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SUPERINTENDENCIA Y COMERCIO
Folios: 56
002 PATENTES D 1 REGISTRO/ 329 COMPLEM

Ref Expediente No. ***00-024.733***
Patente de Invención. ***PRODUCTO TIPO NATA PARA CAFÉ CAPUCCINO CON CARACTERISTICAS MEJORADAS DE FORMACION DE ESPUMA.***
Titular: ***KRAFT FOODS, INC.***

DESTINO: 09

Humberto RUBIO CAMACHO*, mayor de edad, vecino de Santafé de Bogotá D.C., identificado con la cédula de ciudadanía número 17'192.062 de Bogotá, abogado en ejercicio portador de la Tarjeta Profesional No. 50.007 expedida por el Consejo Superior de la Judicatura, en carácter de apoderado de la Sociedad* ***KRAFT FOODS, INC.,*** *me permito anexar:*

1.- *Copia de la solicitud No. 09/286,705 del 06 de Abril de 1999, expedida por la Oficina de Patentes y Marcas de los* ***ESTADOS UNIDOS DE AMERICA****, con su debida traducción al Ingles y al Español, con la cual se basa la prioridad reivindicada, todo de conformidad con el Artículo 4 del Convenio de Paris y concepto del 5 de Enero de 1999, de la Superintendencia de Industria y Comercio.*

Agradezco la atención que se dignen prestar al presente.

Atentamente,

HUMBERTO RUBIO CAMACHO
C.C. 17'192.062 de Bogotá
T.P. 50.007 Consejo Superior de la Judicatura
COD. 4134

1064-01/PI

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TRADUCCIÓN DE UN DOCUMENTO ESCRITO EN INGLES, HOY 2 DE MAYO DEL 2000 EN LA CIUDAD DE SANTAFE DE BOGOTÁ D.C., REPÚBLICA DE COLOMBIA.

NOTA DEL TRADUCTOR: DE LOS DOCUMENTOS QUE SE TRADUCEN A CONTINUACIÓN FORMA PARTE DE UN PAQUETE DE DOCUMENTOS PERTINENTES A UNA PATENTE SOLICITADA EN ESTADOS UNIDOS DE AMÉRICA, TODOS LOS CITADOS DOCUMENTOS ESTÁN UNIDOS MEDIANTE UN GANCHO.

LOS ESTADOS UNIDOS DE AMÉRICA

A TODOS A QUIENES ESTE DOCUMENTO LES INTERESE:

EL DEPARTAMENTO DE COMERCIO DE LOS ESTADOS UNIDOS DE AMÉRICA Oficina de Marcas y Patentes de los Estados Unidos.

Marzo 22, 2000

CERTIFICA QUE LO ANEXO AQUÍ ES UNA COPIA VERDADERA DE LOS ARCHIVOS DE LA OFICINA DE PATENTES Y MARCAS DE LOS ESTADOS UNIDOS DE AMÉRICA DE AQUELLOS PAPELES DE LA SOLICITUD DE PATENTE IDENTIFICADA ABAJO Y QUE CUMPLEN LOS REQUERIMIENTOS PARA CONCEDERLE UNA FECHA DE PRESENTACIÓN BAJO 35 USC 111.

SOLICITUD NUMERO 09/286,705
FECHA PRESENTACIÓN: Abril 06, 1999

Mediante la autoridad otorgada por
EL COMISIONADO DE PATENTES Y MARCAS

(fdo)
H. PHILLIPS
Funcionario Certificador

NOTA DEL TRADUCTOR: EN LA PARTE INFERIOR IZQUIERDA DEL DOCUMENTO HAY UN SELLO DORADO Y EN ALTO RELIEVE DE LA OFICINA DE MARCAS Y PATENTES DE LOS ESTADOS UNIDOS DE AMÉRICA.

REIVINDICACIONES

1. En un producto tipo nata en polvo que comprende proteína, lípido y vehículo, la mejora en la que más del 50% en peso de la citada proteína es proteína de suero de leche parcialmente desnaturalizada, donde la citada proteína de suero de leche parcialmente desnaturalizada está desnaturalizada en un 40 al 90%.

2. Un producto tipo nata según la reivindicación 1 donde la proteína de suero de leche parcialmente desnaturalizada está desnaturalizada en un 50 al 80%.

3. Un producto tipo nata según la reivindicación 1 donde la proteína de suero de leche parcialmente desnaturalizada está desnaturalizada en un 60 al 75%.

4. Un producto tipo nata según la reivindicación 1 donde al menos el 67% en peso de la citada proteína es la citada proteína de suero de leche parcialmente desnaturalizada.

5. Un producto tipo nata según la reivindicación 1 donde al menos el 75% en peso de la citada proteína es la citada proteína de suero de leche parcialmente desnaturalizada.

6. Un producto tipo nata según la reivindicación 1, que comprende además reactivos químicos de carbonatación.

7. Un producto tipo nata según la reivindicación 6, donde los citados reactivos comprenden un ácido y un bicarbonato o carbonato.

8. Un producto tipo nata según la reivindicación 1 donde la citada proteína comprende caseína y donde la relación en peso de suero de leche desnaturalizado:caseína es superior a 1:1.

9. Un producto tipo nata según la reivindicación 8 donde la citada proteína comprende caseína y donde la relación en peso de suero de leche desnaturalizado:caseína es superior a 2:1.

10. Un producto tipo nata según la reivindicación 8 donde la citada proteína comprende caseína y donde la relación en peso de suero de leche desnaturalizado:caseína es superior a 3:1.

11. Un producto tipo nata según la reivindicación 1 donde la citada proteína consiste esencialmente en la citada proteína de suero de leche parcialmente desnaturalizada.

12. Un producto tipo nata según la reivindicación 1 donde la citada proteína esta libre de caseína.

13. Un producto tipo nata según la reivindicación 1 que comprende de 3 a 30% en peso de proteína, 5 a 50% en peso de lípido, y 20 a 92% en peso de vehículo, basado en el peso del producto tipo nata.

14. Un producto tipo nata según la reivindicación 1 que comprende además un edulcorante.

15. Un producto tipo nata según la reivindicación 1 que tiene una densidad aparente de 0,25 a 0,55 g/cc.

16. Un producto tipo nata según la reivindicación 1 que tiene una densidad aparente de 0,1 a 0,25 g/cc.

17. Un método de preparación de un producto tipo nata en polvo que comprende:

proporcionar una suspensión acuosa espesa que puede secarse por pulverización que comprende proteína, lípido y vehículo, siendo más de un 50% en peso de la citada proteína proteína de suero de leche:

calentar la citada suspensión acuosa espesa a una temperatura y durante el tiempo suficiente para desnaturalizar parcialmente la citada proteína de suero de leche de manera que la proteína de suero de leche parcialmente desnaturalizada quede desnaturalizada en un 40 a 90%;

y secar por pulverización la citada suspensión acuosa espesa para proporcionar un producto tipo nata en polvo que comprende proteína, lípido, y vehículo, donde más del 50% de la proteína del citado producto tipo nata es proteína de suero de leche parcialmente desnaturalizada que está desnaturalizada en un 40 a 90%.

18. Un método según la reivindicación 17 donde la citada proteína de suero de leche de la citada suspensión espesa comprende concentrado de proteína de suero de leche.

19. Un método según la reivindicación 17 donde la citada proteína de suero de leche de la citada suspensión espesa comprende aislato de proteína de suero de leche.

20. Un método según la reivindicación 17 donde la citada proteína de suero de leche parcialmente desnaturalizada del citado producto tipo nata está desnaturalizada en un 50 a 80%.

21. Un método según la reivindicación 20 donde la citada proteína de suero de leche parcialmente desnaturalizada del citado producto tipo nata está desnaturalizada en un 60 a un 75%.

22. Un método según la reivindicación 17 donde al menos el 67% de la citada proteína del citado producto tipo nata comprende la citada proteína de suero de leche parcialmente desnaturalizada.

23. Un método según la reivindicación 17 donde al menos un 75% de la citada proteína del citado producto tipo nata comprende la citada proteína de suero de leche parcialmente desnaturalizada.

24. Un método según la reivindicación 17 donde la citada proteína del citado producto tipo nata comprende caseína y donde la relación en peso de suero desnaturalizado:caseína es mayor de 1:1.

25. Un método según la reivindicación 17 donde la citada proteína del citado producto tipo nata comprende caseína y donde la relación en peso de suero de leche desnaturalizado:caseína es mayor de 2:1.

26. Un método según la reivindicación 17 donde la citada proteína del citado producto tipo nata comprende caseína y donde la relación en peso de suero de leche desnaturalizado:caseína es mayor de 3:1.

27. Un método según la reivindicación 17 donde la citada proteína del citado producto tipo nata consiste esencialmente en proteína de suero de leche parcialmente desnaturalizada.

28. Un método según la reivindicación 17 donde la citada proteína del citado producto tipo nata está libre de caseína.

29. Un método según la reivindicación 17 donde la citada proteína del citado producto tipo nata comprende de 3 a 30% en peso de proteína, 5 a 50% en peso de lípido, y 20 a 92% en peso de vehículo, basado en el peso del producto tipo nata.

30. Un método según la reivindicación 17 donde el citado producto tipo nata tiene una densidad aparente de 0,1 a 0,25 g/cc.

31. En una composición de mezcla seca en polvo de capuccino caliente instantáneo que comprende un componente café hidrosoluble y un componente de producto tipo nata en polvo que comprende proteína, lípido y vehículo, la mejora donde más del 50% en peso de la citada proteína del citado componente de producto tipo nata es proteína de suero de leche

parcialmente desnaturalizada, donde la citada proteína de suero de leche parcialmente desnaturalizada está desnaturalizada en un 40 a 90%.

32. Una composición de capuccino según la reivindicación 31 donde la proteína de suero de leche parcialmente desnaturalizada está desnaturalizada en un 50 a 80%.

33. Una composición de capuccino según la reivindicación 31 donde la proteína de suero de leche parcialmente desnaturalizada está desnaturalizada en un 60 a 75%.

34. Una composición de capuccino según la reivindicación 31 donde al menos un 67% en peso de la citada proteína es la citada proteína de suero de leche parcialmente desnaturalizada.

35. Una composición de capuccino según la reivindicación 31 donde al menos un 75% en peso de la citada proteína es la citada proteína de suero de leche parcialmente desnaturalizada.

36. Una composición de capuccino según la reivindicación 31 donde la citada proteína comprende caseína y donde la relación en peso de suero de leche desnaturalizado:caseína es superior a 1:1.

37. Una composición de capuccino según la reivindicación 31 donde la citada proteína comprende caseína y donde la relación en peso de suero de leche desnaturalizado:caseína es superior a 2:1.

38. Una composición de capuccino según la reivindicación 31 donde la citada proteína comprende caseína y donde la relación en peso de suero de leche desnaturalizado:caseína es superior a 3:1.

39. Una composición de capuccino según la reivindicación 31 donde la citada proteína consiste esencialmente en la citada proteína de suero parcialmente desnaturalizada.

40. Una composición de capuccino según la reivindicación 31 donde la citada proteína está libre de caseína.

41. Una composición de capuccino según la reivindicación 31 donde el producto tipo nata comprende de 3 a 30% en peso de proteína, 5 a 50% en peso de lípido y 20 a 92% en peso de vehículo, basado en el peso del producto tipo nata.

42. Una composición de capuccino según la reivindicación 31 donde el producto tipo nata tiene una densidad aparente de 0,25 a 0,55 g/cc.

43. Una composición de capuccino según la reivindicación 31 donde el compuesto tipo nata tiene una densidad aparente de 0,1 a 0,25 g/cc.

44. Una composición de capuccino según la reivindicación 31 que comprende además reactivos químicos de carbonatación.

45. Una composición de capuccino según la reivindicación 44 donde los citados reactivos comprenden un ácido y un bicarbonato o carbonato.

46. Una composición de capuccino según la reivindicación 31 que comprende además un componente edulcorante.

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PA 224883

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

March 22, 2000

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A FILING DATE UNDER 35 USC 111.

APPLICATION NUMBER: *09/286,705* ✓
FILING DATE: *April 06, 1999*

By Authority of the
COMMISSIONER OF PATENTS AND TRADEMARKS

H. PHILLIPS
Certifying Officer

JC586 U.S. PTO
04/06/99

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Kraft Foods

Thomas A. Marcoux
Senior Patent Counsel
Corporate Law Department

Date: April 6, 1999

JC542 U.S. PTO
09/286705
04/06/99

Box Patent Application
Assistant Commissioner for Patents
Washington, D.C. 20231

Re: Our Case: **21559**

Sir:

Transmitted herewith for filing is the Patent Application of inventor(s)
Bary Lyn Zeller
Raymond Martin McGarvey
James Anthony Schulok
for invention entitled:

Cappuccino Creamer With Improved Foaming Characteristics

Enclosed are:

1. Complete application of **39** page(s) of text, which includes **1** page of abstract and **7** page(s) of claims, **46** claim(s) in all, with **3** independent claim(s), **No** multiple dependent claim(s) and **No** page(s) of drawings.

2. Declaration and Power of Attorney.
3. Information Disclosure Statement with PTO-1449 and **18** references.
4. Assignment together with Recordation Form Cover Sheet (Form PTO-1595).
5. Self-addressed post card to be returned after being stamped to indicate receipt of the foregoing in the Patent Office.

CERTIFICATION UNDER 37 CFR 1.10

I hereby certify that this New Application Transmittal and the documents referred to as enclosed therein are being deposited with the United States Postal Service on this date 4/6/99 in an envelope as "Express Mail Post Office to Addressee" Mailing Label Number EL380833953US addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.

Diana D. Winters
(Type or print name of person mailing paper)
Diana D Winters
(Signature of person mailing paper)

tam0138/d

Kraft Foods, Inc. 800 Westchester Avenue • Rye Brook, NY 10573 • Phone 914 335 9220 • Fax 914.335.9644

Please charge our Deposit Account No. 07-0885 in the amount of $1228.00. The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Account No. 07-0885. **One copy of this letter is enclosed for accounting purposes.**

Please address all communications to:

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Very truly yours,

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CAPPUCCINO CREAMER WITH IMPROVED FOAMING CHARACTERISTICS

Background of the Invention

Particulate creamers, i.e. particulate products for whitening coffee, tea and other beverages, have been known for many years and are in wide use. Particulate creamers include a lipid, a carrier, and protein and are usually made by spray drying an aqueous slurry.

Particulate creamers are also used for whitening of beverages, such as hot cappuccino, which are characterized by a surface foam. Particulate non-foaming creamers produced by conventional spray drying methods, when dissolved in hot water, coffee, or the like, will cause the formation of negligible surface foam. The amount of foam produced by dissolution of the creamer particles can be increased by injecting an inert gas during spray drying. Foam may also be obtained by utilizing chemical carbonation reagents with the particulate creamer. Gas-injected particulate creamers are described, for example, in Hedrick, U.S. Patent No. 4,438,147, Kuypers, U.S. Patent No. 4,746,257, and Kuypers, U.S. Patent No. 4,748,040. Chemical carbonation systems suitable for use with particulate creamers are described, for example, in Agbo et al., U.S. Patent No. 5,780,092 and Zeller et al., U.S. Patent No. 5,721,003. A chemical carbonation system may also be employed with a gas-injected creamer.

Hot cappuccino beverages may be prepared from brewed coffee or from instant hot cappuccino dry-mix compositions

containing instant coffee such as those described in the Agbo et al. and Zeller et al. patents mentioned above.

It is an object of the present invention to provide a particulate creamer which, upon reconstitution in a hot coffee beverage, provides a thick, creamy foam having a semi-solid texture similar to that of the surface foam provided by steamed milk in conventional brewed hot cappuccino beverages.

It is a further object of the invention to provide such a particulate creamer which provides such foam when reconstituted in a hot brewed coffee beverage.

It is a further object of the invention to provide such a particulate creamer which contains chemical carbonation reagents which augment the amount of such foam.

It is a further object of the invention to provide particulate, dry mix, instant hot cappuccino compositions which contain such particulate creamers.

It is a further object of the invention to provide a spray drying method for preparing such particulate creamers and to provide a spray-dryable aqueous composition useful in the spray drying method.

Brief Summary of the Invention

The foregoing and other objects which will be apparent to those of ordinary skill in the art from the detailed description which follows are achieved in accordance with the invention by providing:

a particulate creamer comprising protein, lipid, and carrier, in which more than 50% by weight of said protein is partially denatured whey protein, said partially denatured whey protein being from 40 to 90% denatured;

a particulate creamer as just described further comprising chemical carbonation reagents;

a method of preparing a particulate creamer which comprises

providing an aqueous spray-dryable slurry which comprises protein, lipid and carrier, more than 50% by weight of said protein being whey protein, heating said aqueous slurry at a temperature and for a time sufficient to denature said whey protein such that the whey protein is 40 to 90% denatured, and spray drying said aqueous slurry to provide a particulate creamer comprising protein, lipid, and carrier wherein more than 50% of said protein is whey protein which is from 40 to 90% denatured; and

a particulate, dry mix, instant hot cappuccino composition comprising water soluble coffee and a particulate creamer in accordance with the invention.

Detailed Description of Preferred Embodiments

A particulate creamer in accordance with the invention include, as essential constituents, protein, lipid, and carrier.

The major constituent of the protein component of the present creamers is whey protein. More than 50% by weight, preferably at least 67% by weight, and more preferably at least 75% by weight, of the protein is whey protein. The whey protein is from 40-90% denatured, preferably 50-80% denatured, and more preferably 60-75% denatured. If the whey protein denaturation is less than 40%, the semi-solid foam texture is not realized. Denaturation in excess of 90% will produce an amount of functional undenatured whey protein which is insufficient to adequately emulsify and incorporate the oil in the creamer slurry.

The total protein content of the creamer, as well as the content of partially denatured whey protein by weight, is suitably about 3-30%, preferably 5-20% and more preferably 10-15% by weight. These percentages and others set forth hereinafter are on a dry weight basis and are based on the solids content of the composition in question.

The extent of protein denaturation may be determined by the well established technique of differential scanning calorimetry (DSC) in which the amount of heat absorption during complete thermal denaturing of a whey protein creamer is compared with heat absorption during complete thermal denaturing of a completely undenatured reference. A suitable reference is freeze-dried whole milk (FDWM) having the same lipid and moisture content as the whey protein creamer. The whole milk reference is appropriate because whey protein powders which do not contain encapsulated lipid do not have

the mobility to be properly and completely denatured during the DSC scan. The DSC technique is further described in connection with Example 1.

The partially denatured whey protein component of the creamer can be obtained from any source of whey protein, but is preferably obtained from a whey protein concentrate or a whey protein isolate.

Whey protein concentrate (WPC) powder is prepared from liquid whole milk by separating the fat from the milk, acid-precipitating casein from solution, subjecting the solution to ultrafiltration to remove a portion of the lactose from solution, and spray-drying. WPC powders generally contain 25 to 80% protein by dry weight. Whey protein isolate (WPI), on the other hand, is WPC from which a greater amount of lactose has been removed by ultrafiltration. WPI powders contain over 80% protein by dry weight. WPC and WPI are both prepared under mild conditions to prevent protein denaturation. Any denatured proteins which do form during processing are excluded from the product during ultrafiltration. The result is an undenatured whey protein powder which retains excellent water solubility, protein functionality, and nutritional quality. A wide variety of whey protein powders are commercially available which have been designed to provide special characteristics such as improved damage from high temperature thermal processing or from acidic environments.

The heat-sensitive globular protein ß-lactoglobulin accounts for more than 60% of the protein in whey powders.

ß-lactoglobulin can undergo time- and temperature-dependent denaturation when solutions of whey protein are heated to over 65° C. During denaturation, its structure partially unfolds, exposing hydrophobic groups and reactive sulfhydryl groups which can enter into polymerization reactions resulting in gelation and reduced solubility. Other protein fractions in whey protein also undergo denaturation, but most of the functionality of whey protein is derived from ß-lactoglobulin.

The objective of the present invention is to utilize in the creamer slurry whey protein which has been partially denatured to an extent sufficient to reduce its solubility and such that it will provide a considerable amount of hydrated uniformly dispersed insoluble protein to act as an effective gas entrapping medium, foam texturizer, and stabilizer when the spray-dried creamer is reconstituted in a beverage, particularly when combined with a chemical carbonation system. The product of the invention contains buoyant, hydrated, insoluble, non-colloidal, irregularly shaped, whey protein particles, approximately 10-200 microns in size, with an average particle size of about 60 microns, which would not provide coffee whitening or creamy mouthfeel without inclusion of a significant amount of encapsulated fat. The large particle size of the denatured protein in the present creamer surprisingly does not impart an objectionable mouthfeel likely due to a combination of several factors: the denatured protein is extensively hydrated; it contains encapsulated fat

and air bubbles; and it is concentrated in the foam to an extent which imparts a desirable semi-solid texture.

It was surprisingly found that a considerable portion of the whey protein could be extensively denatured and its solubility greatly reduced without resulting in either destabilization of the oil-in-water emulsion formed after thorough mixing of the creamer components, or precipitation of protein aggregates in a reconstituted beverage. The partially denatured protein is easily suspended in the beverage and is preferentially suspended in the foam, especially when chemical carbonation reagents are used to supplement foam volume. It appears that gas bubbles easily become attached to and provide buoyancy to the somewhat hydrophobic, suspended partially denatured protein to carry it to the surface of the beverage where it builds and stabilizes the foam. An even more surprising result is that creamers spray-dried without gas injection under conditions which produce a moderate to high density powder possess a sufficient amount of entrapped gas and/or inherent whey buoyancy to provide a smaller, but continuous and stable, foam layer in a beverage reconstituted without the use of chemical carbonation reagents.

Any method and conditions capable of denaturing the whey protein can be employed. Denaturation is most conveniently carried out by heating the whey protein at a temperature of over 140° F. for a time sufficient to alter its structure and reduce its solubility to an extent that provides a considerable amount of hydrated insoluble protein that acts as

an effective gas entrapping medium, foam texturizer, and stabilizer when the foamed creamer is reconstituted in a beverage. This heating step is preferably conducted by heating a slurry of undenatured whey protein at a temperature of 140° to 160°F for a time sufficient to effect a desired extent of denaturation in accordance with the invention. In general, a time period within the range of 15 minutes to two hours will be suitable, depending on the temperature and desired extent of denaturation. Higher temperatures can be used to shorten heating time, such as would prevail in established HTST or UHT methods. The denaturation of the whey protein can be conducted before preparing the creamer and the denatured whey protein thereafter mixed with the other components of the creamer. Most advantageously, however, the denaturation is effected by first preparing the creamer slurry and then heating the slurry, preferably at a pH of 6.5 to 7.5. As mentioned above, the partially denatured whey protein component is suitably present in the dry mix or precursor creamer of the invention in an amount of about 3 to 30% by weight, preferably 5 to 20% by weight and most preferably 10 to 15% by weight on a dry weight basis.

The creamer of the invention is particularly effective when dry mixed with chemical carbonation reagents, and optionally with other ingredients such as sweeteners, and flavors, for reconstitution in a hot beverage, especially brewed coffee, to produce a whitened beverage which is characterized by a creamy semi-solid surface foam comprising

gas bubbles trapped within a hydrated insoluble protein suspension. The foam is closer in appearance and texture to steamed milk foam than to conventional instant cappuccino foam. The suspended hydrated partially denatured whey protein particles in the creamer provide a thick blanket which effectively coats and traps the gas bubbles in the foam. Not only is greater volume of foam generated, but an opaque, rich, creamy appearance more characteristic of steamed milk is provided due to virtual disappearance of the gas bubbles. In contrast, foams produced from conventional instant cappuccino powders typically appear much more watery and less creamy since the gas bubbles in the foam are coated by thinner, fairly transparent films which can give the foam an appearance more like soap bubbles than steamed milk.

It was surprising that when used with chemical carbonation reagents, the creamer provides a greater volume of foam having a creamier texture when used in brewed coffee than in instant cappuccino. It is believed that because brewed coffee is an acidic beverage, the bicarbonate in the creamer powder reacts instantly to produce a greater number of smaller bubbles which are more uniformly dispersed throughout the beverage. Also it is believed that the acidity causes formation of a greater amount of insoluble whey protein in brewed coffee. Unlike casein, undenatured whey protein is not pH-sensitive and readily dissolves in acidic solution. However, whey protein is rendered increasingly pH-sensitive with denaturation, resulting in lowered solubility in acidic

solution. Therefore, adding the creamer to brewed coffee (pH~5) should produce a greater amount of hydrated insoluble protein than when the creamer is added to water.

It is a particular advantage that the creamer of the invention may contain no casein. Use of conventional creamers containing casein in combination with citric or other strong acids results in formation of floating protein aggregates on the surface of the beverage which become visible after the foam dissipates. The formation of such aggregates is easily avoided by providing a casein-free creamer in accordance with the invention. However, it is possible to use a creamer according to the invention which also contains a limited amount of casein, either dry-mixed or inherent in the creamer, without producing undesirable rafts of floating casein aggregates. The semi-solid hydrated partially denatured whey protein will hide the denatured casein.

Localized denaturation of protein leads to the formation of undesirable floating aggregates. However, if the creamer contains uniformly partially denatured protein, then aggregates with a foreign appearance do not occur. It is believed that localized casein denaturation occurs in the vicinity of each citric or other acid crystal when the acid dissolves into a beverage containing the soluble creamer. These denatured proteins then aggregate into large clumps, typically 5-50 in number, on the surface of the beverage. Non-fat dry milk (NFDM) is typically used to formulate instant cappuccino creamers. NFDM contains approximately 37% protein,

of which about 80% is casein. Therefore, traditional creamers contain a significant amount of casein which can not escape denaturation with citric and other acids used in chemical carbonation systems. In contrast, the denatured whey creamer of the present invention contains a countless number (probably millions) of evenly dispersed partially denatured protein particles having an average particle size of from 20 to 100 microns which give the foam a uniform appearance. If the beverage contains a minor amount of denatured casein, it can be dispersed throughout the semi-solid foam, masking its appearance and preventing aggregation into large particles. Thus, the present creamer can tolerate some amount of casein provided that the whey is sufficiently partially denatured in accordance with the invention.

Partial denaturation of whey results in greater foam volume and texture, but lower beverage whitening as compared to conventional coffee whiteners. Therefore it is an advantage that the creamer may include casein or other protein to enhance beverage whitening while still retaining desirable foaming performance. The denatured whey:casein ratio of the protein of the creamer of the invention is greater than 1:1, preferably at least 2:1, and more preferably at least 3:1. Moreover, as mentioned above, the creamer may be casein-free.

The lipid component of the foaming creamer particles can be a dairy or non-dairy fat, preferably having a melting point of at least 100° F. Suitable non-dairy fats include partially hydrogenated vegetable oil having a melting point of about

100° to 120° F. Preferred non-dairy lipids include partially hydrogenated soybean oil, coconut oil, and palm kernel oil.

Total lipid content of the creamer, including any lipid that is present as such or which may be present with the proteinaceous component or the carrier component of the creamer, is suitably 5 to 50%, preferably 10 to 35% and more preferably 25 to 35%, based on the weight of the dry mix creamer.

Suitable carriers are spray-drying carriers and include gum arabic and water soluble carbohydrates, such as maltodextrin, lactose, corn syrup solids, and sugars. Preferred water soluble carbohydrates include corn syrup solids or lactose or, for a sugar-free product, maltodextrin. The total amount of carrier in the creamer particles is generally about 20 to 92%, preferably 30 to 55%, based on the weight of the creamer.

Carrier may be added separately or may be present along with the protein constituent of the creamer. For example, whey protein powders may contain lactose. Where reference is made to the carrier content of the creamer particles, the content is intended to include all of the carrier that is present in the creamer particles, and not just carrier which may be present in the creamer particles as such. The same is true with respect to the protein content and the lipid content of the creamer.

Optionally, emulsifiers such as a modified starch or a surfactant commonly added to creamers may also be included.

When the creamer contains a sufficient amount of a partially denatured whey protein in accordance with the invention, the addition of such emulsifiers will not be required since the partially denatured whey protein inherently provides this function. When used, a preferred modified starch component is a water-soluble emulsion-stabilizing lipophilic food starch such as N-Creamer-46 starch (National Starch and Chemical Company) in an amount of about 5 to 20% by weight of the creamer. The preferred surfactant is a high HLB emulsifier, such as sodium stearoyl lactylate or polysorbate.

In a preferred method of preparing the creamer, undenatured whey protein, lipid, carrier, and optional ingredients are slurried with water, and the slurry is heated in a manner discussed above to partially denature the whey protein. The resulting mixture is then preferably homogenized before spray drying. Alternatively, the whey protein may be partially denatured beforehand and mixed with the other creamer components to form an aqueous slurry therewith.

The aqueous composition which forms the precursor of the creamers comprises solids in an amount sufficient to permit the slurry to be spray dried in conventional equipment. Generally, the solids content of such slurries will be from 30-70%, preferably 45-60% by weight, based on the weight of the slurry.

Spray drying may be carried out with or without gas injection. Where gas injection is not carried out, density of the creamer particles is generally about 0.25-0.55 g/cc and

preferably about 0.3-0.4 g/cc. When gas injection is carried out, density is generally about 0.1 to 0.25 g/cc and preferably about 0.15-0.2 g/cc. Suitable gasification techniques are disclosed in U.S. Patent No. 4,438,147; U.S. Patent No. 4,746,257; and U.S. Patent No. 4,748,040. It is a particular advantage of the invention that the creamer particles can be dry-mixed with chemical carbonation reagents without causing the formation of visible floating casein aggregates. High density creamers, i.e. those having a density of about 0.25 to 0.55 g/cc are preferred for such products.

The creamers may be used alone to whiten coffee beverages and at least in a brewed coffee beverage will create a significant but generally low amount of a creamy and solid foam which is similar to that of steamed milk foam and which has a high degree of consumer liking, particularly with respect to foam appearance and texture. However, it is a significant advantage that the partially denatured whey creamers of the invention can be dry mixed with chemical carbonation reagents to provide foaming creamers which produce large amounts of foam, particularly when used to whiten brewed coffee, without forming undesirable floating casein aggregates.

Particulate chemical carbonation reagents may be dry-mixed with the spray dried creamer particles to form the preferred foaming creamer compositions of the invention. The

creamer particles of the preferred compositions may be gasified, but are preferably non-gasified.

Suitable chemical carbonation components include a food grade acidulant and an alkali metal bicarbonate or carbonate. The food grade acid is in particulate form, and can be any food grade acid or acids capable of rapidly neutralizing the bicarbonate or carbonate component. Preferred food grade acids include citric acid. Less preferred food grade acids include organic acids such as malic, fumaric, lactic, and tartaric acid, glucono-delta-lactone, acidic food grade gums such as alginic acid, gum arabic, low methoxy pectin and modified cellulose gums, and leavening acids. The term "acid" as used herein to describe the acidic chemical carbonation reagent is intended to include acid salts or anhydrides.

The bicarbonate or carbonate component of the chemical foam-generating system is soluble in hot water, is preferably provided in particulate form, and is preferably a bicarbonate, more preferably an alkali metal bicarbonate, and most preferably potassium bicarbonate. A sodium salt may also be used but the potassium salt can be used in a greater amount without an adverse effect on beverage flavor.

The amount of the bicarbonate or carbonate to be included in the creamer is dependent on the amount of foam which is intended to be produced. A preferred amount of the bicarbonate or carbonate, when present, is from 1 to 7% and more preferably from 2 to 5%, based on the creamer weight. The amount of acid reagent to be included in the creamer

preferably depends on the acidity of the coffee beverage to be whitened. In order to reduce cost, it is preferred to use as little of the acid reagent as possible, while at the same time causing full neutralization of the bicarbonate or carbonate in order to maximize the amount of CO_2 generated. Since the coffee beverage will have some acidity, it is therefore preferred to use less acid reagent than would be required to fully neutralize the bicarbonate or carbonate in the absence of the acidity of the coffee beverage. In general, the amount of acid will suitably be from 50 to 100%, and preferably from 75 to 100%, of the amount of acid that would be required, by itself, to fully neutralize the bicarbonate or carbonate.

The creamers may be packaged and used as such or they may be dry-mixed with chemical carbonation reagents, sweeteners, flavors, and other ingredients conventional in spray dried powder creamers. The creamers may also be used in particulate, instant hot cappuccino compositions. It is preferred, however, to dry mix the creamer with chemical carbonation reagents, preferably with a sweetener and optional flavor, for providing a foaming creamer for a brewed coffee beverage.

When a sweetener is present with the creamer, it is present in an amount such that the coffee beverage is appropriately sweetened when an amount of the sweetened creamer is used which will whiten a coffee beverage to a generally acceptable amount and/or which will provide a coffee beverage with a generally acceptable amount of surface foam.

Where sucrose is the sweetener, an amount of from 50 to 200%, based on the weight of the creamer, is generally suitable. Other sweeteners, both natural and artificial and either alone or in combination may be employed, preferably in an amount to give essentially the same amount of sweetness as sucrose in the amount stated.

When it is desired to reduce or eliminate the sugar content of the formulation and incorporate one or more artificial sweeteners, a bulking agent such as maltodextrin may be substituted for substantially the same amount of sugar. Thickening agents, such as food grade gums, may also be employed to enhance mouthfeel of the beverage.

The creamers of the present invention may also be employed in particulate dry mix instant hot cappuccino compositions which generally include a soluble coffee component, a foaming creamer component (which may be a gas-injected creamer, a non-gas-injected creamer combined with chemical carbonation reagents, or both) a sweetener component, and optional ingredients such as bulking agents, flavor, and the like. The present denatured whey creamers may be substituted for some or all of the creamer component of such compositions.

Example 1

This example demonstrates the difference in foaming performance between creamers having the same composition but different degrees of denaturation.

A batch tank was filled with water and the water heated to 120°F. A dry mix of 15 parts by weight New Zealand Milk Products, Inc. Alacen 855 Whey Protein Concentrate (WPC) and 55 parts by weight 24 DE corn syrup solids (CSS) was added to the heated water and mixed for 15 minutes. 30 parts by weight of melted partially hydrogenated soybean oil (PHSBO) was added and mixed for 15 minutes while raising the temperature to 160°F for 45 minutes. A portion of the slurry was homogenized using a two-stage homogenizer, set to 2200 psi for the first stage and 500 psi for the second stage, and spray-dried through a high-pressure nozzle at 600 psi to make **Creamer A.**

The remaining slurry was maintained at 160°F for an additional 45 minutes (90 minutes total) and another portion then homogenized and spray-dried to make **Creamer B.** The final remaining slurry was maintained at 160°F for an additional 30 minutes (120 minutes total) and then homogenized and spray-dried to make **Creamer C.** All three dried creamers had a moisture content of less than 3% and were composed of 15% WPC, 30% PHSBO, and 55% CSS on a dry weight basis. Dried Creamer A had on off-white color, Creamer B a light yellow color, and Creamer C a darker yellow color similar to that of butter.

The extent of whey protein denaturation in each spray-dried creamer was measured using Differential Scanning Calorimetry (DSC). For each creamer, two distinct regions of heat absorption corresponding to melting of the encapsulated PHSBO, centered at 95°F, and denaturation of whey protein, centered at approximately 160°F, were identified. A re-scan

of the same samples produced only the PHSBO melting region since the whey protein was completely and irreversibly denatured as a result of the first scan. The more the whey protein is denatured during creamer production, the less heat it absorbs during the DSC scan. The extent of whey protein denaturation was calculated for each creamer by subtracting the measured DSC whey protein heat absorption from that of a completely undenatured Freeze-Dried Whole Milk (FDWM) reference having the same encapsulated fat level. The extent of the denaturation of the whey protein in each of the creamers is reported in Table 1.

Light microscopy was used to document the comparably large size of the denatured whey protein particles in the product of the present invention which clearly distinguishes it from conventional foaming cappuccino creamers. Analysis of Creamer B revealed the widespread presence of irregularly shaped, large denatured whey particles approximately 10-200 microns in size, with an average particle size of about 60 microns. Similar analysis of a control product, a conventional gasified foaming cappuccino creamer used commercially to formulate Maxwell House Cafe™ Cappuccino, revealed only very small (approximately micron-sized) particles. The hydrated insoluble protein particles in the present creamer have sufficient buoyancy to float and build on the surface of the beverage, when reconstituted, to create a small head of semi-solid foam, even without gas injection during spray-drying or the use of chemical carbonation

reagents. Microscopy also revealed the presence of numerous protein-encapsulated air bubbles in the creamer which surely contribute to buoyancy.

Creamer foaming performance was measured by dry blending with sugar and chemical carbonation reagents and reconstituting the mixture with 250 mL of 160°F brewed coffee in a graduated 60mm-wide cylindrical column and measuring the thickness of the foam head versus time. The mixture was comprised of 9.8g of creamer containing 1.5g WPC containing 1.2g whey protein, 10.0g sugar, 0.225g citric acid, and 0.375g potassium bicarbonate. A solid foam texture was obtained for each creamer. The initial foam height and foam height after one, two, three and five minutes, for each of the creamers are reported in Table 1.

Table 1: Foaming Performance versus Extent of Whey Protein Denaturation

Creamer	WPC Content	Whey Protein Denaturation	Foam Type	Foam Initial (mm)	Foam 1 min. (mm)	Foam 2 min. (mm)	Foam 3 min. (mm)	Foam 5 min. (mm)
A	15%	49%	solid	22	18	15	13	12
B	15%	66%	solid	24	20	18	16	14
C	15%	74%	solid	25	21	19	18	17
D	15%	15%	gas	10	7	6	5	4

Comparison Example A

Creamer D having the same composition as creamers A, B and C was prepared by the general procedure as for creamers A, B and C but employed a milder thermal denaturation to produce only 15% denaturation of the whey protein. In this case the creamer slurry was held at 160°F for only 10 minutes after

addition of the Alacen 855 WPC. The creamer slurry was homogenized using a single-stage homogenizer at 500 psi and spray-dried using a high-pressure nozzle. Creamer D was tested as in Example 1. As reported in Table 1, creamer D produced a much smaller volume of foam having a gaseous texture.

Example 2

This example demonstrates that a lipophilic starch can be used without adversely affecting the foaming performance of creamers containing whey protein. However, as shown in Comparison Example B, its use in formulating creamers without whey protein is not effective in producing stable foams. Dry-mix addition of undenatured or insufficiently denatured whey protein to such creamers is also not effective, as shown in Comparison Example C.

A batch tank was filled with water and heated to 160°F. A dry mixture of 10 parts by weight National Starch, Inc. N-Crearner-46 starch and 55 parts by weight 24 DE CSS was added and mixed for 15 minutes. 5 parts by weight Alacen 855 WPC was added and mixed for 15 minutes followed by addition of 30 parts PHSBO. The resulting 45%-solids slurry was held with continuous mixing at 160°F for an additional 45 minutes and then homogenized and spray-dried to make **Creamer E**. The extent of whey protein denaturation was 70%.

The foaming performance of Creamer E was measured by dry blending it with chemical carbonation reagents and

reconstituting the mixture with 240 mL of 160°F brewed coffee in a graduated 60mm-wide cylindrical column and measuring the thickness of the foam head versus time. The mixture used was comprised of 9.8g of creamer containing 0.5g WPC containing 0.4g whey protein, 0.225g citric acid, and 0.375g potassium bicarbonate. A solid foam texture was obtained. The results are reported in Table 2.

Comparison Example B

Creamer F was prepared using the procedure of Example 2 using 15 parts by weight N-Creamer-46, 55 parts by weight 24 DE CSS, 30 parts by weight PHSBO, and no WPC. 8.8g creamer was dry blended with 1.0g Alacen 855 WPC containing 0.8g whey protein, 0.225g citric acid, and 0.375g potassium bicarbonate and the foaming performance measured using the method described in Example 2. As reported in Table 2, gaseous foam texture was obtained. Even though the mixture contained twice the level of whey protein as formulated in Creamer E, Creamer F exhibited very poor performance because the whey protein was undenatured.

Comparison Example C

Creamer G was prepared using the procedure of Example 2 above except that the slurry was held for only 15 minutes after addition of the WPC. The creamer was formulated using 5 parts by weight N-Creamer-46, 15 parts by weight WPC, 50 parts by weight 24 DE CSS, and 30 parts by weight PHSBO. The extent

of whey protein denaturation was 31%. 9.8g creamer was dry blended with 0.225g citric acid, and 0.375g potassium bicarbonate and the foaming performance was measured as described in Example 2. A gaseous foam texture was obtained. The results are reported in Table 2. Even though the mixture contained the same amount of WPC as the creamers of Example 1, the extent of denaturation was insufficient to produce a solid foam.

Table 2: Foaming Performance of Creamers containing Starch

Creamer	Creamer WPC Content	Starch Content	Extent of WPC Denaturation	WPC Added	Foam Type	Foam Initial (mm)	Foam 1 min. (mm)	Foam 2 min. (mm)	Foam 3 min. (mm)	Foam 5 min. (mm)
E	5% (0.5g)	10%	70%	---	solid	24	20	18	17	16
F	none	15%	N/A	1.0g	gas	12	4	0	0	0
G	15% (1.5g)	5%	31%	---	gas	15	11	9	8	7

Example 3

This example demonstrates that a mixture of creamers having different extents of whey protein denaturation can be used to obtain intermediate foaming performance.

The highly denatured Creamer B from Example I was mixed with the minimally denatured Creamer D of Comparison Example A in varying proportions. The foam type and foaming performance was evaluated by reconstituting a dry blend containing 9.8g creamer, 0.225g citric acid, and 0.375g potassium bicarbonate in 240 mL of 160°F brewed coffee using the column described in Example 2. The results are summarized in Table 3. When the combined level of denaturation reached about 30% a slightly solid foam texture was obtained but the foam was still

primarily gaseous. A solid foam texture was obtained when the combined level of denaturation reached about 40%.

Table 3: Foaming Performance of Creamer Mixtures having Different Extents of Denaturation

Creamer D	Creamer B	Net Extent of Denaturation	Foam Initial (mm)	Foam 5 min. (mm)	Foam Texture	Beverage Whitening
100%	---	15%	8	4	gas	most white
75%	25%	28%	12	7	gas/solid	more white
50%	50%	40%	16	9	solid	moderate
25%	75%	53%	19	11	more solid	less white
---	100%	66%	23	13	most solid	least white

Example 4

This example demonstrates that buffering the creamer slurry can produce an acceptable partially denatured whey protein creamer but may reduce foamability.

Creamer H was prepared according to the general methods described in Comparison Example A using an amount of slurry heating sufficient to effect 77% denaturation of the whey protein. In this case, the slurry containing the Alacen 855 WPC was held at 160°F for 35 minutes and then heated to 180°F prior to homogenizing and spray-drying. The creamer has the same composition as Example 1 creamers with the exception that 1 part by weight of trisodiurn citrate, an alkaline buffer, was added to the slurry after dissolution of the WPC. 0.8g creamer was dry blended with 10g sugar, 0.225g citric acid, and 0.375g potassium bicarbonate.

A solid foam was obtained upon reconstitution in 240 mL 160°F coffee using the column described in Example 2.

However, the presence of the buffer in the creamer somewhat reduced the volume of foam expected. Based on the level of denaturation, an initial foam height of at least 25 mm would be expected, but only 18 mm was obtained. It was found that addition of buffer to the creamer increases its solution pH and has the effect of reducing the amount of carbon dioxide generated from the reaction of the carbonation reagents. Increasing the amount of carbonation reagents can be used to increase foamability but may adversely affect the flavor of the coffee beverage.

Example 5

This example demonstrates that the product of this invention can also be used to formulate instant cappuccino mixes containing instant coffee powder.

Creamers A and C were used to formulate instant cappuccino products including instant coffee as an ingredient. The cappuccino mixes, comprised of 10.0g sugar, 9.8g creamer, 2.0g instant coffee, 0.225g citric acid, and 0.375g potassium bicarbonate, were reconstituted in 250 mL of 180°F water and the foaming performance measured as in the previous examples. The results are summarized in Table 4.

Table 4: Foaming Performance Comparison - Brewed Coffee versus Instant Cappuccino Mix

Creamer	Product Application	Foam Type	Foam Initial (mm)	Foam 1 min. (mm)	Foam 2 min. (mm)	Foam 3 min. (mm)	Foam 5 min. (mm)
A	Brewed Coffee	solid	22	18	15	13	12
C	Brewed Coffee	solid	25	21	19	18	17
A	Instant Cappuccino Mix	solid	14	11	9	8	7
C	Instant Cappuccino Mix	solid	19	17	15	14	13

It was surprising that the creamer provided a lower volume of foam in a reconstituted instant cappuccino mix than when used in brewed coffee applications. It is believed that the acids in brewed coffee can react instantly with the bicarbonate in the mix to produce a greater volume of carbon dioxide and a greater number of smaller bubbles which are more resistant to rupture in the foam. By comparison, the reactivity of the acids in the instant coffee formulation is delayed since the coffee powder must first dissolve in the water.

Example 6

This example demonstrates improvement in consumer liking which can be attained when whey protein creamer is adequately denatured.

Creamers D, G and B described in the previous examples having different levels of whey protein denaturation, 15%, 31%, and 66%, respectively, were used individually to formulate flavored, sweetened, instant cappuccino powders.

Single servings of these dry blended powders, containing 9.5g creamer, 12.0g sugar, 0.5g natural and artificial vanilla flavor, 0.18g citric acid, and 0.375g potassium bicarbonate, were pre-weighed into opaque cups for reconstitution with 8 oz. hot, freshly brewed Maxwell House coffee by 75 panelists in an independent consumer test. Another cappuccino powder was prepared using 9.5g Creamer B, 10.0g sugar, 0.5g natural and artificial vanilla flavor, and 3.0g non-fat dried milk (NFDM) powder without chemical carbonation reagents for similar reconstitution and evaluation.

The panelists closely observed and tasted the products and rated the appearance of the foam and their overall liking of the beverage (combined appearance and flavor) for each product on a 10-point scale. A score of 10 indicates the highest possible degree of liking. Results are summarized in Table 5.

Table 5: Consumer Test Preference Results

Cappuccino Mix Creamer	Chemical Carbonation	Extent of WPC Denaturation	Foam Texture	Overall Liking	Appearance of Foam Liking
B	yes	66%	solid	7.1	8.3
D	yes	15%	gas	6.5	6.4
G	yes	31%	gas	6.8	7.6
B	no	66%	solid	6.7	6.4

Creamers B and D were identical in composition and differed only in their extent of whey protein denaturation, 66% and 15%, respectively. The cappuccino mix containing Creamer B (66% whey protein denaturation) and chemical

carbonation was statistically preferred over the mix containing Creamer D (15% whey protein denaturation) with respect to "overall liking" and "appearance of foam".

Creamers D and G differed somewhat with respect to formulation and extent of denaturation. Creamer G was formulated with 5% starch and had twice the extent of denaturation resulting in 50% more foam generation which produced a statistical preference for "appearance of foam" relative to Creamer D, but essentially the same "overall liking".

The cappuccino mix formulated with Creamer B without chemical carbonation surprisingly achieved the same "appearance of foam" liking score as the mix formulated with Creamer D, even though it produced less than one-fourth the volume of foam. In this case, the enhanced appearance and texture of the lower-volume solid-texture foam of Creamer B was sufficient to match the liking of the much greater volume of Creamer D foam having the typical gaseous appearance and texture of foams characteristic of conventional instant cappuccino mixes.

In addition, the panelists answered a series of multiple-choice questions to indicate their degree of satisfaction with a variety of flavor, foam, and appearance attributes. Results are summarized in Table 6.

Table 6: Consumer Test Attribute Data Summary

Finished Product Attribute	Cappuccino Mix Creamer	Not Enough (%)	Just Right (%)	Too Much (%)	JR/NE(1) Ratio	Relative(2) Effectiveness
Amount of Foam	B	23	73	4	3.2	1
	D	73	25	1	0.3	1/9th
	G	47	51	3	1.1	1/3rd
	B-no carb.	72	27	1	0.4	1/8th
Foam Duration	B	13	79	8	6.1	1
	D	87	13	0	0.1	1/41th
	G	71	28	1	0.4	1/15th
	B-no carb.	31	68	1	2.2	1/3rd
Creaminess	B	17	76	7	4.5	1
	D	61	36	3	0.6	1/8th
	G	45	48	7	1.1	1/4th
	B-no carb.	35	57	8	1.6	1/3rd
		Too Small	Just Right	Too Large	JR/TS(1) Ratio	Relative(2) Effectiveness
Bubble Size	B	7	79	15	11.3	1
	D	53	44	3	0.8	1/14th
	G	23	69	8	3.0	1/4th
	B-no carb.	31	56	13	1.8	1/3rd

(1) JR is Just Right; NE is Not Enough; TS is Too Small
(2) Relative Effectiveness is fraction of JR/NE or JR/TS relative to that of Creamer B mix.

The cappuccino mix formulated with the 66% denatured creamer (Creamer B) and chemical carbonation received higher "just right" scores on "foam duration" (6x higher), "amount of foam" (3x higher), "bubble size" (2x higher), and "creaminess" (2x higher) relative to the cappuccino mix formulated with the 15% denatured creamer (Creamer D). This confirms that there were great and easily recognized differences between these two creamers which were identical in composition and flavor, but

denatured to different extents to produce foam heads having very different volume, texture, and appearance. Another surprising result was that the mix containing Creamer B without chemical carbonation received higher Relative Effectiveness scores on "foam duration", "creaminess", and "bubble size" than the mixes containing Creamers D and G, despite the much greater volume of foam generated by the latter products. Again, this was directly attributed to the greater liking of the solid foam produced by Creamer B.

In summary, the results of this test clearly indicate that foam volume, texture, and appearance significantly affect consumer liking. The principal finding is that sufficiently denaturing the whey protein in a creamer to produce a solid foam texture and appearance is a tool which can be used to greatly increase consumer liking. The cappuccino mix formulated with the 66% denatured creamer (Creamer B) and chemical carbonation was the clear statistical winner on overall liking of product, foam appearance, amount of foam, foam duration, foam bubble size, and beverage creaminess. In addition, except for the lower amount of foam produced, the cappuccino mix formulated with the same creamer without chemical carbonation was the next most effective on all other attributes reported, specifically foam duration, foam bubble size, and beverage creaminess. Taken individually and in aggregate, these findings demonstrate the utility of the novel product of this invention.

Initial foam height and foam texture for Creamers A through H are summarized in Table 7.

Table 7: Creamer Denaturation and Foaming Performance Summary

Creamer	% Whey Protein	Extent of Denaturation	Initial Foam Height (mm)	Foam Texture
A	12.0	49%	22	solid
B	12.0	66%	24	solid
C	12.0	74%	25	solid
D	12.0	15%	10	gas
E	4.0	70%	24	solid
F	0	N/A	12	gas
G	12.0	31	15	gas
H	12.0	77%	18	solid

What Is Claimed Is:

1. In a particulate creamer comprising protein, lipid, and carrier, the improvement wherein more than 50% by weight of said protein is partially denatured whey protein, said partially denatured whey protein being from 40 to 90% denatured.

2. A creamer according to claim 1 wherein the partially denatured whey protein is from 50 to 80% denatured.

3. A creamer according to claim 1 wherein the partially denatured whey protein is from 60 to 75% denatured.

4. A creamer according to claim 1 wherein at least 67% by weight of said protein is said partially denatured whey protein.

5. A creamer according to claim 1 wherein at least 75% by weight of said protein is said partially denatured whey protein.

6. A creamer according to claim 1, further comprising chemical carbonation reagents.

7. A creamer according to claim 6, wherein said reagents comprise an acid and a bicarbonate or carbonate.

8. A creamer according to claim 1 wherein said protein comprises casein and wherein the weight ratio of denatured whey:casein is greater than 1:1.

9. A creamer according to claim 8 wherein said protein comprises casein and wherein the weight ratio of denatured whey:casein is greater than 2:1.

10. A creamer according to claim 8 wherein said protein comprises casein and wherein the weight ratio of denatured whey:casein is greater than 3:1.

11. A creamer according to claim 1 wherein said protein consists essentially of said partially denatured whey protein.

12. A creamer according to claim 1 wherein said protein is casein-free.

13. A creamer according to claim 1 comprising from 3 to 30% by weight protein, 5 to 50% by weight lipid, and 20 to 92% by weight carrier, based on the weight of the creamer.

14. A creamer according to claim 1 further comprising a sweetener.

15. A creamer according to claim 1 having a bulk density of from 0.25 to 0.55 g/cc.

16. A creamer according to claim 1 having a bulk density of 0.1 to 0.25 g/cc.

17. A method of preparing a particulate creamer which comprises:

providing an aqueous spray-dryable slurry which comprises protein, lipid and carrier, more than 50% by weight of said protein being whey protein;

heating said aqueous slurry at a temperature and for a time sufficient to partially denature said whey protein such that the partially denatured whey protein is 40 to 90% denatured;

and spray drying said aqueous slurry to provide a particulate creamer comprising protein, lipid, and carrier, wherein more than 50% of the protein of said creamer is partially denatured whey protein which is from 40 to 90% denatured.

18. A method according to claim 17 wherein said whey protein of said slurry comprises whey protein concentrate.

19. A method according to claim 17 wherein said whey protein of said slurry comprises whey protein isolate.

20. A method according to claim 17 wherein said partially denatured whey protein of said creamer is from 50 to 80% denatured.

21. A method according to claim 20 wherein said partially denatured whey protein of said creamer is from 60 to 75% denatured.

22. A method according to claim 17 wherein at least 67% of said protein of said creamer comprises said partially denatured whey protein.

23. A method according to claim 17 wherein at least 75% of said protein of said creamer comprises said partially denatured whey protein.

24. A method according to claim 17 wherein said protein of said creamer comprises casein and wherein the weight ratio of denatured whey:casein is greater than 1:1.

25. A method according to claim 17 wherein said protein of said creamer comprises casein and wherein the weight ratio of denatured whey:casein is greater than 2:1.

26. A method according to claim 17 wherein said protein of said creamer comprises casein and wherein the weight ratio of denatured whey:casein is greater than 3:1.

27. A method according to claim 17 wherein said protein of said creamer consists essentially of said partially denatured whey protein.

28. A method according to claim 17 wherein said protein of said creamer is casein-free.

29. A method according to claim 17 wherein said creamer comprises from 3 to 30% by weight protein, 5 to 50% by weight lipid, and 20 to 92% by weight carrier, based on the weight of the creamer.

30. A method according to claim 17 wherein said creamer has a bulk density of 0.1 to 0.25 g/cc.

31. In a particulate, dry mix, instant hot cappuccino composition comprising a water soluble coffee component and a particulate creamer component comprising protein, lipid, and carrier, the improvement wherein more than 50% by weight of said protein of said creamer component is partially denatured whey protein, said partially denatured whey protein being from 40 to 90% denatured.

32. A cappuccino composition according to claim 31 wherein the partially denatured whey protein is from 50 to 80% denatured.

33. A cappuccino composition according to claim 31 wherein the partially denatured whey protein is from 60 to 75% denatured.

34. A cappuccino composition according to claim 31 wherein at least 67% by weight of said protein is said partially denatured whey protein.

35. A cappuccino composition according to claim 31 wherein at least 75% by weight of said protein is said partially denatured whey protein.

36. A cappuccino composition according to claim 31 wherein said protein comprises casein and wherein the weight ratio of denatured whey:casein is greater than 1:1.

37. A cappuccino composition according to claim 31 wherein said protein comprises casein and wherein the weight ratio of denatured whey:casein is greater than 2:1.

38. A cappuccino composition according to claim 31 wherein said protein comprises casein and wherein the weight ratio of denatured whey:casein is greater than 3:1.

39. A cappuccino composition according to claim 31 wherein said protein consists essentially of said partially denatured whey protein.

40. A cappuccino composition according to claim 31 wherein said protein is casein-free.

41. A cappuccino composition according to claim 31 wherein the creamer comprises from 3 to 30% by weight protein, 5 to 50% by weight lipid, and 20 to 92% by weight carrier, based on the weight of the creamer.

42. A cappuccino composition according to claim 31 wherein the creamer has a bulk density of from 0.25 to 0.55 g/cc.

43. A cappuccino composition according to claim 31 wherein the creamer has a bulk density of 0.1 to 0.25 g/cc.

44. A cappuccino composition according to claim 31 further comprising chemical carbonation reagents.

45. A cappuccino composition according to claim 44 wherein said reagents comprise an acid and a bicarbonate or carbonate.

46. A cappuccino composition according to claim 31 further comprising a sweetener component.

Abstract of the Disclosure

A particulate creamer comprising protein, lipid, and carrier, in which more than 50% by weight of the protein is partially denatured whey protein, the partially denatured whey protein being from 40 to 90% denatured. The creamer is particularly suitable for foaming creamer compositions. The foaming creamer composition, when added to a brewed hot coffee beverage, produces a large amount of a creamy and semi-solid foam. The creamer is preferably prepared by heat treating a slurry comprising the protein, lipid and carrier constituents of the creamer to effect denaturation of the whey protein, followed by spray drying the slurry. The creamer may also be employed in dry mix instant cappuccino compositions.

89-61

PATENT

Attorney's Docket No. 21559

COMBINED DECLARATION AND POWER OF ATTORNEY

(ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL, DIVISIONAL, CONTINUATION OR CIP)

As a below named inventor, I hereby declare that:

TYPE OF DECLARATION

This declaration is of the following type: *(check one applicable item below)*

- ☒ original
- ☐ design
- ☐ supplemental

NOTE: If the declaration is for an international Application being filed as a divisional, continuation or continuation-in-part application do not check next item; check appropriate of last three items.

- ☐ national stage of PCT

NOTE: If one of the following 3 items apply then complete and also attach ADDED PAGES FOR DIVISIONAL, CONTINUATION OR CIP.

- ☐ divisional
- ☐ continuation
- ☐ continuation-in-part (CIP)

INVENTORSHIP IDENTIFICATION

My residence, post office address and citizenship are as stated below next to my name, I believe I am the original, first and sole inventor *(if only one name is listed below)* or an original, first and joint inventor *(if plural names are listed below)* of the subject matter which is claimed and for which a patent is sought on the invention entitled:

TITLE OF INVENTION

CAPPUCCINO CREAMER WITH IMPROVED FOAMING CHARACTERISTICS

SPECIFICATION IDENTIFICATION

the specification of which: *(complete (a), (b) or (c))*

(a) ☒ is attached hereto.

(b) ☐ was filed on _____ as ☐ Serial No. _____ or ☐ Express Mail No., *as Serial No. not yet known* _____ and was amended on _____ *(if applicable).*

(c) ☐ was described and claimed in PCT International Application No. _____ filed on_____ and as amended under PCT Article 19 on _____ *(if any).*

NOTE: Amendments filed after the original papers are deposited with the PTO which contain new matter are not accorded a filing date by being referred to in the declaration. Accordingly, the amendments involved are those filed with the application papers or, in the case of a supplemental declaration, are those amendments claiming matter not encompassed in the original statement of invention or claims. See 37 CFR 1.67.

ACKNOWLEDGMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, Sec. 1.56.

☒ In compliance with this duty an information disclosure statement (37 CFR 1.97) is attached hereto or was filed on _____.

PRIORITY CLAIM (35 U.S.C. 119 (a) - (d))

I hereby claim foreign priority benefits under Title 35, United States Code, Sec. 119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

(complete (d) or (e))

(d) ☐ no such applications have been filed.
(e) ☐ such applications have been filed as follows.

TE: Where item (c) is entered above and the International Application which designated the U.S. claimed priority check item (e), enter the details below and make the priority claim.

PRIOR FOREIGN PCT APPLICATION(S), FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119 (a) - (d)

COUNTRY (OR INDICATE IF PCT)	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 USC 119
			☐ YES ☐ NO
			☐ YES ☐ NO
			☐ YES ☐ NO
			☐ YES ☐ NO
			☐ YES ☐ NO

CLAIM FOR BENEFIT OF PRIOR U.S. PROVISIONAL APPLICATION(S)
(35 U.S.C. 119 (e))

[redacted]ereby claim the benefit under Title 35, United States Code, 119 (e) of any United States provisional application(s) listed below:

PROVISIONAL APPLICATION NUMBER	FILING DATE
_____	_____
_____	_____
_____	_____

9/13

CLAIM FOR BENEFIT OF EARLIER US/PCT APPLICATION(S) UNDER 35 U.S.C. 120

☐ The claim for the benefit of any such applications are set forth in the attached ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR DIVISIONAL, CONTINUATION OR CONTINUATION-IN PART (C-I-P) APPLICATION.

ALL FOREIGN APPLICATION(S), IF ANY FILED MORE THAN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION

_____

_____

_____

Note: If the application filed more than 12 months from the filing date of this application is a PCT filing forming the basis for this application entering the United States as (1) the national state, or (2) a continuation, divisional, or continuation-in-part, then also complete ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR DIVISIONAL CONTINUATION OR C-I-P APPLICATION for benefit of the prior U.S. or PCT application(s) under 35 U.S.C. 120.

92 6A

POWER OF ATTORNEY

As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(List name and registration number)*

Joseph T. Harcarik	#26,904	Thomas R. Savoie	#25,259
Thomas A. Marcoux	#29,826	Debbie K. Wright	#33,817

☐ Attached, as part of this declaration and power of attorney, is the authorization of the above-named attorney(s) to accept and follow instructions from my representative(s).

SEND CORRESPONDENCE TO

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Patent Law Department (RA-6N)
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800 Westchester Avenue
Rye Brook, New York 10573

DIRECT TELEPHONE CALLS TO:

Thomas A. Marcoux
(914) 335-9220

DECLARATION

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

SIGNATURE(S)

Note: Carefully indicate the family (or last) name, as it should appear on the filing receipt and all other documents.

Full name of sole or first inventor

Bary	Lyn	Zeller
(GIVEN NAME)	(MIDDLE INITIAL OR NAME)	FAMILY (OR LAST NAME)

Inventor's signature Bary Lyn Zeller

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tam0136/d

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***

CHECK PROPER BOX(ES) FOR ANY OF THE FOLLOWING ADDED PAGE(S) WHICH FORM A PART OF THIS DECLARATION

56
94-66

☐ Signature for subsequent joint inventors. *Number of pages added*_____.

☐ Signature by administrator(trix), executor(trix) or legal representative for deceased or incapacitated inventor. *Number of pages added*_____.

☐ Signature inventor who refuses to sign or cannot be reached by person authorized under 37 CFR 1.47. *Number of pages added*_____.

☐ Added page for signature by one joint inventor on behalf of deceased inventor(s) where legal representative cannot be appointed in time. (37 CFR 1.47) *Number of pages added*_____.

***

☐ Added pages to combined declaration and power of attorney for divisional, continuation, or continuation-in-part (CIP) application.

☐ *Number of pages added*_____.

***

☐ Authorization of attorney(s) to accept and follow instructions from representative.

***

If no further pages form a part of this Declaration then end this Declaration with this page and check the following item

☒ **This declaration ends with this page.**