

DESCRIPTION

TITLE OF THE INVENTION: IRON PYROPHOSPHATE

COMPOSITION

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TECHNICAL FIELD

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[0001] The present invention relates to a coated ferric pyrophosphate composition which is suitably used in fermented milks such as yogurt, yogurt beverages, lactic acid bacteria beverages, and the like, and a fermented milk containing the composition.

BACKGROUND ART

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[0002] In the recent years, in order to fortify iron in fermented milks, various studies on the blending of iron materials have been made.

[0003] However, blending of a water-soluble iron material such as ferrous sulfate, sodium iron citrate, or iron lactate would impair the flavor of the fermented milk by iron taste.

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[0004] On the other hand, a water-insoluble iron material is difficult to added to beverage because if the water-insoluble iron material is blended as it is with a fermented milk, the water-insoluble iron material sediments.

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[0005] In view of the above, a fermented milk blended with a ferric pyrophosphate emulsifying agent coating composition which stably suspends in acidic milk subjected to lactate fermentation, and very highly unlikely to exhibit unpleasant flavor peculiar to iron has been reported (see Patent Publication 1).

PRIOR ART PUBLICATIONS

PATENT PUBLICATIONS

[0006] Patent Publication 1: Japanese Patent Laid-Open No. Hei-10-
5 225263

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0007] However, it was clarified that the ferric pyrophosphate emulsifying
10 agent coating composition described in Patent Publication 1, reacts with a
protein in a fermented milk when the fermented milk having an absolute
value of a zeta potential of 10 mV or less is added, a disadvantage in
dispersibility is caused.

[0008] In addition, a conventional ferric pyrophosphate emulsifying agent
15 coating composition would give a flavor derived from an emulsifying
agent when the blending amount is increased, so that there are some
limitations in the blended amount to the foodstuff which are sensitive to
flavors derived from the raw materials blended such as a fermented milk
having a low solid nonfat (SNF).

20 [0009] An object of the present invention is to provide a coated ferric
pyrophosphate compound capable of blending with a fermented milk while
having excellent dispersibility without impairing its flavor, and a
fermented milk containing the coated ferric pyrophosphate composition.

25 MEANS TO SOLVE THE PROBLEMS

[0010] The present invention relates to:

[1] a coated ferric pyrophosphate composition containing ferric pyrophosphate coated with 1 to 10 parts by mass of a polyoxyethylene sorbitan fatty acid ester or 1 to 10 parts by mass of a glycerol fatty acid ester, and 0.05 to 1 part by mass of an enzymatically decomposed lecithin, based on 100 parts by mass of the ferric pyrophosphate, wherein the composition has a zeta potential of from -25 to -39 mV, and an average particle size of from 1 to 4 μm ; and

[2] an iron-fortified fermented milk, containing a coated ferric pyrophosphate composition as defined in the above [1] in an amount of from 1.0 to 10 mg, calculated as iron derived from ferric pyrophosphate per 100 g of a fermented milk having an absolute value of a zeta potential of 10 mV or less.

EFFECTS OF THE INVENTION

[0011] The coated ferric pyrophosphate composition of the present invention exhibits some effects such as the composition can be stably dispersed in a fermented milk without impairing its flavors.

MODES FOR CARRYING OUT THE INVENTION

[0012] The coated ferric pyrophosphate composition of the present invention has a structure in which ferric pyrophosphate is coated with a polyoxyethylene sorbitan fatty acid ester or a glycerol fatty acid ester, and an enzymatically decomposed lecithin. The coated ferric pyrophosphate composition of the present invention can be dispersed in a fermented milk

by agglomerating particles pulverized to a very fine particle size into an appropriate particle size. On the other hand, in the ferric pyrophosphate emulsifying agent coated composition described in Patent Publication 1, a prior art, the particles exist in the form of very fine particles, to which agglomeration does not take place by itself. Usually, the agglomeration of the particles is considered to be undesirable phenomena because lowered dispersibility and precipitations are caused. However, in the present invention, it was confirmed that the effects that are beyond expectations by one of ordinary skill in the art are exhibited such as the agglomeration is controlled to be adjusted to an appropriate particle size, so that an iron-containing composition in which precipitations are not caused, and can inhibit a reaction with proteins in the fermented milk is obtained.

[0013] It is desired that a polyoxyethylene sorbitan fatty acid ester having the number of carbon atoms of the fatty acid of 12 or more, and preferably from 12 to 18, and an HLB of 10 or more, and preferably from 14 to 17 is used, from the viewpoint of flavors and physical properties. A constituent sorbitan fatty acid ester refers to an esterified product of sorbitan and a fatty acid, which is prepared by condensing sorbitan, obtained by dehydrating sorbitol, or sorbitol itself with a fatty acid. Depending upon the situations of the reaction, sorbitol, sorbitan, sorbite and esters thereof are in a mixture thereof, and these existing proportions would differ depending upon the reaction conditions or manufacturers. Upon use in the present invention, its components are not particularly limited, and a commercially available product can be suitably utilized.

[0014] The amount of the polyoxyethylene sorbitan fatty acid ester is from

1 to 10 parts by mass, based on 100 parts by mass of the ferric pyrophosphate, from the viewpoint of particle size control, and the amount is more preferably from 1 to 8 parts by mass, and even more preferably from 1 to 5 parts by mass, from the viewpoint of flavors.

5 [0015] The glycerol fatty acid ester includes an ester formed between glycerol and a fatty acid, or a mixture of a monoglyceride, a diglyceride, and a triglyceride, which is an ester obtained by transesterification of glycerol and a fat or oil. The number of carbon atoms of the fatty acid is preferably from 8 to 18, and more preferably 12 to 14. The mixture of a
10 monoglyceride, a diglyceride, and a triglyceride may be subjected to a separation and purification treatment according to a molecular distillation method or a column method, thereby increasing the content of the monoglyceride.

[0016] The amount of the glycerol fatty acid ester is from 1 to 10 parts by
15 mass, based on 100 parts by mass of ferric pyrophosphate, from the viewpoint of particle size control, and the amount is preferably from 1 to 8 parts by mass, and more preferably from 1 to 5 parts by mass, from the viewpoint of flavors.

[0017] As the enzymatically decomposed lecithin, a monoacyl
20 glycerophospholipid containing, as a main component, lysophosphatidyl choline, lysophosphatidyl ethanolamine, lysophosphatidyl inositol, and lysophosphatidylserine, obtainable by subjecting a vegetable lecithin or an egg yolk lecithin to hydrolysis with phospholipase A in a limiting manner at a fatty acid ester moiety; and at least one member selected from the
25 group consisting of phosphatidic acid, lysophosphatidic acid, phosphatidyl

glycerol, and lysophosphatidyl glycerol, which are produced using phospholipase D can be suitably used. Among them, lysophosphatidyl choline, lysophosphatidyl ethanolamine, and lysophosphatidylserine are preferred, and lysophosphatidyl choline is more preferred. The phospholipases used in enzymatic decomposition may be any of those having phospholipase A and/or D activity, regardless of being from the animal origins such as pig pancreas, plant origins such as cabbage, microbial origins such as moulds.

[0018] The enzymatically decomposed lecithin all have surfactant activity, also equally have a phosphate group in a hydrophilic group moiety, and have marked strong property in the adsorption coating strength on the surface of ferric pyrophosphate, as compared to a nonionic surfactant such as a sucrose fatty acid ester or a glycerol fatty acid ester. Therefore, an adsorption interfacial layer of thermally stable enzymatically decomposed lecithin is formed on the surface of the fine particles of water-insoluble minerals, which is not removed even when subjected to a heat treatment, effectively controls agglomeration, and whereby consequently obtaining excellent dispersibility of ferric pyrophosphate.

[0019] The amount of the enzymatically decomposed lecithin is from 0.05 to 1 part by mass, based on 100 parts by mass of ferric pyrophosphate, from the viewpoint of particle size control, and the amount is more preferably from 0.05 to 0.5 parts by mass, and even more preferably from 0.05 to 0.2 parts by mass, from the viewpoint of flavors.

[0020] The coated ferric pyrophosphate composition is obtained by homogeneously mixing a pulverized product of ferric pyrophosphate with

a polyoxyethylene sorbitan fatty acid ester or a glycerol fatty acid ester and an enzymatically decomposed lecithin.

[0021] In addition, in the preparation of the coated ferric pyrophosphate composition of the present invention, other emulsifying agent, such as a sorbitan fatty acid ester or a sucrose fatty acid ester may be used together, within the range that would not impair the effects of the present invention.

[0022] As a method for pulverizing ferric pyrophosphate, a physical crushing method with a wet pulverizer such as Dynomill, sand-mill, or CoBall mill; an emulsifier or disperser such as Nanomizer, Microfluidizer, or Homogenizer; a ultrasonication disperser is preferred, and the wet pulverization method is more preferred from the viewpoint of particle size control.

[0023] Therefore, preferred methods for producing a coated ferric pyrophosphate composition include a method including mixing a solution containing a pulverized product of ferric pyrophosphate pulverized according to a wet pulverization in an amount of from 10 to 30% by mass or so, and a mixture of a polyoxyethylene sorbitan fatty acid ester or a glycerol fatty acid ester, and an enzymatically decomposed lecithin; a method including mixing ferric pyrophosphate and a polyoxyethylene sorbitan fatty acid ester or a glycerol fatty acid ester, subjecting to wet pulverization, and mixing a mixture obtained and an enzymatically decomposed lecithin; and the like. By adding glycerol in the step of wet pulverization, the separation of the produced aggregated particles can be prevented after wet pulverization. The amount of the glycerol blended is not particularly limited, and the amount is preferably 60% by mass or less,

of the coated ferric pyrophosphate composition.

[0024] The zeta potential of the coated ferric pyrophosphate composition of the present invention is preferably from -25 to -39 mV, from the viewpoint of appropriately controlling attractive forces generated between the proteins contained in the fermented milk, and stably dispersing the coated ferric pyrophosphate composition in the fermented milk. The zeta potential can be adjusted by combinations of various kinds of emulsifying agents and amounts used.

[0025] The average particle size of the coated ferric pyrophosphate composition of the present invention is from 1 to 4 μm , and preferably from 1 to 3 μm , from the viewpoint of dispersing the coated ferric pyrophosphate composition in the fermented milk, and preventing the proteins contained in the fermented milk and the coated ferric pyrophosphate composition from reacting and causing precipitation. Here, the coated ferric pyrophosphate composition of the present invention takes the form of agglomerated particles in which coated ferric pyrophosphate particles are agglomerated in the production step, and the above average particle size refers to an average particle size of the agglomerated particles. The average particle size can be adjusted by the combinations of various kinds of emulsifying agents and amounts used thereof.

[0026] The coated ferric pyrophosphate composition of the present invention can be blended in any of the foodstuff, and the coated ferric pyrophosphate composition can be suitably blended in a fermented milk, and especially a fermented milk having an absolute value of a zeta potential of 10 mV or less.

[0027] In the present invention, a fermented milk refers to fermented dairy products or resembling products thereof in general, obtained by lactate fermentation of milk or dairy products or resembling products thereof. Specifically, the fermented milk includes not only fermented milks
 5 specified by the Ministerial ordinance, such as yogurt, but also lactic acid bacteria beverages and kefir, and the like. The forms thereof include plain-type, flavored-type, fruit-type, sweetened-type, soft-type, drink-type, solid (hard) type, frozen-type, and the like, and especially the fermented milk is preferably used in drink-type.

10 In addition, as the above milk or dairy products, raw milk such as cow milk, dairy media made of dairy products such as skim milk, fully dried milk, and dairy cream, and soybean milk, and the like can be used.

[0028] The microbes usable in the production of the fermented milk are not particularly limited, so long as the microbes are those usually used in
 15 foods. The microbes include, for example, lactic acid bacteria such as bacteria belonging to the genus *Lactobacillus*, such as *Lactobacillus casei*, *Lactobacillus mali*, *Lactobacillus acidophilus*, *Lactobacillus delbrueckii subsp. bulgaricus*, and *Lactobacillus helveticus*, bacteria belonging to the genus *Streptococcus*, such as *Streptococcus thermophilus*, bacteria
 20 belonging to the genus *Lactococcus*, such as *Lactococcus lactis*, bacteria belonging to the genus *Enterococcus*, such as *Enterococcus faecalis*; Bifidobacteria such as bacteria belonging to the genus *Bifidobacterium* such as *Bifidobacterium breve*, *Bifidobacterium bifidum*, and *Bifidobacterium longum*, and the like.

25 [0029] In addition, the conditions and the method for inoculating the above

microbe to a milk or dairy product to allow fermentation are not particularly limited, and conditions and methods ordinarily used in the production of the fermented milk may be applied. For example, the milk or dairy product may be allowed to be fermented, for example, at a temperature of from 30 to 40°C until a pH reaches from 3.0 to 5.0, and as to the method thereof, a method suitable for the microbe used in the fermentation which is appropriately selected from fermentation with allowing to stand, fermentation with stirring, fermentation with shaking, fermentation with aeration, or the like is used.

10 [0030] As described above, a fermented milk contains a bacterium, a protein, or the like, so that precipitations are likely to take place. Especially in a case where an absolute value of a zeta potential is 10 mV or less, the precipitates are likely to take place, thereby making it difficult to add a functional material such as iron. However, the coated ferric pyrophosphate composition of the present invention inhibits a reaction with the protein, the composition can be stably dispersed in a fermented milk. Therefore, the coated ferric pyrophosphate composition of the present invention can be suitably blended in a fermented milk having an absolute value of a zeta potential of 10 mV or less.

20 [0031] In addition, the coated ferric pyrophosphate composition of the present invention has less flavor of an emulsifying agent, so that its taste is less flavorful, whereby the composition can be suitably blended also in a fermented milk having a low SNF, sensitive to the flavors derived from the raw materials blended. The value of SNF is from 0.1 to 7% by mass, and more preferably from 1 to 5% by mass.

[0032] The blending amount of the coated ferric pyrophosphate composition is from 1.0 to 10 mg, and more preferably from 1.0 to 5 mg, calculated as iron derived from the ferric pyrophosphate per 100 g of the fermented milk having an absolute value of a zeta potential of 10 mV or less, from the viewpoint of flavor.

[0033] In the iron-fortified fermented milk of the present invention, a syrup can be added in the same manner as the cases where ordinary fermented milks such as yogurt, yogurt beverages, and lactic acid bacteria beverages. The syrup as referred to herein is not particularly limited, which are sweeteners, nutrient ingredients, stabilizers, viscosity-adjusting components, acidulants, spices, and the like that are generally used. More specifically, the syrup includes sweeteners, such as sucrose, glucose, fructose, galacto-oligosaccharide, palatinose, xylose, maltose, sorbitol, xylitol, erythritol, Palatinit, and reduced sugar syrup; high-intensity sweeteners, such as sucralose, aspartame, Thaumatin, acesulfame potassium (K), and stevia; thickening (stabilizing) agents such as soybean polysaccharides, agar, gelatin, carrageenan, guar gum, xanthan gum, pectin, locust bean gum, and gellan gum; acidulants, such as citric acid, lactic acid, acetic acid, malic acid, tartaric acid, and gluconic acid; vitamins, such as vitamin A, vitamin B's, vitamin C, vitamin D, and vitamin E; flavors such as collagen peptide, fresh fruit juice, peach, melon, banana, tropical, yogurt-based, berry-based, orange-based, *Chaenomeles sinensis*-based, perilla-based, citrus-based, apple-based, mint-based, grape-based, apricot-based, and pear flavors, and the like.

[0034] In the production of a fermented milk such as iron-fortified yogurt

of the present invention, a coated ferric pyrophosphate composition may be added at any stage of the production steps of an ordinary fermented milk. For example, a sterilized coated ferric pyrophosphate composition may be added to an acidic milk that is subjected to lactate fermentation, a sterilized syrup is optionally added, and thereafter subjected to a homogenized treatment, or alternatively a sterilized coated ferric pyrophosphate composition-containing syrup that is previously mixed may be added to an acidic milk subjected to a homogenized treatment.

[0035] Here, in a case where a fermented milk such as yogurt produced contains vitamin C, it is desired that a coated ferric pyrophosphate composition and a syrup containing vitamin C are each sterilized, and individually added to an acidic milk subjected lactate fermentation. Here, individually added means that each is simultaneously or separately added, not adding a previously mixed product.

EXAMPLES

[0036] The present invention will be described more specifically by means of Examples, without intending to limit the scope of the present invention to these Examples.

[0037] Examples 1 to 12 and Comparative Examples 1 to 3

Four-hundred grams of ferric pyrophosphate was mixed and dispersed in 1,600 g of ion-exchanged water, and this dispersion was subjected to a wet pulverization with a wet triturator Dynomill, to provide a ferric pyrophosphate composition containing 20% by mass of a pulverized product of ferric pyrophosphate.

[0038] The resulting composition was mixed with a polyoxyethylene sorbitan fatty acid ester or a glycerol fatty acid ester, an enzymatically decomposed lecithin, and water, each as listed in Table 1, and thereafter the mixture was subjected to dispersion and homogenization treatment with a homogenizer, to provide a dispersion of a coated ferric pyrophosphate composition, containing from 10 to 15% by mass of agglomerated particles of coated ferric pyrophosphate.

[0039] Comparative Examples 4 and 5

The amount 65.6 g of ferric chloride (hexahydrate) and an enzymatically decomposed lecithin listed in Table 1 were dissolved in 304.8 g of ion-exchanged water to prepare an iron-containing solution, and the iron-containing solution was gradually added to a pyrophosphate solution prepared by dissolving 100 g of tetrasodium pyrophosphate (decahydrate) in 2,540 g of ion-exchanged water while stirring, and a pH of the liquid mixture was adjusted to 3.0. After the termination of the salt formation of ferric pyrophosphate by a neutralization reaction, the mixture was subjected to a liquid-solid separation by centrifugation, and a ferric pyrophosphate-enzymatically decomposed lecithin complex at a solid phase part was collected. The complex was resuspended in ion-exchanged water, and a glycerol fatty acid ester listed in Table 1 was added thereto, to provide 1,000 g of a coated ferric pyrophosphate composition containing 4% by mass of a ferric pyrophosphate-enzymatically decomposed lecithin complex.

[0040] The average particle size and the zeta potential were measured for the coated ferric pyrophosphate compositions obtained in Examples and

Comparative Examples. The results are shown in Table 1.

[0041] The average particle size is a volume-average particle size measured with a laser diffraction particle size distribution analyzer (LS 13 320: manufactured by Beckman Coulter). The preparation of the sample, the measurement conditions, and the measurement method are as follows.

[Preparation of Sample]

A coated ferric pyrophosphate composition is diluted with pure water.

[Measurement Conditions]

Polarization Intensity Differential Scattering (PIDS): without using assembly

Refractive Index, Real number part: 1.6, imaginary number part: 0

[Measurement Method]

A sample was added so that a relative concentration in the laser diffraction particle size distribution analyzer is within the range of from 8 to 12%, and thereafter the measurement is carried out.

[0042] The zeta potential is measured with a zeta potential measurement instrument (Zetasizer 3000: manufactured by Malvern Instruments). The preparation of the sample, the measurement conditions, and the measurement method are as follows.

[Preparation of Sample]

A coated ferric pyrophosphate composition is diluted with pure water.

[Measurement Conditions]

Number of Repeat Measurement: set at 5 times

Data Sampling Time: Rapid being selected.

Individual Measurement Idle Time : 0

Measurement Temperature: 25°C

[Measurement Method]

5 A sample was added to a zeta potential measurement instrument so that the count rate (KCPs), which is a count rate in units of 1,000 photons per second counted during the measurement, is 3,000 or less, and the measurement is started.

[0043] [Preparation of Fermented Milk Containing Coated Ferric

10 Pyrophosphate Composition]

 A starter of *Lactobacillus casei* YIT9029 was inoculated in an amount of 0.5% by mass to a 15% by mass nonfat powder milk medium (containing 3.5% by mass of glucose), and cultured at 37°C until its pH reached 3.6, and thereafter the culture medium was subjected to a

15 homogenization treatment at 15 MPa. Twenty-three parts by weight of the culture medium and 77 parts by weight of a syrup containing a coated ferric pyrophosphate composition (containing 17% by mass sugar) were mixed to produce a fermented milk (lactic acid bacteria beverage). Here, the coated ferric pyrophosphate composition was blended in the fermented

20 milk, so that an iron content originated from ferric pyrophosphate was 4.7 mg, per 100 g of the fermented milk, for each of the compositions obtained in Examples 1 to 12 and Comparative Examples 1 to 5. The resulting fermented milk had a pH of 3.6, SNF of 3.1% by mass, and a zeta potential of 4.2 mV.

25 [0044] [Evaluation of Reactivity]

The resulting fermented milk was heated at 70°C for 30 minutes. After heating, the presence or absence of agglomeration with the fermented milk component was visually observed, and the reactivity with the fermented milk was evaluated such that a case where no changes took place was evaluated as “○,” and a case where changes were found was evaluated as “×.” The results are shown in Table 1.

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[0045]

Table 1

	Polyoxyethylene Sorbitan Fatty Acid Ester			Glycerol Fatty Acid Ester	Enzymatically Decomposed Lecithin	Ghatti Gum	Average Particle Size (μm)	Zeta Potential (mV)	Reactivity (Agglomeration)
	Polysorbate 20	Polysorbate 60	Polysorbate 80						
Ex. 1	-	6.3g(1.6)	-	-	0.3g(0.08)	-	1.91	-33.7	○
Ex. 2	-	13g(3.2)	-	-	0.6g(0.16)	-	1.98	-32.1	○
Ex. 3	-	19g(4.8)	-	-	1.0g(0.24)	-	1.90	-34.5	○
Ex. 4	-	32g(7.9)	-	-	1.6g(0.40)	-	1.47	-33.8	○
Ex. 5	6.3g(1.6)	-	-	-	0.3g(0.08)	-	2.35	-29.9	○
Ex. 6	-	-	6.3g(1.6)	-	0.3g(0.08)	-	2.51	-28.7	○
Ex. 7	-	-	-	6.3g(1.6)	3.2g(0.79)	-	2.31	-33.1	○
Ex. 8	-	-	-	16g(4.0)	3.2g(0.79)	-	2.25	-36.3	○
Ex. 9	-	-	-	24g(6.0)	3.2g(0.79)	-	2.21	-35.8	○
Ex. 10	-	-	-	32g(7.9)	3.2g(0.79)	-	1.52	-38.9	○
Ex. 11	-	8.0g(2.0)	-	-	0.4g(0.10)	-	1.62	-37.2	○
Ex. 12	-	11g(2.7)	-	-	0.5g(0.13)	-	3.45	-29.2	○
Comp. Ex. 1	-	63g(16)	-	-	3.2g(0.79)	-	0.47	-42.1	×
Comp. Ex. 2	-	-	-	95g(24)	3.2g(0.79)	-	0.50	-44.0	×
Comp. Ex. 3	-	-	-	-	-	120g(30)	0.25	-45.7	×
Comp. Ex. 4	-	-	-	60g(15)	5g(1.25)	-	0.21	-46.2	×
Comp. Ex. 5	-	-	-	80g(20)	20g(5.00)	-	0.20	-51.2	×

Note 1) The amount used inside parenthesis is expressed by mass ratio based on 100 parts by mass of ferric pyrophosphate.

Note 2) Polysorbate 20 (polyoxyethylene sorbitan monolaurate, HLB: 16.7): "LEODOR TW-L120," manufactured by Kao Corporation
 Polysorbate 60 (polyoxyethylene sorbitan monostearate, HLB: 14.9): "ADMUL T-60K," manufactured by Kerry
 Polysorbate 80 (polyoxyethylene sorbitan monooleate, HLB:15.0): "ADMUL T-80K," manufactured by Kerry
 Glycerol Fatty Acid Ester (diglycerol monolaurate, HLB:8.5): "SUNSOFT Q-12D," manufactured by Taiyo Kagaku Co., Ltd.
 Enzymatically Decomposed Lecithin: "SUNLECITHIN A," manufactured by Taiyo Kagaku Co., Ltd.
 Ghatti gum: "GHATTI GUM SD," manufactured by San-Ei Gen F. F. I., Inc.

[Table 1]

[0046] It can be seen from the results of Table 1 that the coated ferric pyrophosphate compositions of Examples 1 to 12 have controlled zeta potentials, and inhibit the reaction with a protein as fine particles (1 to 4 μm), whereby the composition can be homogeneously dispersed in the fermented milk. By contrast, the coated ferric pyrophosphate compositions of Comparative Examples 1 to 5 made of very fine particles have large absolute values of zeta potentials form reaction products in the fermented milk, so that it can be seen to lack dispersibility.

[0047] [Measurements of Whey Off and Precipitation]

A container was charged with each of fermented milks containing a coated ferric pyrophosphate composition of Example 1 and Comparative Example 4 used in the evaluation of reactivity and a fermented milk obtained without a coated ferric pyrophosphate composition (Comparative Example 6) in an amount of 80 ml (about 86 g), and tightly sealed, and the contents were stored at 10°C for 7, 14, 21, or 28 days to measure whey-off (phenomenon of forming a transparent layer on an upper part of the beverage) and precipitations.

[0048] Here, whey-off was directly measured in a state where that the contents were placed in the container. In addition, as to the precipitations, samples inside the container were gently discarded, and the weight of the precipitates remaining in the bottom of the container after placing the container upside-down for one minute was measured, and the precipitations were calculated according to the following formula:

[0049]

$$\text{Amount of Precipitation (\% by weight)} = \frac{\text{Weight of Container (Including Precipitates) After Placing Up-Side Down for One Minute} - \text{Weight of Empty Container}}{\text{Weight of Filling Product} - \text{Weight of Aluminum Cap} - \text{Weight of Empty Container}} \times 100$$

[0050] [Table 2]

5 Table 2

	Number of Storage Days	Example 1	Comparative Example 4	Comparative Example 6 (Without Addition)
Whey-Off (mm)	7 Days	6	15	5
	14 Days	8	17	8
	21 Days	10	22	10
	28 Days	10	22	10
Amount of Precipitation (% by Mass)	7 Days	1.2	1.7	0.9
	14 Days	1.7	2.1	1.3
	21 Days	2.4	4.0	1.9
	28 Days	2.7	4.2	2.3

[0051] It can be seen from the results of Table 2 that the fermented milk of Example 1 does not have a great difference in the whey-off and the amount of precipitation from the fermented milk of Comparative Example 6 without addition of a coated ferric pyrophosphate composition, as

compared to those of the fermented milk of Comparative Example 4.

[0052] [Evaluation of Flavor]

Each of the fermented milks obtained using the coated ferric pyrophosphate compositions of Example 1 and Comparative Example 4 and a fermented milk obtained without a coated ferric pyrophosphate composition (Comparative Example 6) was stored at 10°C for 28 days. The flavor was evaluated immediately after the preparation (day 0), after 14-day storage, and after 28-day storage.

[0053] As a result, the fermented milks of Example 1 and Comparative Example 6 do not have the flavor of an emulsifying agent or the flavor characteristic of iron, so that a flavor in an acceptable level as a manufactured article was maintained, but the fermented milk of Comparative Example 4 had a strong flavor of an emulsifying agent, and further was found to have a flavor characteristic of iron at a point of storing for 14 days, so that the results were unacceptable as a manufactured article.

[0054] Example 13

A starter of *Lactobacillus casei* YIT9029 was inoculated in an amount of 0.5% by mass to a 15% by mass nonfat powder milk medium (containing 3.5% by mass of glucose), and cultured at 37°C until its pH reached 3.6, and thereafter a mixture prepared by mixing the culture medium and a 3% by mass soybean polysaccharide solution was subjected to a homogenization treatment at 15 MPa.

In addition, a syrup containing a coated ferric pyrophosphate composition obtained in Example 1 (containing 3.6% by mass of iron

originated from ferric pyrophosphate) in an amount of 0.1% by mass, the syrup containing 14% by mass of sugar, 0.2% by mass of a collagen peptide, and 0.06% by mass of vitamin C, was prepared.

Thirty-two parts by weight of the above mixture and 68 parts by weight of the syrup were mixed, to produce a fermented milk (lactic acid bacteria beverage). The fermented milk had a pH of 3.6, SNF of 3.1% by mass, and a zeta potential of -4.5 mV.

[0055] The resulting fermented milk does not cause separation even when stored for 14 days at 10°C, so that it was a beverage having excellent flavor with very high physical stability.

INDUSTRIAL APPLICABILITY

[0056] The coated ferric pyrophosphate composition of the present invention is usable in a fermented milk such as yogurt, a yogurt beverage, or a lactic acid bacteria beverage.

CLAIMS

[Claim 1] A coated ferric pyrophosphate composition comprising ferric
5 pyrophosphate coated with 1 to 10 parts by mass of a polyoxyethylene
sorbitan fatty acid ester or 1 to 10 parts by mass of a glycerol fatty acid
ester, and 0.05 to 1 part by mass of an enzymatically decomposed lecithin,
based on 100 parts by mass of the ferric pyrophosphate, wherein the
composition has a zeta potential of from -25 to -39 mV, and an average
10 particle size of from 1 to 4 μm .

[Claim 2] The coated ferric pyrophosphate composition according to claim 1,
for blending with a fermented milk having an absolute value of a zeta
potential of 10 mV or less.

[Claim 3] An iron-fortified fermented milk, containing a coated ferric
15 pyrophosphate composition as defined in claim 1 in an amount of from 1.0
to 10 mg, calculated as iron derived from ferric pyrophosphate per 100 g
of a fermented milk having an absolute value of a zeta potential of 10 mV
or less.