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(54) Title: FREEZE-DRIED, AERATED DAIRY OR DAIRY-SUBSTITUTE COMPOSITIONS AND METHODS OF MAKING
THEREOF

(57) **Abrégé/Abstract:**

The present invention comprises a freeze-dried, aerated dairy or dairy-substitute composition comprising a dairy or dairy-substitute ingredient and an emulsifier and methods of making thereof.



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(54) Title: FREEZE-DRIED, AERATED DAIRY OR DAIRY-SUBSTITUTE COMPOSITIONS AND METHODS OF MAKING THEREOF

(57) Abstract: The present invention comprises a freeze-dried, aerated dairy or dairy-substitute composition comprising a dairy or dairy-substitute ingredient and an emulsifier and methods of making thereof.

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FREEZE-DRIED, AERATED DAIRY OR DAIRY-SUBSTITUTE COMPOSITIONS AND METHODS OF MAKING THEREOF

BACKGROUND

5 Aerated milk compositions, such as aerated yogurt products are known in the art. Aeration can provide desirable characteristics such as light, fluffy textures. It is also known in the art that aerated products are subject to physical and chemical instability and therefore can destabilize over time. One solution to such instability issues in aerated milk-based products includes the addition of a hydrated emulsifier to already cultured dairy products before
10 aeration (See e.g. U.S. Patent No. 7,005,157, hereinafter “the ‘157 patent”). Specifically, the ‘157 patent teaches against adding ingredients directly to the milk blend prior to fermentation because such ingredients can adversely affect processing considerations such as fermentation times. The ‘157 patent teaches that the addition of a hydrated emulsifier post-fermentation avoids adversely lengthening fermentation times while contributing to stability. Freeze-drying
15 is a process well known in the food industry. It is critical in further drying aerated products that the resulting product retain sensory attributes that are important to consumers. Using the invention taught in the ‘157 patent, hydration of the aerated product before freeze-drying can detrimentally affect physical stability. For example, a hydrated, aerated product when freeze-dried may result in increased fragility during shipping and handling of the product.

20 As a further example, dissolvability is an important issue in a freeze-dried product. Specifically, the aerated product, which has been dried and treated with air, nitrogen or other gases, must still remain readily dissolvable upon consumption at such a rate as to transfer flavor to the consumer’s taste buds. Moreover, the product should be readily dissolvable to reduce the risk of choking hazards for consumers with restricted or under-developed oral
25 motor skills or digestive functions. As a known solution, increasing the aeration can improve dissolvability. However, increased aeration has the negative effect of reducing the hardness of the end product. When the hardness is reduced beyond a certain level, the physical stability of product can be compromised.

Therefore, there is a need for a product that is freeze-dried and aerated that has
30 improved physical stability and improved dissolvability.

SUMMARY

The present invention comprises a freeze-dried, aerated dairy or dairy-substitute composition comprising a dairy or dairy-substitute ingredient, an emulsifier, wherein said dairy or dairy-substitute composition is pasteurized, and methods of making thereof.

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DETAILED DESCRIPTION

As used throughout, ranges are used as a shorthand for describing each and every value that is within the range. Any value within the range can be selected as the terminus of the range. When used, the phrase "at least one of " refers to the selection of any one member individually or any combination of the members. The conjunction "and" or "or" can be used in the list of members, but the "at least one of " phrase is the controlling language. For example, at least one of A, B, and C is shorthand for A alone, B alone, C alone, A and B, B and C, A and C, or A and B and C.

"Freeze-dry" is a dehydration process that works by freezing the material and then reducing the surrounding pressure to allow the frozen water in the material to sublime directly from the solid phase to gas.

"Aeration" is the process of introducing air to increase gas concentration in liquids. Aeration may be performed by bubbling a gas through the liquid, spraying the liquid into the gas or agitation of the liquid to increase surface absorption.

"Dissolvability" is defined as the change in hardness of a product in going from a dry to a wet state.

"Hardness" is defined as the peak stress prior to fracturing a material. Universal Tester model 4465 with 100 N static load cell, manufactured by Instron in Canton, MA, is used. The probe used for testing is a compression anvil #2830-011. Initial settings for speed of probe were 1 mm/second to approximately 90% compression. Speed based upon journal article in J. Texture Studies, 36 (2005), pp 157-173, "Effects of Sample Thickness of Bite Force for Raw Carrots and Fish Gels." Testing is repeated on 10-15 replicate samples for each variable.

"Viscosity" is defined as a measure of the resistance of a substance to flow. Viscosity is measured using a Brookfield viscometer with a Helipath® stand with an F-T bar before the composition is aerated. Viscosity aids in holding the shape of a substance through aeration and deposit.

The present invention comprises a dairy or dairy substitute composition useful in the preparation of a freeze-dried, aerated product. The first component of the composition comprises a dairy or dairy substitute ingredient. The dairy or dairy substitute ingredient is selected from any dairy or dairy substitute ingredient ordinarily known in the art.

5 Specifically, the dairy ingredient is selected from the group including but not limited to milk, milk powder, yogurt, skim milk and milk proteins and combinations thereof. The dairy substitute ingredient is selected from but not limited to soy proteins and rice proteins and combinations thereof. The dairy or dairy substitute ingredient is present in amount of from 50% to 98%, preferably from 60% to 90 % and most preferably from 70% to 85% of the
10 composition.

The second component of the present composition comprises an emulsifier. While not wishing to be bound by any theories, it is believed that the emulsifier reduces the surface tension at the air-liquid interface, therefore allowing for stable dispersion of air bubbles within the viscous liquid matrix. The emulsifier is preferably a lactylated mono and diglyceride. The
15 lactylated mono and diglyceride is selected from the group consisting of but not limited to lactic and citrate acid esters of mono- and diglycerides, distilled monoglycerides, and combinations thereof. While not wishing to be bound by any theories, it is believed that the lactic acid moiety of the whipping agent resides in the aqueous phase at the interface of the aqueous phase and the hydrophobic phase while the mono and diglycerides reside in
20 hydrophobic phase of the whipped dairy foam. The lactylated mono and diglycerides are present in an amount of from 0.001 to 1%, preferably from 0.01 to 0.5%, and most preferably from 0.1 to 0.4% of the composition. It is believed that the lactylated mono and diglyceride component of the present invention promotes stabilization of the final aerated composition.

The combination of the first component and the second component are then
25 pasteurized through procedures commonly used in the industry. Pasteurization can take between 1 to 10 minutes between 170F to 210F, preferably between 180F to 205F.

The composition of the present invention can further comprise optional ingredients such as starch, including but not limited to corn starch, rice starch (native, physically or chemically modified) and tapioca starch; sugar/sweeteners, stabilizers, flavors, colors, fruit
30 purees, prebiotics, probiotics, vegetable purees, fibers, fortificants such as DHA, minerals and vitamins, and gelatins such as porcine, fish and bovine.

HARDNESS, DISSOLVABILITY AND VISCOSITY

The consumer preference for the final product of the present invention is believed to be based on physical characteristics such as hardness, viscosity and dissolvability. While each characteristic is important, the correct balance between the three components is desired to optimize the end product of the present invention. Viscosity is defined as a measure of the resistance of a substance to flow. Viscosity is measured using a Brookfield viscometer with a Helipath® stand with an F-T bar before the composition is aerated. It is believed that while the viscosity aids in holding the shape of a substance through aeration and deposit, the hardness aids in physical stability. The dissolvability, also a hardness measurement, is the change in hardness of a product in going from a dry to a wet state. With increased aeration, which aids in dissolvability, the hardness can be negatively affected. The compositions and methods of the present invention have unexpectedly discovered the optimum balance between viscosity, hardness and dissolvability to provide a physically stable and consumer acceptable product.

The composition of the present invention has a hardness value of from 0.5 to 8 pounds force, preferably from 1.5 to 5.5 peak load. Peak load force can be measured using an Instron Universal Testing Machine fitted with a 100N load cell and a #2830-011 compression anvil. The traveling is at a speed of 1 mm/sec until initial piece fraction occurs.

The composition of the present invention has a dissolvability in the range of from 0.1 to 8 peak load, preferably from 0.1 to 30 pounds force.

The composition of the present invention has a viscosity of from 1,000 to 150,000 cp, dependent upon the temperature and speed of the viscometer used to measure the viscosity. In the preferred embodiment, the viscosity of the wet composition ranges from 30,000 to 60,000 cp at a 10 RPM speed of the spindle 6 in a Brookfield Viscometer. The most preferred range is from 35,000 to 50,000 cp. In an alternate embodiment, the present invention has a viscosity of from 1,000 to 700,000 cp, dependent upon the temperature and speed of the viscometer used to measure the viscosity. In the preferred embodiment for the alternate embodiment, the viscosity of the wet composition ranges from 100,000 to 400,000 cp at a 5 RPM speed of the spindle 6 in a Brookfield Viscometer. The most preferred range for the alternate embodiment is from 200,000 to 350,000 cp. It should be noted that the viscosity can be adjusted based on the RPM and is dependent upon dissolvability and the stabilizer.

METHOD OF MAKING

A method of preparing a freeze-dried, aerated, milk product comprising the steps of (a) providing a dairy or dairy substitute blend, (b) adding an emulsifier, (c) thermally processing the dairy or dairy substitute blend, (d) fermenting the blend, (e) admixing a gas with the blend;
5 (f) simultaneously aerating the gas and the dairy or dairy substitute blend to form an aerated product, and (f) cooling the product; and (g) freeze-drying the product.

Yogurt production :

1. Pasteurized lowfat milk is transferred from a tanker truck to large hold tank.
- 10 2. All dry ingredients (sugar, gelatin, starch, nonfat dry milk, emulsifier, as well as functional ingredients such as prebiotics) are incorporated into milk via addition to a high shear blender (such as Bredo Liqwifier) to achieve homogenous dispersion and initial hydration.
3. Once all dry ingredients have been incorporated, the mixture is agitated for 30 minutes at 35-38 deg F.
- 15 4. Following agitation, the mixture is transferred to the HTST plate heat exchanger for thermal processing. The thermal process conditions used require that all achieve and maintain a minimum temperature of 191 deg F at the end of a 4.5 minutes hold time. This temperature and hold time can vary depending upon the mechanics of the process, for example it is possible to go slightly higher in temperature and have a 7 or 8 minute hold time.
- 20 5. As an optional step for optimizing the formula and the consistency of aeration, homogenizing of the mixture can occur. The typical homogenization pressures are 2000 to 2500 psi at a first stage and 200-600 psi at a second stage.
6. After the hold time at 191 deg F, the mix is cooled to 100-112 deg F, and transferred to the culturing vat. At this point, the yogurt culture is added (for example, a freeze-dried culture,
25 ABY-2C, supplied by Danisco Ingredients, or other vendors). The culture is blended with the pasteurized mix for 30-60 minutes, the mixing is stopped and the vat is maintained at 104-107 deg F for 4-6 hours. Yogurt is allowed to acidify to pH 4.5 to 4.6, and is then agitated (broken) and cooled to 60 deg F in the culture tank. Final pH will range from is 4.1-4.4.
7. Yogurt is transferred to 250 gal. blending tanks by pumping through a cooling press, which
30 lowers temp to 37-45 deg F. Pasteurized fruit puree, flavors and any desired color will be added. Mixture will be blended with gentle agitation and recirculation for 10-15 minutes. Blended fruit yogurt is transferred to 275 gallon totes.

Production Frozen Yogurt Drops

1. Yogurt will be conveyed/pumped from 275 gallon totes (previously stored at 34-40 deg F) to the aerator (in this case, a Mondomix aerator, although other brands exist).
2. Nitrogen gas is admixed to the yogurt via the Mondo mixer (connected to plant ice water circulation system, to maintain mixing head temperature at 35-45 deg F). Product overrun can range from 20% to 80%. However, preferably, the overrun target will be between 30% and 50% and most preferably between 35% and 45%. This process happens continuously.
3. Aerated yogurt is pumped, maintained at 38-50 deg F, under pressure, to a depositor manifold, where it is distributed to multiple nozzles which, via a metering pump, create the appropriately shaped deposit form (in this case, a large chocolate chip shape, although other shapes/forms are possible). The current target shape has a diameter of 13-22 mm (ideal is 15-20mm), a height of 7-12 mm (ideal is 8-10), and a weight of 0.8-1.3 grams (ideal is 1.0-1.1 g).
4. Drops are deposited onto a solid, stainless steel freezer belt (in this case, the maker of the belt and freezer is Sandvik).
5. Freezer tunnel air temperature is approximately -20 to -30 deg F, with high velocity air circulation. Dwell time in the tunnel can range from 3-5 minutes. Frozen pieces exit the tunnel with an internal temperature of 24-28 deg F.
6. Products are removed from the freezer belt and conveyed to a bulk case packer, where they are filled into 20-30 lb, plastic bag lined cases. Cases are closed, taped and stored at -20 deg F until shipment to OFD.

The following composition of the present invention can be prepared. The percentages listed are based on the total weight of the composition.

Example 1: Unflavored yogurt:

Ingredient	Percentage by weight
Low fat Milk	82.89
Non-fat dry milk (NFDM)	4
Sugar	9
Starch/Gelatin Stabilizer Blend	3.7
Yogurt Culture + Skim Milk	0.01
Lactem Emulsifier (Lactic Acid Esters of Monoglycerides)	0.4

Example 2:

<u>Ingredient</u>	<u>% of formula</u>
Lowfat Milk (1.65%fat)	78.442148
NFDM Low Heat	3.68628
Sugar, White Satin	8.5068
Starch/Gelatin Stabilizer Blend (0.38% Lactem, 1.1% Tapioca Starch, 2.3% gelatin	3.87532
Peach Puree, Single Strength, Frozen, Organic	5
Natural Peach Flavor	0.3
Natural Annatto Extract	0.18
Yogurt Culture	0.009452
TOTAL	100

Example 3

<u>Ingredient</u>	<u>% of final formula</u>
Lowfat Milk (1.65% fat)	78.442148
NFDM, Low Heat	3.68628
Sugar, White Satin	8.5068
Starch/Gelatin Stabilizer Blend #1795	3.87532
Peach Puree, Single Strength, Frozen, Organic	5
Natural Peach Flavor WONF C13206	0.3
Natural Annatto Extract 1211663	0.18
Yogurt Culture ABY-2C	0.009452
TOTAL	100

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The composition described above is made using the methods described herein.

It should be appreciated that the present invention is not limited to the specific embodiments described above, but includes variations, modifications and equivalent embodiments defined by the following claims.

CLAIMS:

1. A freeze-dried, aerated dairy or dairy substitute composition comprising:
a dairy or dairy-substitute ingredient;
an emulsifier; and
a viscosity enhancer,
wherein said composition is pasteurized.
2. The freeze-dried composition of claim 1, wherein the emulsifier is selected from the group consisting of lactylated mono and diglycerides, polysorbates, caseinate, whey proteins, egg white protein, and combinations thereof.
3. The freeze-dried composition of claim 1, wherein the emulsifier is a lactylated mono and diglyceride.
4. The freeze-dried composition of claim 3, wherein the lactylated mono and diglyceride is selected from the group consisting of lactic acid esters of mono- and diglycerides, citrate acid esters of mono and diglycerides and distilled monoglycerides.
5. The freeze-dried composition of claim 3, wherein the lactylated mono and diglyceride is a lactic acid ester of monoglycerides or a blend of mono and diglycerides.
6. The freeze-dried composition of claim 3, 4, or 5, wherein the lactylated mono and diglycerides are present in an amount of from 0.001% to 1% of the composition.
7. The freeze-dried composition of any one of claims 1 to 6, wherein the viscosity enhancer is selected from the group consisting of starch, and hydrocolloids.
8. The freeze-dried composition of claim 7, wherein the viscosity enhancer is selected from the group consisting of carrageenan, guar gum, locust bean gum, pectin, and combinations thereof.

9. The freeze-dried composition of any one of claims 1 to 8, wherein the dairy or dairy substitute ingredient is selected from the group consisting of milk, milk powder, yogurt, skim milk, milk proteins, hydrolyzed milk proteins, soy proteins, whey proteins, and rice proteins.
10. The freeze-dried composition of any one of claims 1 to 9, wherein the dairy or dairy substitute ingredient is present in amount of from 60% to 98% of the composition.
11. The freeze-dried composition of any one of claims 1 to 10, further comprising a gelling agent, wherein the gelling agent is gelatin.
12. The freeze-dried composition of any one of claims 1 to 11, wherein the composition has a hardness value of from 0.5 to 8 force peak load.
13. The freeze-dried composition of any one of claims 1 to 12, further comprising at least one sugar.
14. The freeze-dried composition of any one of claims 1 to 13, wherein the composition has a dissolvability in the range of from 0.1 to 8 pounds force peak load.
15. The freeze-dried composition of any one of claims 1 to 14, wherein the viscosity of the composition is from 1000 to 500,000 cp.
16. A freeze-dried aerated dairy composition comprising:
a dairy ingredient; and
0.001 to 1% lactylated mono and diglyceride,
wherein said dairy composition is pasteurized.
17. The freeze-dried composition of claim 16, wherein the dairy ingredient is present in an amount of from 60% to 98% of the composition.
18. The freeze-dried composition of claim 16 or 17, further comprising a starch.

19. The freeze-dried composition of claim 16, 17, or 18, wherein the dairy ingredient is selected from the group consisting of milk, milk powder, yogurt, skim milk, and milk proteins.
20. The freeze-dried composition of any one of claims 16 to 19, wherein the composition has a hardness value of from 0.5 to 8 pounds force.
21. The freeze-dried composition of any one of claims 16 to 20, wherein the lactylated mono and diglyceride is selected from the group consisting of lactic acid esters of mono and diglycerides, citrate acid esters of mono and diglycerides and distilled monoglycerides.
22. The freeze-dried composition of claim 21, wherein the lactylated mono- and diglyceride is a lactic acid ester of monoglycerides or a blend of mono and diglycerides.
23. The freeze-dried composition of any one of claims 16 to 22, further comprising at least one sugar.
24. A method of preparing a freeze-dried, aerated, dairy or dairy substitute product comprising the steps of:
 - (a) providing a dairy or dairy substitute blend;
 - (b) adding an emulsifier to the blend;
 - (c) thermally processing the dairy or dairy substitute blend;
 - (d) fermenting the blend;
 - (e) admixing a gas with the blend;
 - (f) simultaneously aerating the gas and the dairy or dairy substitute blend to form an aerated product;
 - (g) forming portions of the aerated product in a predetermined size and shape;
 - (h) cooling the portions; and
 - (i) freeze drying the portions.
25. The method of claim 24, wherein the dairy or dairy substitute blend is present in an amount of from 60% to 98% of the product.

26. The method of claim 24 or 25, wherein the emulsifier comprises lactylated mono and diglyceride present in an amount of from 0.001 to 1% of the product.
27. The method of claim 26, wherein the lactylated mono- and diglyceride is selected from the group consisting of lactic acid esters of mono- and diglycerides and distilled monoglycerides.
28. The method of claim 27, wherein the lactylated mono and diglyceride is a lactic acid ester of monoglycerides or a combination of mono and diglycerides.
29. The method of any one of claims 24 to 28, wherein the freeze-dried, aerated, dairy or dairy substitute product has a hardness value of from 0.5 to 8 force peak load.
30. The method of any one of claims 24 to 29, further comprising the step b(1) of providing a starch and a gelatin.
31. The method of any one of claims 24 to 30, wherein the dairy or dairy-substitute blend consists of a milk ingredient selected from the group consisting of milk, milk powder, yogurt, skim milk, and milk proteins.
32. The method of any one of claims 24 to 31, further comprising the step b(2) of adding at least one sugar and a stabilizer.
33. The method of any one of claims 24 to 32, wherein the freeze-dried, aerated, dairy or dairy substitute product has a dissolvability in the range of from 0.1 to 8 force peak load.
34. The method of any one of claims 24 to 33, wherein the viscosity of the freeze-dried, aerated, dairy or dairy substitute product is from 1,000 to 500,000 cp.