Force-deformation conditions associated with brittleness and crispness in selected foods. *J. Texture Studies* 9, 437-459.
- VICKERS, Z. 1975. Development of a Psychoacoustical Theory of Crispness. Ph.D. Thesis, Cornell University, Ithaca, NY.
- VICKERS, Z. and BOURNE, M. C. 1976a. Crispness: a review. *J. of Food Sci.* 41 (5), 1153-1157.
- VICKERS, Z. and BOURNE, M. C. 1976b. A psychoacoustical theory of crispness. *J. of Food Sci.* 41 (5), 1158-1164.
- VICKERS, Z. 1979. Crispness and Crunchiness of Foods. In *Food Texture and Rheology*, (P. Sherman, ed.) Academic Press, London, England.
- VICKERS, Z. M. and WASSERMAN, S. S. 1980. Sensory qualities of food sounds based on individual perceptions. *J. Texture Studies* 10, 319-332.

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XP-002530798

ACOUSTIC TESTING OF SNACK FOOD CRISPNESS USING NEURAL NETWORKS

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(Manuscript received January 4, 2002; in final form July 30, 2003)

ABSTRACT

The crispness of selected snack foods, Pringles potato chips, Paprika extruded snack and Munchy crackers, was evaluated by crushing the snack samples with a pair of pincers, and analyzing the frequency domain spectra of acoustic patterns by the neural networks (NNs). The inputs for training the NNs comprised 102 amplitudes of sound signals in 0-7 kHz frequency range at the intervals of about 69 Hz with moisture content or crispness grades as outputs. Both backpropagation (BPNN) and probabilistic (PNN) models showed good performance in classifying the snack foods into four grades of sensory crispness. The prediction accuracy of PNN models ranged approximately from 96 to 98% and was higher than the accuracy of BPNN models by about 10 to 25%. Results showed that frequency domain spectra of acoustic signals could be successfully analyzed by the NNs for predicting the crispness of snack food products.

INTRODUCTION

Many studies have been carried out in the past on acoustical measurements of food quality attributes (Drake 1963, 1965; Vickers and Bourne 1976a; Vickers 1980, 1983, 1987; Mohamed *et al.* 1982; Seymour and Hamann 1984; Edminster and Vickers 1985; Duizer *et al.* 1998; Liu and Tan 1999). A basic premise of these studies has been that physical measurements of crushing sounds could provide new information to correlate with sensory evaluation of food texture. Duizer (2001) has reviewed the main aspects of acoustic research for studying the sensory perception of crisp, crunchy and crackly textures.

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The loudness of crushing sounds differs greatly for crispy and less-crispy foods, and a high degree of correlation has been reported between sound amplitude and perceived loudness (Drake 1963, 1965). Vickers and Bourne (1976b) found that the amplitude and the number of sounds produced from biting wet and dry foods varied with the crispness of samples. The perceived loudness of the crushing sounds had a high positive correlation with the perceived crispness of the foods (Vickers and Wasserman 1979; Christensen and Vickers 1981). Average sound energy was correlated with sensory crispness by Mohamed *et al.* (1982). Crisp foods produced higher pitched sounds and louder than crunchy foods (Vickers 1984, 1985). The logarithm of number of sound occurrences and sound amplitude had high correlation with auditory perception of crispness (Edminster and Vickers 1985).

Fast Fourier Transform (FFT) has been applied in several studies to analyze the sound signals in frequency domain. Seymour and Hamann (1988) divided the acoustic spectra into four frequency ranges to determine the mean values of sound pressure, sound pressure level and sound intensity, and found that sound pressure was lowest for the highest moisture food products. Lee *et al.* (1988) found that the sound spectra of crisp potato chips had a greater amount of high-frequency components than those from stale samples. Duizer *et al.* (1998) determined the mean amplitudes of acoustic signatures between 1 and 2 kHz and between 6 and 7 kHz to relate with the sensory characteristics of extruded snack products. Barton *et al.* (1998) analyzed the popping sounds during extrusion to determine the average power of the signal by FFT and used artificial neural network (NN) to predict bulk density and fracture force of extruded product. Liu and Tan (1999) used short-time Fourier transform and analyzed sound signals to extract forty-two features. Comparison of predicted and actual sensory crispness scores based on thirty-two features showed that NN performed better than principal component regression.

The sound from the crushing of a food contains a large amount of information. Despite a large number of studies, the analysis of food crushing sounds continues to be a difficult task because of a very complex relationship between sensory attributes of crispness and acoustic measurements. In addition, the procedures for extracting sound signal features are not straightforward. Therefore, the objective of this study was to develop a reliable and easy way to implement methodology for evaluating the sensory crispness of snack food products based on direct application of frequency domain spectra of acoustic signals and NN models.

MATERIALS AND METHODS

Snack Food Samples

All samples were purchased at a local supermarket from the same lot of manufacturing, and used before the suggested date of expiration. Three different types of snack foods (Pringles brand potato chips, Paprika brand extruded snacks, and Munchy brand crackers with initial moisture content of about 3.1, 2.0 and 3.7% db, respectively) were selected from a wide variety of commercially available products.

Moisture Determination and Conditioning

The moisture content of snack samples was determined by placing duplicate samples weighing about 5 g in hot air oven maintained at $105 \pm 1^\circ\text{C}$ until the samples reached constant weight. To alter the level of crispness, the snack foods were conditioned to different moisture contents by exposing the samples to the ambient air at about 70% relative humidity to gain weight corresponding to approximately 1.5% db increase in moisture content successively. The samples were subsequently packed in polyethylene bags, heat-sealed and placed in air-tight containers for one week to allow uniform distribution of moisture. It was possible to condition the snack samples to four or five levels of moisture content with this procedure. Moisture determinations were made following the acoustic testing and sensory evaluation separately.

Sensory Evaluation of Crispness

Eleven judges, 9 females and 2 males, participated in the sensory evaluation of crispness. The panelists were either Thai graduate students or researchers in 25-40 year age group with background in food science and technology. The panel could be considered semitrained as well as discriminant and homogeneous.

A scoring test was used to quantify the increasing levels of sensory crispness from 0 to 9 by simply estimating the apparent strength or intensity of subjective impressions relative to a reference sample with known numerical value (Mohamed *et al.* 1982). The marks on the category scales were anchored with the verbal intensity of sensory crispness and later converted to numerical scale. The sensory assessment was carried out in 3 test sessions for each particular type of snack. About five or more pieces of snack weighing approximately 10 g were presented to the panelists each time. Before each test session began, the panelists were served the crispy reference snack samples that had been assigned extremely crispy. All panelists were familiar with the word Krob in Thai which closely matches with crispness sensation. The freshly

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opened snacks were chosen as reference samples for each particular type of snack. All sensory tests were performed in duplicate in a random manner.

The panelists were instructed to make their decision on crispness only after biting snack samples with their incisors. Panelists in the research of Sherman and Deghaidy (1978) indicated that brittleness was evaluated in the mouth during the first bite of mastication. Vickers and Christensen (1980) also supported that the sensory information comprising loudness and firmness, required for determining food crispness, was present in the initial bite.

Acoustic Measurements

Sound Acquisition System. A 9V DC powered microphone connected to an analog-to-digital converter (Pico ADC-212, Pico Technology Ltd., UK) was used for sound signal acquisition. The voltage output of the microphone in the form of amplitude-time signal was converted into a power spectrum of frequencies using Pico FFT built-in software, and displayed on a PC.

To imitate biting with incisors, a pair of pincers having cutting area of 13 mm in length was used. The cutting was performed by hand. The position of microphone was fixed 3 cm away from the pincers. All food sound recordings were made in a quiet room without sound proofing. Both the PC and microphone were grounded and care was taken in minimizing the electrical noise from external sources. The total number of tests was 182 for Pringles potato chips (3.1 - 8.1% db), 234 for Paprika extruded snack (2.0 - 10.3% db), and 163 for Munchy crackers (3.7 - 8.6% db) in their respective moisture content ranges.

Application of FFT. Recent studies have reported improvement with discrete Fourier transform (DFT) based procedures by first estimating the frequency and then applying the DFT using a window (Lai *et al.* 1997). The preliminary tests showed the highest frequency in the sound signals was around 7 kHz. Thus the frequency bandwidth option of 11736 Hz, with 1024 data bins, was selected to give the frequency resolution of 11.46 Hz. This allowed the total sample duration of about 87.3 ms, which was adequate for all sound signals generated by different snack food samples. Hanning window function as recommended by Seymour and Hamann (1984) was used to force the signal to appear periodic. The amplitude of resulting spectrum was 3/8 of the true values and simply needed to be multiplied by 8/3 to obtain the correct amplitude.

Neural Network Models

A user friendly commercial software, NeuroShell 2 (Ward System Group, Frederick, MD), was used for developing neural network (NN) models. A backpropagation feedforward neural network (BPNN) model with 102 inputs nodes, 3 layers of hidden slabs with 20 neurons in each slab, and 1 output node

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was developed for each type of snack food for estimating moisture content. The input to each node corresponded to the recorded sound signal amplitude from FFT at a selected frequency and the output node represented the moisture content of the snack sample. The input spectral patterns were extracted from the frequency domain data, and the first and 102nd input nodes corresponded to 34 Hz and 6980 Hz, respectively, with the intervals of 69 Hz. The acoustic patterns were divided into training and test sets by extracting 25% patterns randomly for the test set for developing NN models. The training and test sets comprised 146 and 36 patterns for Pringles potato chips, 188 and 46 patterns for Paprika extruded snack, and 131 and 32 patterns for Munchy crackers, respectively. A sigmoid logistic function was used to scale the data into 0 to 1 active range both in training and test sets. The BPNN model was developed with the training set and tested by test set. The accuracy of the testing after every 200 training cycles was recorded and the model with highest accuracy for test pattern was saved. If the subsequent test result was better than the previous one, the model saved previously was replaced. The process was terminated if there was no test pattern with lower error than the minimum error recorded after 20,000 or more consecutive iterations.

The probabilistic neural network (PNN) was a three-layer network that classified input patterns into four categories of coded outputs represented by either 0 or 1. There were 102 neurons in the input layer and 4 neurons in the output layer corresponding to the four categories of crispness. The input data in acoustic patterns were scaled by a linear function in 0 to 1 range. The PNN architecture required the number of neurons in the hidden layer at least equal to or more than the number of patterns in the training set. Therefore, the PNN model was developed in this study using 250 neurons in the hidden layer. The network produced activations in the output layer corresponding to the probability density function estimated for that category. The highest output represented the most probable category. Unlike BPNN, the PNN training patterns were propagated through the network only once. A genetic algorithm was used for finding appropriate individual smoothing factors for each input as well as an overall smoothing factor to improve the networks generalization (Ward Systems Group 1995).

RESULTS AND DISCUSSION

Sensory Crispness

The plots of moisture content versus sensory score of crispness for three types of snack products are presented in Fig. 1. The average sensory scores exhibited an inverse relationship with the moisture content of the snack samples

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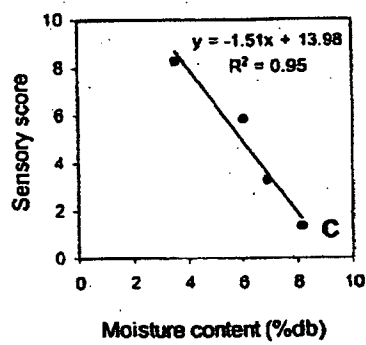
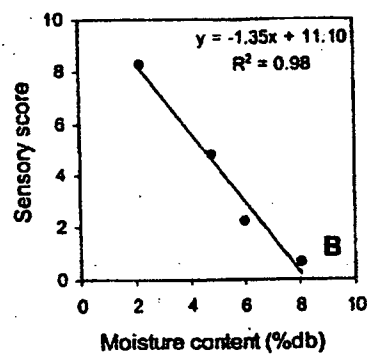
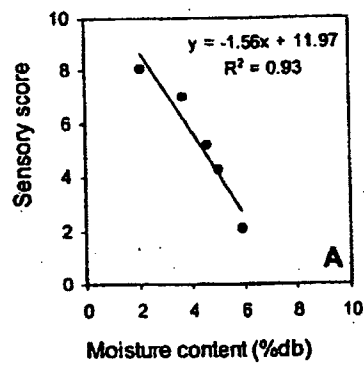


FIG. 1. CORRELATION BETWEEN MOISTURE CONTENT AND SENSORY CRISPNESS SCORES (A) PRINGLES POTATO CHIPS, (B) PAPRIKA EXTRUDED SNACK AND (C) MUNCHY CRACKERS

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as observed also by Katz and Labuza (1981). Such relationships between crispness and moisture content have been reported to be sigmoid shaped (Peleg 1994; Roudaut *et al.* 1998; Suwonsichon and Peleg 1998). However, the apparent linear relationship obtained in this study is due to the narrow range of moisture content and can still be used to predict sensory scores. The values of the coefficients of determination (R^2) for the fitted relationships were 0.93, 0.98 and 0.95 for Pringles potato chip, Paprika extruded snack and Munchy cracker, respectively. It has been suggested that the simple correlation coefficient between the instrumental measurements and sensory scores exceeding ± 0.9 ($R^2 > 0.81$) could be used with confidence as a predictor of sensory quality (Bourne 1983). Therefore, the developed relationships between sensory scores and moisture content of snack products were considered good for all practical purposes.

Characteristics of Acoustic Signals

Time Domain Characteristics. Figures 2, 3 and 4 show typical amplitude-time plots of the crushing sounds produced by the three types of snack products both at low and high moisture content levels. All snack samples exhibited uneven and irregular amplitude-time patterns in a similar fashion. The recorded range of signal amplitude varied within ± 2 V. The samples producing louder sound also resulted in higher amplitudes. Generally, all snack samples produced sound signals of approximate duration within 100 ms (Fig. 2 - 4). The duration of sound signals obtained in this study was shorter than the 200-300 ms signal duration for sounds produced by biting crisp foods with the incisors and holding a microphone about 3 cm in front of the mouth (Vickers 1991). However, Liu and Tan (1999) reported the sound signal duration of about 20 ms when conducting similar tests for the crushing of a starch-based snack with a pair of pliers between two parallel plates.

The duration of sound signals for different snack samples appeared to be a unique characteristic for each type of snack product. In addition to the moisture content, the thickness of food samples apparently influenced the duration of sound signals. In general, snack samples with lower moisture contents tended to produce longer signal durations in comparison with higher moisture content samples. Vickers and Bourne (1976b) reported that the thickness of the samples can vary the character of the sound patterns. The duration of sound signal for Pringles potato chips was approximately 40 ms and the shortest due to their being very thin as compared to the Munchy crackers with maximum thickness and showing a signal duration of about 90 ms. The presence of a hollow core in the case of Paprika extruded snack caused the sound signals to show separate patterns possibly corresponding to the collapse of the two walls.

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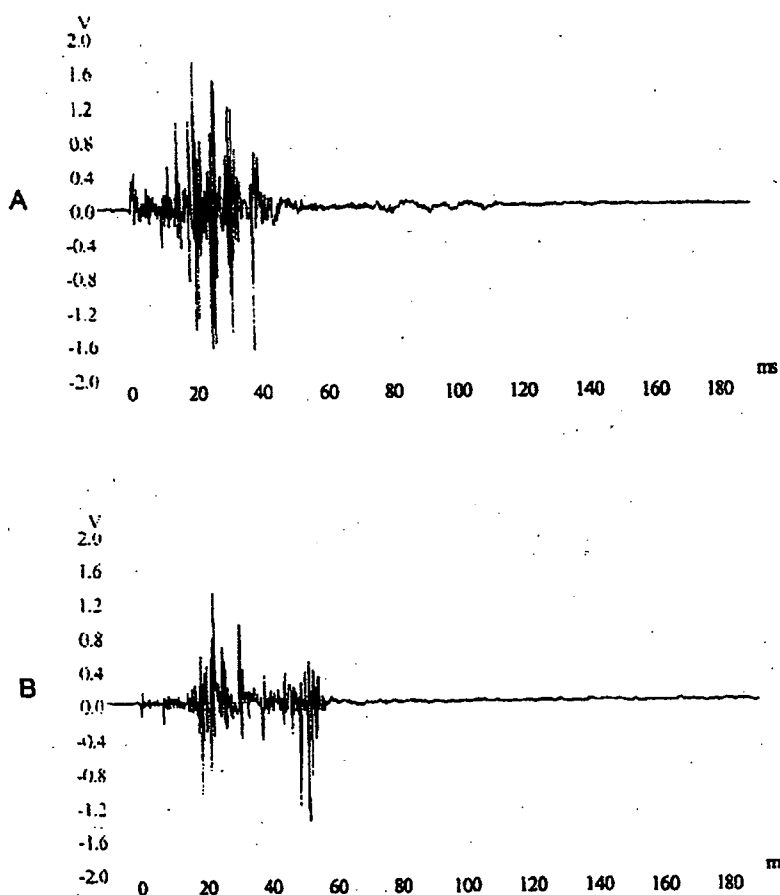


FIG. 2. TYPICAL AMPLITUDE VERSUS TIME PLOTS FOR PRINGLES POTATO CHIPS
(A) 3% MOISTURE CONTENT AND (B) 8% MOISTURE CONTENT

Despite the unique characteristics of the duration of sound signals produced by different food products, its relationship with sensory crispness could not be established in line with the findings of similar studies (Edminster and Vickers 1985; Vickers 1987, 1988). It should be pointed out that the differences in sound duration most probably results from an interaction between the physical properties of the samples such as thickness and moisture content and the method

of crushing the samples. Thus, a direct comparison of the duration of sounds observed in the various studies could only be made qualitatively.

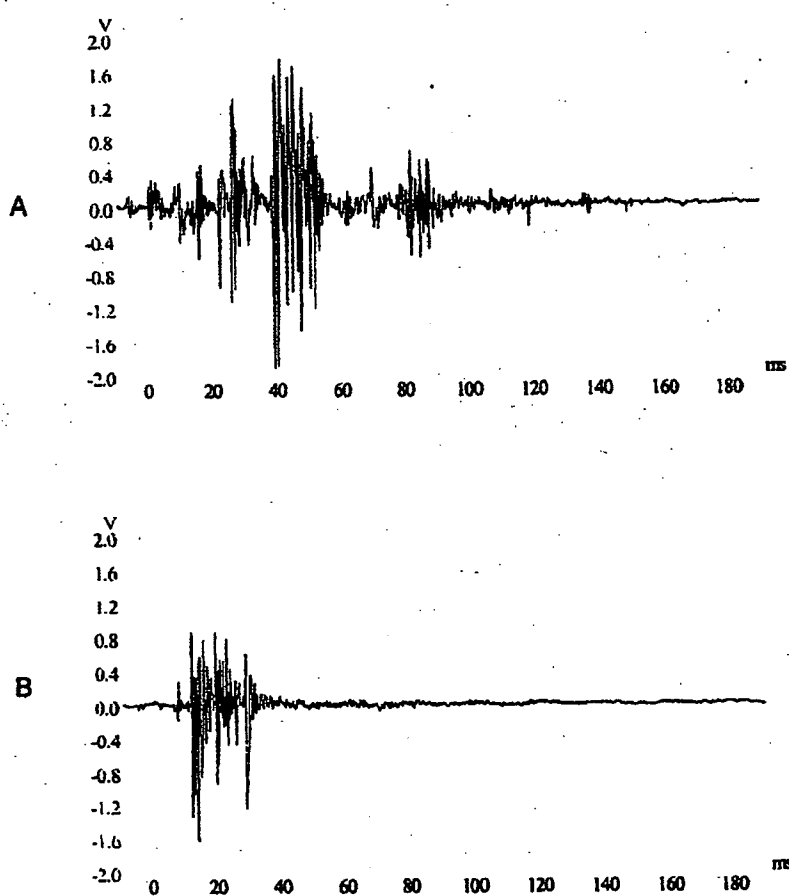


FIG. 3. TYPICAL AMPLITUDE VERSUS TIME PLOTS FOR PAPRIKA EXTRUDED SNACK (A) 2% MOISTURE CONTENT AND (B) 9% MOISTURE CONTENT

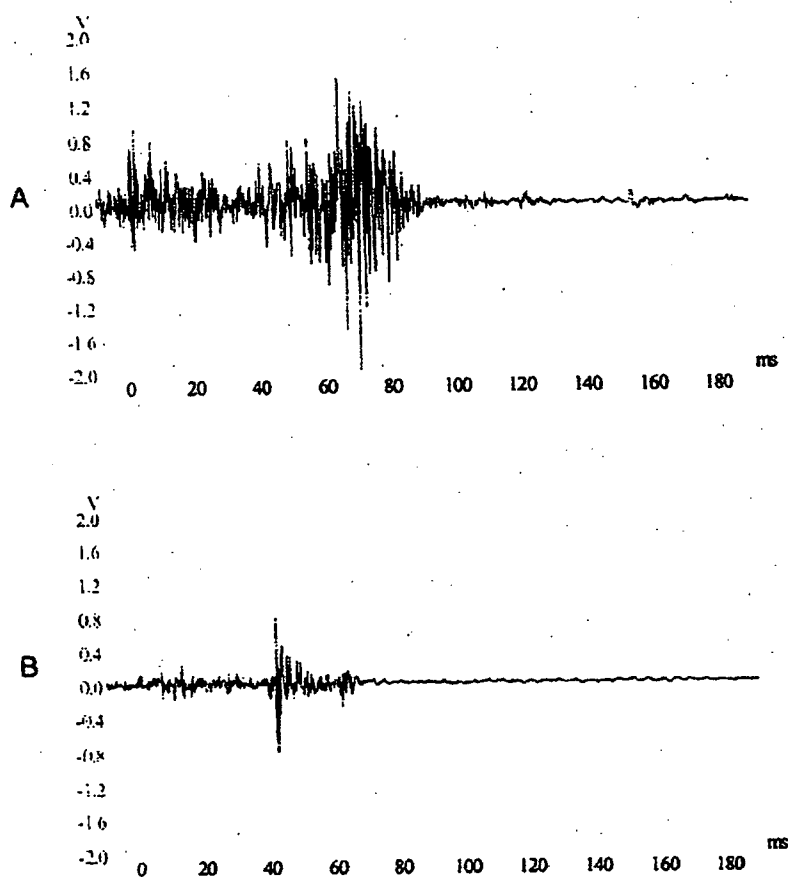


FIG. 4. TYPICAL AMPLITUDE VERSUS TIME PLOTS FOR MUNCHY CRACKER
(A) 4% MOISTURE CONTENT AND (B) 8% MOISTURE CONTENT

Frequency Domain Characteristics. Preliminary tests were carried out to analyze the information contained in the frequency domain spectra obtained for a total 414 Pringles potato chips with average moisture content of about 5.0 (93 samples), 6.3 (169 samples), 7.8 (103 samples) and 10.3% db (49 samples). The average amplitude of individual sound signals in 3-5 kHz frequency range did not reveal a meaningful relationship with the moisture content as shown in Fig. 5. Duizer *et al.* (1998) also reported insignificant differences in the average

amplitudes of the sound signals from the extruded snack foods stored at different water activities. Subsequently, the acoustic patterns in 1-10 kHz frequency range were grouped according to the average moisture content of about 4.1, 5.9, 6.4 and 10.4% db resulting in 140 samples, and the mean amplitude of individual sound signals in each moisture content group was calculated. Figure 6 shows that mean signal amplitude apparently decreased with an increase in the moisture content. There were no sharp peaks present in this particular plot due the effect of averaging. The presence of a hump for the sound signal amplitudes in the frequency range of 3-5 kHz was also apparent. The presence of some interference at the beginning of the sound spectrum due to the pick-up of electrical noise from the surroundings can also be noticed in Fig. 6.

The results from the preliminary tests indicated that averaging the signal amplitudes in selected frequency ranges did not yield a definite trend with the change in the moisture content of the samples. Therefore, it was decided to use the sound signal amplitudes in frequency domain spectra in the final analysis. Figure 7(A) shows the frequency-amplitude data when frequencies higher than 7 kHz were neglected due to absence of any meaningful information in higher frequency range. Finally, the 102 data bins that were extracted from the frequencies ranging from 34 to 6980 Hz with the intervals of 69 Hz are shown in Fig. 7(B).

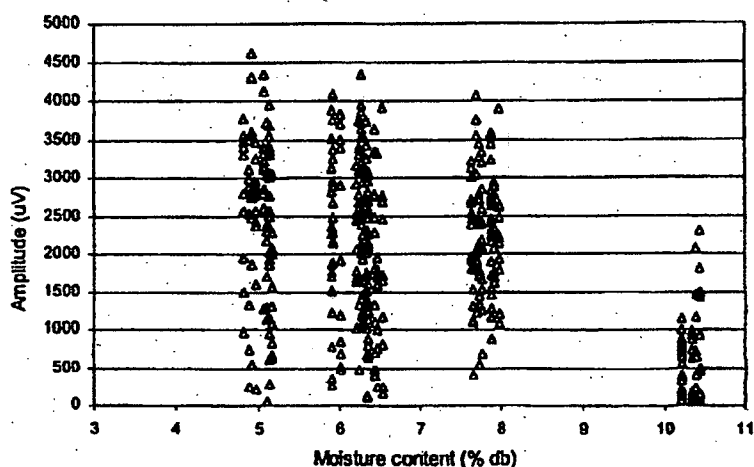


FIG. 5. AVERAGE SOUND SIGNAL AMPLITUDE IN 3-5 kHz RANGE AS A FUNCTION OF MOISTURE CONTENT FOR 414 PRINGLES POTATO CHIPS

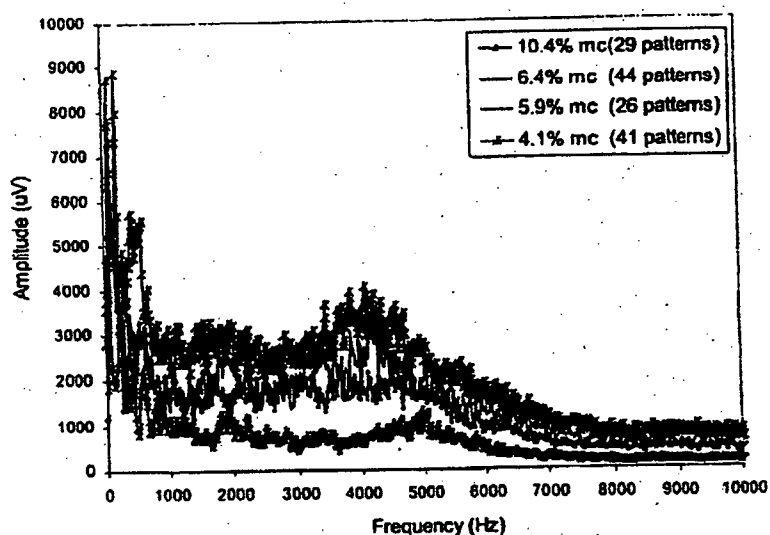


FIG. 6. AVERAGE SOUND SIGNAL AMPLITUDE AS A FUNCTION OF FREQUENCY FOR PRINGLES POTATO CHIPS AT DIFFERENT MOISTURE CONTENT

The lower moisture content samples, which were considered crisper, showed a change in dominant frequency and amplitude when compared with the same type of snack with higher moisture contents. Both frequency range and amplitude tended to decrease with decreasing crispness of the snack foods. However, the change in the signal amplitudes was more obvious than in frequencies with increasing moisture content.

There was a great deal of variability in the individual acoustic signatures as observed also by Duizer *et al.* (1998). A possibility existed that some important data bins might have been lost in Fig. 7 when extracting 102 data bins from a total of 700 data bins for Pringles potato chips at moisture content of 3% db. The highest signal amplitude of about 43,000 μV in original data in Fig. 7(A) was reduced to about 30,000 μV in Fig. 7(B) due to the data extraction procedure. Though the loss of some important data cannot be avoided, the method of extraction should be able to capture the essential features of the signal amplitude versus frequency patterns.

The frequency spectra of Pringles potato chips generally exhibited a main peak around 3 kHz similar to the results reported by Seymour and Hamann (1984) when crushing the same brand of potato chips. They found that most of

the recorded sound patterns showed frequencies in the range of 1-2 kHz with another separate peak appearing around 3 kHz.

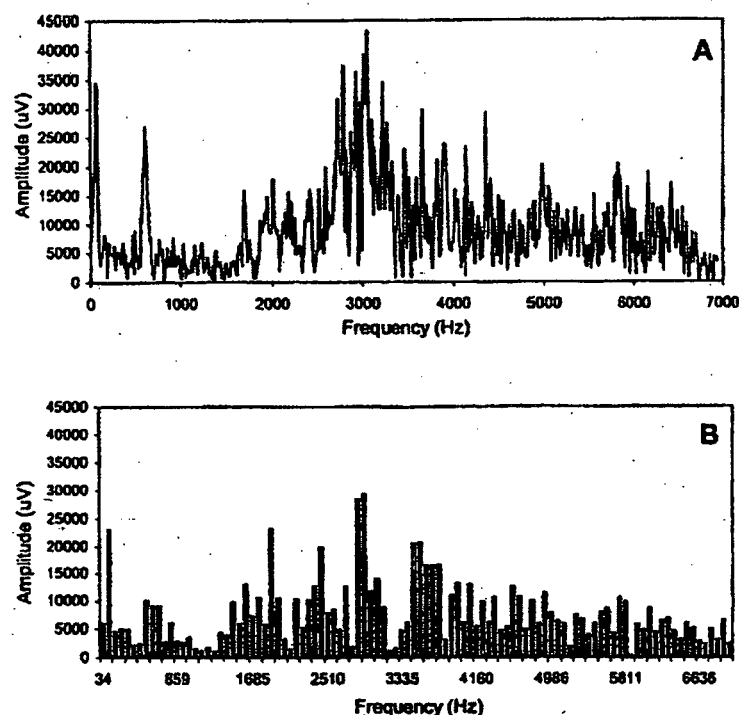


FIG. 7. RELATIONSHIP BETWEEN THE AMPLITUDE AND FREQUENCY OF SOUND SIGNALS FOR PRINGLES POTATO CHIPS AT MOISTURE CONTENT OF 3% dB; (A) SOUND SIGNAL IN FREQUENCY BANDWIDTH RANGE OF 1-7 kHz AND (B) DATA BINS EXTRACTED FROM THE ORIGINAL SOUND SIGNAL AT THE FREQUENCY INTERVALS OF 69 Hz

NN Models for Estimating Moisture Content of Snack Foods

A BPNN architecture with three hidden slabs was trained with 102 inputs of acoustic signal amplitudes for estimating the moisture content of each snack product. Figure 8 shows the sequential comparison plots of the predicted and experimental values of the moisture content. These results indicated that the NNs had the capability to generalize the complex acoustic patterns and could prove to be useful in monitoring the texture of snack foods. In general, the BPNN model predicted the moisture content of Munchy crackers with highest accuracy

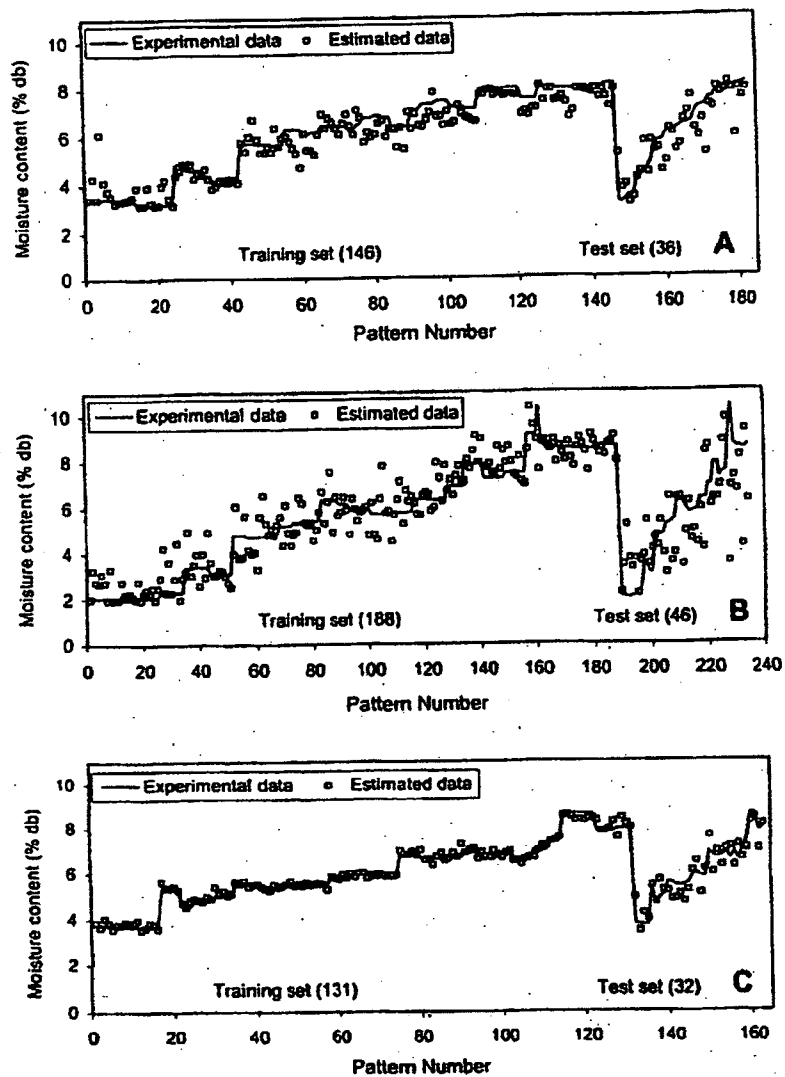


FIG. 8. PERFORMANCE OF BPNN FOR ESTIMATING THE MOISTURE CONTENT BASED ON ACOUSTIC MEASUREMENTS (A) PRINGLES POTATO CHIPS (TRAINING SET DATA $R^2 = 0.85$; TEST SET DATA $R^2 = 0.71$), (B) PAPRIKA EXTRUDED SNACK (TRAINING DATA SET $R^2 = 0.90$, TEST DATA $R^2 = 0.42$) AND (C) MUNCH CRACKERS (TRAINING DATA SET $R^2 = 0.97$, TEST DATA $R^2 = 0.84$)

both in training and test data sets. A general comparison of experimental and predicted moisture content is shown in Fig. 9 for different snack products. These plots indicated the tendency of the NN models for over prediction in low moisture content range and for under prediction in the high moisture content range. Similar trends have been reported to occur in the development of NN models because of the setting of the active ranges of the scaling function applied to the input data (Altendorf *et al.* 1999; Liu and Tan 1999). The type of the snack also appeared to influence the accuracy of the network predictions because of the degree of variation in the sound signals of each snack food. Among the three snack foods, the NN model predictions for Munchy crackers were the best due to its regular shape, considerable thickness and less variations in the acoustic signals.

NN Models for Classifying the Snack Foods Based on Crispness Grades

Analysis of variance of sensory crispness scores indicated that significant differences existed among the groups of snack samples with different moisture contents. Accordingly, it was possible to classify the snack food samples into different quality grades designated as "extremely", "highly", "moderately" and "slightly" crispy based on the sensory evaluations of the crispness. The ranges of sensory crispness scores and corresponding moisture contents for each type of snack sample are shown in Table 1.

The BPNN and a probabilistic neural network (PNN) were trained for the classification purpose. In the case of BPNN, the predicted values of moisture content for each snack sample were used for estimating the corresponding sensory scores from the experimental relationships and subsequent grouping into four categories. A PNN was developed separately for each snack type using coded outputs for the four quality grades. A genetic adaptive algorithm was used to find the suitable smoothing factors of 0.957, 0.752 and 0.755 for Pringles potato chips, Paprika extruded snack and Munchy crackers, respectively, for the developed PNN models. The comparative performance of the BPNN and PNN based classifiers is presented in Table 2 for the grading of each snack product. PNN classifiers performed better than the BPNN for all three types of snack samples. The improvement in prediction accuracy was about 25%, 15% and 10% for Paprika extruded snack, Pringles potato chips and Munchy crackers, respectively. The PNNs are considered more suitable for the classification tasks, but the BPNNs generally perform better when continuous output is desired (Ward System Group 1995). Even though the PNN classifiers showed a higher prediction accuracy than the BPNN, the implementation with PNN may be somewhat tedious due to their long training periods as compared to the BPNN.

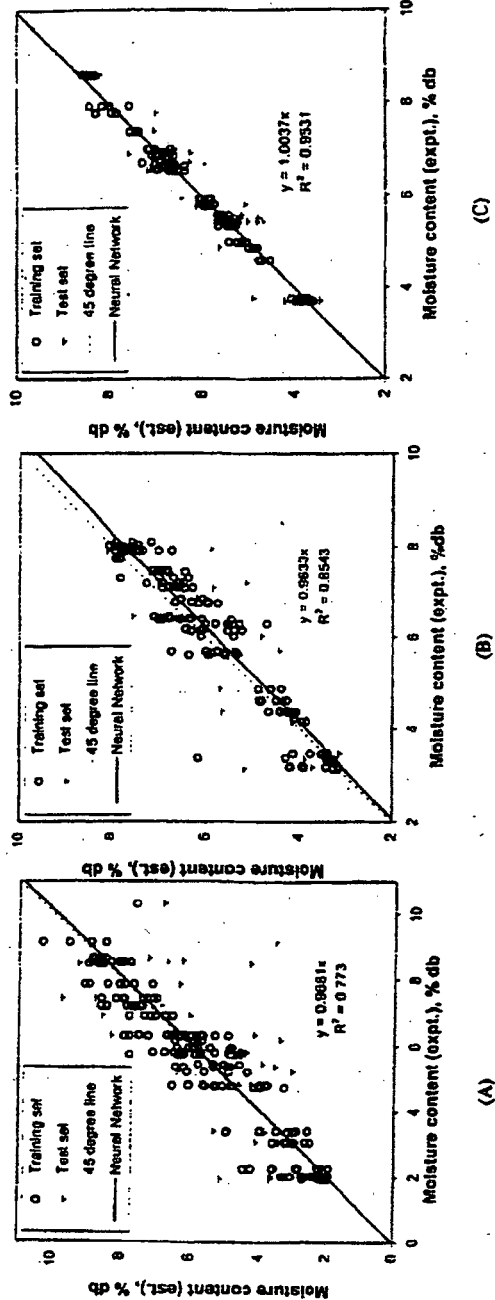


FIG. 9. COMPARISON OF EXPERIMENTAL AND ESTIMATED MOISTURE CONTENTS FROM BPNN MODEL BASED ON ACOUSTIC MEASUREMENTS (A) PRINGLES POTATO CHIPS, (B) PAPRIKA EXTRUDED SNACK AND (C) MUNCHY CRACKERS

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TABLE 1.
CLASSIFICATION OF SNACK SAMPLES BASED ON SENSORY CRISPNESS
AND MOISTURE CONTENT

Quality grade	Sensory crispness scores	Moisture content (% db)		
		Pringles potato chips	Paprika extruded snack	Munchy crackers
Extremely crispy	> 6	< 3.8	< 3.77	< 5.3
Highly crispy	4 - 6	3.8 - 5.0	3.8 - 5.3	5.3 - 6.6
Moderately crispy	2 - 4	5.0 - 6.3	5.3 - 6.7	6.6 - 7.9
Slightly crispy	< 2	> 6.34	> 6.73	> 7.9

TABLE 2.
PERFORMANCE COMPARISON OF BPNN AND PNN MODELS FOR THE
CLASSIFICATION OF SNACK FOOD PRODUCTS INTO DIFFERENT
CRISPNESS GRADES

Grade	Actual number	Estimated number based on		Classification accuracy (%)	
		BPNN	PNN	BPNN	PNN
Pringles potato chips					
Extremely crispy	29	20	29	69.0	100
Highly crispy	23	21	23	91.3	100
Moderately crispy	34	31	32	91.2	94.1
Slightly crispy	96	80	95	83.3	99.0
Paprika extruded snack					
Extremely crispy	63	53	60	84.3	95.2
Highly crispy	20	11	17	55.0	85.0
Moderately crispy	75	33	73	44.0	97.0
Slightly crispy	76	70	75	92.0	98.7
Munchy cracker					
Extremely crispy	36	34	36	94.4	100
Highly crispy	56	48	56	85.7	100
Moderately crispy	50	45	47	90.0	94.0
Slightly crispy	21	19	21	90.5	100

CONCLUSIONS

This study aimed at evaluating the crispness of selected snack foods based on acoustic testing. The sensory crispness and moisture content of snack products: Pringles potato chips, Paprika extruded snack and Munchy crackers were highly correlated with R^2 of about 0.93 and higher, showing inverse linear relationships in the narrow range of moisture content. The snack foods exhibited characteristic acoustic patterns upon crushing with uneven and irregular amplitude-time relationships for overall duration less than 100 ms depending upon their physical properties and possible variations in manual operation. The analysis of acoustic signals in frequency domain based on the averaging of the

amplitudes either in a fixed range of frequencies for individual patterns or at frequencies selected at the fixed intervals for several patterns did not prove useful for assessing the crispness of snack foods. The frequency domain spectra of sound produced by the crushing of snack foods could be used for training the NNs for quality evaluation. Both BPNN and PNN models showed good performance in classifying the snack foods into four grades of sensory crispness when the amplitudes of sound signals in 0-7 kHz frequency range at the intervals of about 69 Hz comprised 102 inputs for training the networks. The prediction accuracy of PNN models ranged approximately from 96 to 98% and was higher than the accuracy of BPNN models by about 10 to 25%. The developed methodology provided a reliable means of analyzing the food crushing sound for predicting the crispness.

REFERENCES

- ALTENDORF, C.T., ELLIOTT, R.L., STEVENS, E.W. and STONE, M.L. 1999. Development and validation of a neural network model for soil water content prediction with comparison to regression techniques. *Trans. Am. Soc. Agr. Eng.* 42(3), 691-699.
- BARTON, G.W., ELSEY, J., JUNGK, S., FRANCIS, G., SELLAHEWA, J. and CHESSARI, C. 1998. Acoustic based on-line quality estimation. *CEANET Technical Computing Solution*. URL: <http://www.ceanet.com.au/kb/papers/acoustic.htm>. Accessed July 14, 2000.
- BOURNE, M.C. 1983. Correlating instrumental measurement with sensory evaluation of texture. In *Sensory Quality in Foods and Beverages: Definition, Measurement and Control*, (A.A. Williams and R.K. Atkin, eds.) pp. 155-172, Ellis Horwood Ltd., London.
- CHRISTENSEN, C.M. and VICKERS, Z.M. 1981. Relationship of chewing sounds to judgements of food crispness. *J. Food Sci.* 46, 547-578.
- DRAKE, B.K. 1963. Food crushing sound: an introductory study. *J. Food Sci.* 28, 233-241.
- DRAKE, B.K. 1965. Food crushing sound: comparisons of objective and subjective data. *J. Food Sci.* 30, 556-559.
- DUIZER, L. 2001. A Review of acoustic research for studying the sensory perception of crisp, crunchy and crackly texture. *Trends Food Sci. Technol.* 12, 17-24.
- DUIZER, L.M., CAMPANELLA, O.H. and BARNES, G.R.G. 1998. Sensory, instrumental and acoustic characteristics of extruded snack food products. *J. Texture Studies* 29, 397-411.

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111

- EDMINSTER, J.A. and VICKERS, Z.M. 1985. Instrumental acoustical measures of crispness in foods. *J. Texture Studies* 16, 153-167.
- KATZ, E.E. and LABUZA, T.P. 1981. Effect of water activity on the sensory crispness and mechanical deformation of snack food products. *J. Food Sci.* 46, 403-409.
- LAI, L.L., CHAN, W.L. and SO, A.T.P. 1997. A two-ANN approach to frequency and harmonic evaluation. *Conference Publication at fifth International Conference on Artificial Neural Networks*. Churchill College, University of Cambridge, UK.
- LEE III, W.E., DEIBEL, A.E., GLEMBIN, A.E. and MUNDAY, E.G. 1988. Analysis of food crushing sounds during mastication: frequency-time studies. *J. Texture Studies* 21, 27-38.
- LIU, X. and TAN, J. 1999. Acoustic wave analysis for food crispness evaluation. *J. Texture Studies* 30, 397-408.
- MOHAMED, A.A.A., JOWITT, R. and BRENNAN, J.G. 1982. Instrumental and sensory evaluation of crispness: 1 - in friable foods. *J. Food Eng.* 1, 55-75.
- PELEG, M. 1994. A mathematical model of crunchiness/crispness loss in breakfast cereals. *J. Texture Studies* 25, 403-410.
- ROUDAUT, G., DACREMONT, C. and LE METSE, M. 1998. Influence of water on the crispness of cereal-based foods: Acoustic, mechanical and sensory studies. *J. Texture Studies* 29, 199-213.
- SEYMOUR, S.K. and HAMANN, D.D. 1984. Design of a microcomputer-based instrument for crispness evaluation of food products. *Trans. Am. Soc. Agr. Eng.* 27(4), 1245-1250.
- SEYMOUR, S.K. and HAMANN, D.D. 1988. Crispness and crunchiness of selected low moisture foods. *J. Texture Studies* 19, 79-95.
- SHERMAN, P. and DEGHAIDY, F.S. 1978. Force-deformation conditions associated with the evaluation of brittleness and crispness in selected foods. *J. Texture Studies* 9, 437-459.
- SUWONSICHON, T. and PELEG, M. 1998. Instrumental and sensory detection of simultaneous brittleness loss and moisture toughness in three puffed cereals. *J. Texture Studies* 29, 225-274.
- VICKERS, Z.M. 1980. Food sounds: how much information do they contain. *J. Food Sci.* 45, 1494-1496.
- VICKERS, Z.M. 1983. Pleasantness of food sounds. *J. Food Sci.* 48, 783-786.
- VICKERS, Z.M. 1984. Crispness and crunchiness: a difference in pitch? *J. Texture Studies* 15, 157-163.
- VICKERS, Z.M. 1985. The relationships of pitch, loudness and eating technique to judgments of the crispness and crunchiness of food sounds. *J. Texture Studies* 16, 85-95.

- VICKERS, Z.M. 1987. Sensory, acoustical, and force-deformation measurements of potato chip crispness. *J. Food Sci.* 52(1), 138-140.
- VICKERS, Z.M. 1988. Evaluation of crispness. In *Food Structure — Its Creation and Evaluation*, (J.M.V. Blanshard and J.R. Mitchell, eds.) pp. 433-448, Butterworths, London.
- VICKERS, Z.M. 1991. Sound perception and food quality. *J. Food Quality* 14, 87-96.
- VICKERS, Z.M. and BOURNE, M.C. 1976a. Crispness in foods — a review. *J. Food Sci.* 41, 1153-1157.
- VICKERS, Z.M. and BOURNE, M.C. 1976b. A psychoacoustical theory of crispness. *J. Food Sci.* 41, 1158-1164.
- VICKERS, Z.M. and CHRISTENSEN, C.M. 1980. Relationship between sensory crispness and other sensory and instrumental parameters. *J. Texture Studies* 11, 291-307.
- VICKERS, Z.M. and WASSERMAN, S.S. 1979. Sensory qualities of food sounds based on individual perceptions. *J. Texture Studies* 10, 319-332.
- Ward System Group, Inc. 1995. NeuroShell2 manual. Executive Park West, 5 Hillcrest Drive, Frederick, MD.

PATENT COOPERATION TREATY

PCT/IB2008/002933

PCT

NOTIFICATION OF RECEIPT OF RECORD COPY

(PCT Rule 24.2(a))

From the INTERNATIONAL BUREAU

006943.02502

To:

ROKOS, Rebecca, P.
Banner & Witcoff, Ltd.
10 South Wacker Drive
Suite 3000
Chicago, IL 60606-7407
ETATS-UNIS D'AMERIQUE

DOCKETED

JAN 15 2009

Notice Read

Date of mailing (day/month/year) 12 December 2008 (12.12.2008)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference 006943.02502	International application No. PCT/IB2008/002933

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:

CORPORATIVO INTERNACIONAL MEXICANO. S. DE R.L. DE C.V. (for all designated States except US)
SANCHEZ, Velvet et al (for US)

International filing date: 31 October 2008 (31.10.2008)
Priority date(s) claimed: 31 October 2007 (31.10.2007)
Date of receipt of the record copy by the International Bureau: 03 November 2008 (03.11.2008)
List of designated Offices:

AP: BW, GH, GM, KE, LS, MW, MZ, NA, 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, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR
OA: BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG
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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.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Sayegh Nadine e-mail ro.ib@wipo.int Telephone No. +41 22 338 92 22
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Facsimile No. +41 22 910 06 10

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NO

INFORMATION ON 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 39 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 that 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 19 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 19926, 19932 and 19934, 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 limit)**, 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 of 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 16 months from the priority date, provided that any such priority document may still be submitted to the International Bureau before the 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 16-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 16-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 and 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 a 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 16-month time limit (and all other PCT time limits) is the filing date of the earliest application whose priority is claimed (Article 2(xi)(b)).

PATENT COOPERATION TREATY

WO 2009/056971
PCT/IB2008/002933

From the INTERNATIONAL BUREAU

PCTNOTIFICATION CONCERNING
AVAILABILITY OF THE PUBLICATION
OF THE INTERNATIONAL APPLICATION

To:

SUAREZ RAMIREZ, Juan, Carlos
Goodrich, Riquelme y Asociados. A.C.
Paseo de la Reforma 265 Mz. 2
Col. y Deleg. Cuauhtémoc
Mexico 06500 D.F.
MEXIQUE006943.02502
DOCKETED

SEP 16 2009

Publication

Date of mailing (day/month/year)
13 August 2009 (13.08.2009)Applicant's or agent's file reference
006943.02502**IMPORTANT NOTICE**International application No.
PCT/IB2008/002933International filing date (day/month/year)
31 October 2008 (31.10.2008)Priority date (day/month/year)
31 October 2007 (31.10.2007)Applicant
CORPORATIVO INTERNACIONAL MEXICANO. S. DE R.L. DE C.V. et al

The applicant is hereby notified that the International Bureau:

- ☐ has published the above-indicated international application on under
No. WO
- ☒ has republished the above-indicated international application on 13 August 2009 (13.08.2009) under
No. WO 2009/056971
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 published international application.

A copy of the international application is available for viewing and downloading on WIPO's website at the following address:
www.wipo.int/pctdb (in the appropriate field of the structured search, enter the PCT or WO number).

The applicant may also obtain a paper copy of the published international application from the International Bureau by sending an e-mail to
patentscope@wipo.int or by submitting a written request to the contact details provided below.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

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X2

Industria y Comercio
SUPERINTENDENCIA

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO



No. 10-053449- -00000-0000

Fecha: 2010-05-05 16:03:55
Tra. 11 PATENTEIYII
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Dep. 2020 DIR.NUEVASCR
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PATENTE DE INVENCION ☐

MODELO DE U...

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Indicación que se solicita una patente.

Datos de identificación del solicitante o de la persona que presenta la solicitud

Descripción de la invención

Dibujos de ser estos pertinentes

Comprobante de pago de las tasas establecidas (De ser el caso formato de descuento)

Completa ☐

Incompleta ☐

PATENTE DE INVENCION PCT ☒ MODELO DE UTILIDAD PCT ☐ Art.33 Decisión 486/00, Circular Única



Indicación que se solicita una PCT



Copia de la solicitud en español, tal como fue presentada inicialmente (capítulo descriptivo, reivindicatorio, resumen)



Dibujos de ser estos pertinentes



Comprobante de pago de las tasas establecidas (de ser el caso formato de descuento)

Completa ☒

Incompleta ☐

DISEÑO INDUSTRIAL ☐

(Art. 119 Decisión 486/00)



Indicación que se solicita Diseño industrial



Datos de identificación del solicitante o de la persona que presenta la solicitud



Representación gráfica y fotográfica del Diseño industrial o muestra del material que incorpora el diseño



Comprobante de pago de las tasas establecidas

Completa ☐

Incompleta ☐

ESQUEMA DE TRAZADO ☐

(Art. 92 Decisión 486/00)



Indicación que se solicita un esquema de trazado



Datos de identificación del solicitante o de la persona que presenta la solicitud



Representación gráfica de un esquema de trazado



Comprobante de pago de las tasas establecidas

Completa ☐

Incompleta ☐



Bogotá D.C.,
2020

Doctor(a)
RODRIGUEZ D' ALEMAN DILIA MARIA
Apoderado(a) y/o Representante de
CORPORATIVO INTERNACIONAL MEXICANO, S. DE R.L. DE C.V.

REFERENCIA	Radicación No.	10 053449
	Solicitud internacional	PCT/IB2008/002933
	Fecha inicio fase nacional	31/05/2010
	Trámite	11
	Evento	379
	Actuación	430
	Oficio No.	107129

Como resultado del examen de forma, realizado con fundamento en el artículo 38 de la Decisión 486 de la Comisión de la Comunidad Andina, artículo 27 del Tratado de Cooperación en Materia de Patentes (PCT), regla 51 bis del Reglamento y Circular Única de la Superintendencia de Industria y Comercio, se le comunica que:

1. La solicitud no contiene el poder debidamente otorgado, con el lleno de los requisitos exigidos por los artículos 63 y subsiguientes del Código de Procedimiento Civil. Adicionalmente, deberá presentar el documento que acredita la existencia y representación legal de la sociedad solicitante, cuando ésta fuere persona jurídica.
2. El solicitante debe presentar un nuevo título que permita identificar la materia de la cual trata la solicitud, ya que el título relacionado no se encuentra con la precisión necesaria para identificar claramente el objeto de la solicitud de patente. (Regla 4.3 PCT, Art 26-27 D-486, Circular única 5.2.9)
3. La solicitud no contiene la copia del documento en que consta la cesión del derecho a la patente del inventor al solicitante o a su causante, conforme a lo establecido por el artículo 26 literal k) de la Decisión 486 de la Comisión de la Comunidad Andina. Cuando se trate de documentos otorgados en el extranjero, estos deberán legalizarse de conformidad con lo dispuesto por los artículos 259 y 260 del Código de Procedimiento Civil. Cuando se trate de las declaraciones a que hace referencia la Regla 4.17 ii) del Tratado de Cooperación en Materia de Patentes PCT., el alcance de las tales declaraciones se determinará según indiquen claramente una cesión de derechos del inventor al solicitante o su causante, de conformidad con lo dispuesto en el numeral 5.2.15 del Capítulo Quinto, Título X de la Circular Única de Superintendencia de Industria y Comercio.

En cumplimiento de lo dispuesto por el artículo 39 de la Decisión 486, se le requiere para que dentro del término de dos meses siguientes a la fecha de notificación del presente oficio, complete los requisitos anteriormente enunciados. En caso de no dar cumplimiento al presente requerimiento, la solicitud se considerará abandonada y perderá su prelación.

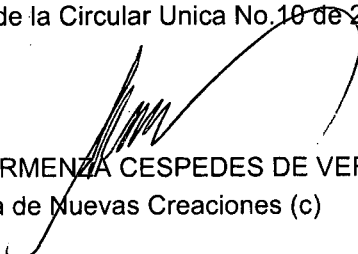
Continúa en la página siguiente...



Continuación radicado No: 10 053449


Industria y Comercio
SUPERINTENDENCIA

Notifíquese el presente oficio conforme a lo dispuesto en el numeral 5.2, literal e), del capítulo quinto del título primero de la Circular Unica No.10 de 2001.


ALIX CARMENZA CESPEDES DE VERGEL
Directora de Nuevas Creaciones (c)

El anterior requerimiento fue notificado por fijación en lista de fecha
adpa11

04 JUN. 2010