

FOOD INGREDIENT AND COCOA AND/OR MALT BEVERAGE PRODUCTS

Field of the invention

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The present invention relates to a food ingredient comprising galactooligosaccharides, a way of producing it and cocoa and/or malt beverage products comprising the ingredient.

10 Background

Many food products traditionally comprise high amounts of sugar, which is important to achieve the sweet taste and texture the consumers expect of the product. For health reasons there is a desire to reduce the amount of sugar in many food products and to
15 replace it with healthier ingredients like e.g. fibers, but to ensure the consumer liking of the product, it is desired to achieve this without sacrificing taste and texture. One solution is to use artificial sweeteners that provide sweetness without the energy contribution of sugar, but these do not contribute to the texture like sugar and furthermore, many consumers want to avoid artificial ingredients such as sweeteners.
20 Food products such as e.g. cocoa and/or malt beverages traditionally comprise milk, which includes lactose, and sucrose to achieve the desired taste and texture. For the reasons given above, there is a desire to reduce the amount of sugar, preferably replacing it with healthier ingredients, keeping the taste and texture of the original product.

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It is known that lactose can be polymerized by beta-galactosidase to produce galactooligosaccharide (GOS). GOS acts as prebiotics and is used as an ingredient primarily in infant formulae and baby food. The yield of GOS from polymerization of lactose is normally below 50%, often in the range of 10-30%.

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Summary of the invention

The inventors have found that a food ingredient with a specific combination of milk protein, sugars and GOS can be used in food products, such as cocoa and/or malt

- beverages, to replace skim milk powder or other milk ingredients as well as part of the sucrose normally added, to achieve similar taste and texture with reduced total sugar content and at the same time contribute prebiotic GOS to the product. Accordingly, the invention relates to a food ingredient comprising 20-40 % by dry weight of milk protein; and 35-55% by dry weight of a mixture of lactose, glucose, galactose and galactooligosaccharide, said mixture containing: 0.1-30% by weight of lactose, 8-40% by weight of glucose, 0.1-20% by weight of galactose and 40-90% by weight of galactooligosaccharide.
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- 10 In further aspects, the invention relates to a method of producing a food ingredient, a cocoa and/or malt beverage powder and a liquid cocoa and/or malt beverage product.

Detailed description of the invention

15 Definitions

- By beta-galactosidase is understood one or more enzymes with enzymatic activity of enzyme class EC 3.2.1.23, also called beta-D-galactoside galactohydrolase, exo-(1->4)-beta-D-galactanase or lactase, which catalyses the hydrolysis of terminal non-reducing beta-D-galactose residues in beta-D-galactosides, as well as transgalactosylation by transferring a galactose moiety of a beta-D-galactoside to another sugar molecule.
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- EC (Enzyme Committee) numbers refer to the definition of enzymatic activity and nomenclature given by the Nomenclature Committee of the International Union of Biochemistry and Molecular Biology as in force on 3rd July 2019.
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- Galactooligosaccharides (GOS) are oligosaccharides composed of different galactosyl residues (usually from 2 to 9 units) and a terminal glucose linked by β -glycosidic bonds, such as β -(1-2), β -(1-3), β -(1-4), and β -(1-6). GOS are normally produced through the enzymatic conversion of lactose.
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Food ingredient

In one aspect, the present invention relates to a food ingredient comprising 20-40% by dry weight of milk protein. By milk protein is meant any protein or combination of

proteins derived from milk. The milk proteins may have been derived from milk in any suitable way. In a preferred embodiment, the food ingredient comprises 25-40%. More preferably 30-40% by dry weight of milk protein.

- 5 The food ingredient further comprises 35-55% by dry weight of a mixture of Lactose, Glucose, Galactose and GOS, said mixture containing: 0.1-30% by weight of lactose, 8-40% by weight of glucose, 0.1-20% by weight of galactose and 40-90% by weight of GOS. In a preferred embodiment, the food ingredient comprises 45-55% by dry weight of said mixture of Lactose, Glucose, Galactose and GOS; in a more preferred
10 embodiment, the food ingredient comprises 50-55% by dry weight of said mixture of Lactose, Glucose, Galactose and GOS. In another preferred embodiment of the invention, said mixture of Lactose, Glucose, Galactose and GOS comprises 60-90% by weight of GOS, more preferred 70-90% by weight of GOS. In yet another preferred embodiment of the invention, said mixture of Lactose, Glucose, Galactose and GOS
15 contains: 1-20% by weight of lactose, 15-35% by weight of glucose, 1-10% by weight of galactose and 50-85% by weight of GOS. In a more preferred embodiment of the invention, said mixture of Lactose, Glucose, Galactose and GOS contains: 1-14% by weight of lactose, 15-29% by weight of glucose, 1-8% by weight of galactose and 70-90% by weight of GOS.

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The food ingredient may further comprise 0.5-30% by dry weight of milk fat and/or minerals derived from milk, preferably 2-20%, more preferably 6-10% by dry weight of milk fat and/or minerals derived from milk. By milk fat is meant fat derived from milk in any suitable way. By milk derived minerals are meant minerals derived from
25 milk in any suitable way, e.g. calcium, sodium, potassium, phosphorus and/or magnesium salts. Milk fat and/or milk derived minerals may e.g. origin from liquid milk, such as skim milk, partially skimmed milk and/or whole milk, or from milk powder, such as e.g. skim milk powder and/or whole milk powder.

- 30 In a preferred embodiment, the food ingredient comprises 5-20% by dry weight of vegetable oil, more preferably 8-15% by dry weight of vegetable oil. The vegetable oil may be any suitable vegetable oil, preferably palm oil.

Process for producing a food ingredient

In another aspect the invention relates to a method of producing a food ingredient of the invention. Accordingly, in one embodiment, the invention relates to a process for producing a food ingredient, the process comprising:

- 5 a) providing an aqueous composition comprising 30-80% by weight of non-fat milk solids including lactose,
- b) adding a beta-galactosidase to the composition
- c) allowing the beta-galactosidase to react for 10-240 minutes at 50-65°C; and
- d) heat treating the composition after step c) at a temperature of 70-150°C for 10-150 seconds

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An aqueous composition comprising 30-80% by weight of non-fat milk solids including lactose may be provided in any suitable way known in the art, e.g. by concentrating milk, such as e.g. skim milk and/or whole milk, to the desired solids concentration, e.g. by evaporation or filtration, or by dissolving milk powder, such as
15 e.g. skim milk powder and/or whole milk powder, in water to arrive at the desired solids concentration. The aqueous composition provided in step a) preferably comprises between 40 and 65% by weight of non-fat milk solids. The aqueous composition provided in step a) preferably comprises 15-45% lactose by weight, more preferably 20-45% lactose by weight. It has been found that this level of solids and/or lactose
20 facilitates the hydrolysis of lactose and formation of GOS. In a preferred embodiment, the composition further comprises 5-20% by weight of vegetable fat, e.g. palm oil.

A beta-galactosidase is added to the aqueous composition provided in step a). The beta-galactosidase may be any suitable beta-galactosidase. The amount of beta-
25 galactosidase added may depend on the specific enzyme, its level of activity and its formulation. The skilled person will now how to choose the amount according to the desired result. Typically, the amount will be in the order of 0.5-2% by weight of lactose in the aqueous composition. The aqueous composition may be at the desired reaction temperature when the beta-galactosidase is added, or it may be heated to the
30 reaction temperature following the addition of the beta-galactosidase. In step b), the beta-galactosidase is allowed to react with the lactose in the aqueous composition to hydrolyse the lactose and produce GOS. The enzyme is allowed to react for 10-240 minutes at 50-65°C. It has been found that this temperature range facilitates the hydrolysis of lactose and formation of GOS.

After the beta-galactosidase has been allowed to react in step c), the composition is heat treated at 70-150°C for 10-150 seconds, preferably at 72-130°C for 10-120 seconds. The purpose of the heat treatment is to prevent substantial degradation of the GOS by further reaction of the beta-galactosidase, as well as ensuring the microbiological stability of the product, without creating excessive denaturation of protein or formation of Maillard reaction products. The food ingredient may be used directly as it is after the heat treatment, or it may e.g. be packed, stored and/or distributed for subsequent use. If the food ingredient is not spray dried, the heat treatment of step d) is preferably conducted at 140-145°C for 10-30 seconds.

In a preferred embodiment, the method comprises spray drying the composition after the heat treatment of step d). It has been found that the heat treatment may not in itself necessarily completely inactivate the beta-galactosidase, but in combination with subsequent spray drying, it ensures full inactivation of the beta-galactosidase. In this way, a more severe heat treatment that would completely inactivate the beta-galactosidase, but also create unnecessary protein denaturation and formation Maillard products, can be avoided by spray drying the composition after the heat treatment to produce a dry powdered food ingredient. When the heat treatment is followed by spray drying, it is preferably conducted at 80-90°C for 10-30 second. The powdered food ingredient may further be packed and distributed, or used directly in the production of a food product, e.g. a cocoa and/or malt beverage product.

In a specific embodiment, the invention relates to a process for producing a food ingredient, the process comprising:

- a) concentrating skim milk to a solids concentration of 30-80% by weight;
- b) adding a beta-galactosidase to the concentrated skim milk;
- c) allowing the beta-galactosidase to react for 10-240 minutes at 50-65°C;
- d) heat treating the composition after step c) at 80-90°C for 10-30 seconds; and
- e) spray drying the composition.

In another specific embodiment, the invention relates to a process for producing a food ingredient, the process comprising:

- a) providing an aqueous composition comprising 30-80% by weight of non-fat milk

solids,

b) adding a beta-galactosidase to the composition

c) allowing the beta-galactosidase to react for 10-240 minutes at 50-65°C; and

d) heat treating the composition after step c) at 140-145°C for 10-30 seconds.

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Cocoa and/or malt beverage powder

In one embodiment, the invention relates to a cocoa and/or malt beverage powder comprising: 10-35% by weight of non-fat milk solids; 0-65% by weight of malt extract solids; 0-15% by weight of cocoa solids; 6-15% by weight of vegetable oil and/or milk
10 fat; 0-25% by weight of sucrose; 1-6% by weight of glucose; 0.1-5% by weight of lactose; and 3-10% by weight of GOS.

Non-fat milk solids may be derived from any suitable milk source, such as e.g. liquid milk, e.g. skim milk and/or whole milk, and/or milk powder, e.g. skim milk powder
15 and/or whole milk powder. If liquid milk is used, it may be concentrated, e.g. by evaporation or filtration. Malt extract solids may be in any suitable form, e.g. in the form of a powdered or liquid extract of malted barley and/or wheat. Cocoa solids may be from any suitable cocoa source, e.g. in the form of cocoa powder, cocoa mass and/or cocoa butter. Vegetable oil may be any suitable vegetable oil, preferably palm
20 oil. Milk fat may be derived from any suitable milk source, such as e.g. liquid milk or cream, e.g. skim milk, cream, and/or whole milk, and/or milk powder, e.g. skim milk powder, cream powder, and/or whole milk powder, and/or may be in the form of butter, butter oil and/or anhydrous milk fat. If liquid milk or cream is used, it may be concentrated, e.g. by evaporation or filtration.

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Glucose, lactose and GOS are preferably derived from the food ingredient of the present invention. A cocoa and/or malt beverage powder of the invention preferably comprises 10-30% by dry weight of the food ingredient of the invention, more preferably 15-25% by dry weight of the food ingredient of the invention. In a preferred
30 embodiment of the invention, the cocoa and/or malt beverage powder comprises 2-4% by weight of glucose; 0.1-2% by weight of lactose; and 5-10% by weight of GOS.

A cocoa and/or malt beverage powder of the invention may comprise sucrose. Due to the amounts of lactose, glucose and GOS present in the product, the amount of sucrose

may be reduced as compared to a conventional cocoa and/or malt beverage powder while retaining an acceptable taste, sweetness and texture. In a preferred embodiment, a cocoa and/or malt beverage product of the invention does not comprise sucrose. In another preferred embodiment, a cocoa and/or malt beverage powder of the invention
5 comprises 1-25% by weight of sucrose, more preferably 5-20% by weight of sucrose.

A cocoa and/or malt beverage powder of the invention may comprise any other suitable ingredients known in the art, such as e.g. vitamins, minerals, buffer salts, emulsifiers and stabilizers.

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A cocoa and/or malt beverage powder of the invention may be produced by any suitable method known in the art. The ingredients may e.g. be in powder form and mixed in the dry state, some or all ingredients may be mixed in aqueous solution/suspension and subsequently dried to a powder, or some or all powdered
15 ingredients may e.g. be co-agglomerated to produce a powder with improved solubility.

In a preferred embodiment, the invention relates to a cocoa and malt beverage powder comprising 15-35% by weight of non-fat milk solids; 20-50% by weight of malt
20 extract solids; 5-15% by weight of cocoa solids; 6-15% by weight of vegetable oil and/or milk fat; 0-25% by weight of sucrose; 1-6% by weight of glucose; 0.1-5% by weight of lactose; and 3-10% by weight of galactooligosaccharide.

Liquid cocoa and/or malt beverage product

25 In one embodiment, the invention relates to a liquid cocoa and/or malt beverage product comprising: 3-10% by weight of non-fat milk solids; 1-6% by weight of malt extract solids; 0-5% by weight of cocoa solids; 0.3-5% by weight of vegetable oil and/or milk fat; 0-5% by weight of sucrose; 0.4-1.5% by weight of glucose; 0.01-1% by weight of lactose; and 0.5-5% by weight of GOS.

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A liquid cocoa and/or malt beverage product is a cocoa and/or malt beverage product in liquid form which is suitable to be consumed without addition of liquid. It may e.g. be packed in a container from which it can be consumed directly upon opening.

Non-fat milk solids may be derived from any suitable milk source, such as e.g. liquid milk, e.g. skim milk and/or whole milk, and/or milk powder, e.g. skim milk powder and/or whole milk powder. If liquid milk is used, it may be concentrated, e.g. by evaporation or filtration. Malt extract solids may be in any suitable form, e.g. in the form of a powdered or liquid extract of malted barley and/or wheat. Cocoa solids may be from any suitable cocoa source, e.g. in the form of cocoa powder, cocoa mass and/or cocoa butter. Vegetable oil may be any suitable vegetable oil, preferably palm oil. Milk fat may be derived from any suitable milk source, such as e.g. liquid milk or cream, e.g. skim milk, cream, and/or whole milk, and/or milk powder, e.g. skim milk powder, cream powder, and/or whole milk powder, and/or may be in the form of butter, butter oil and/or anhydrous milk fat. If liquid milk or cream is used, it may be concentrated, e.g. by evaporation or filtration.

Glucose, lactose and GOS are preferably derived from the food ingredient of the present invention. A liquid cocoa and/or malt beverage product of the invention preferably comprises 10-30% by dry weight of the food ingredient of the invention, more preferably 15-25% by dry weight. In a preferred embodiment, the liquid cocoa and/or malt beverage product comprises 0.5-1% by weight of glucose; 0.01-0.5% by weight of lactose; and 1-4% by weight of GOS.

A liquid cocoa and/or malt beverage product of the invention may comprise sucrose. Due to the amounts of lactose, glucose and GOS present in the product, the amount of sucrose may be reduced as compared to a conventional cocoa and/or malt beverage powder while retaining an acceptable taste, sweetness and texture. In a preferred embodiment, a cocoa and/or malt beverage product of the invention does not comprise sucrose. In another preferred embodiment, a cocoa and/or malt beverage powder of the invention comprises 0.1-5% by weight of sucrose, more preferably 1-3% by weight of sucrose.

A liquid cocoa and/or malt beverage product of the invention may comprise any other suitable ingredients known in the art, such as e.g. vitamins, minerals, buffer salts, emulsifiers and stabilizers.

A liquid cocoa and/or malt beverage product of the invention may be produced in any

suitable way known in the art. The ingredients may be in liquid and/or powdered form and may be mixed into an aqueous solution/suspension, e.g. with the addition of water to achieve the desired concentration of ingredients. A food ingredient of the invention is preferably added in liquid form, but may also be added in powdered form.

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A food ingredient of the invention may form the basis of producing a liquid cocoa and/or malt beverage product of the invention. For example, a food ingredient may be produced by the method of the invention, and after the beta-galactosidase has been allowed to react in step c), the remaining ingredients of the liquid cocoa and/or malt
10 beverage product may be added to the ingredient and the total composition may be heat treated according to step d) of the method of the invention, preferably at 140-145°C for 10-30 seconds.

In a preferred embodiment, the invention relates to a liquid cocoa and/or malt beverage
15 product comprising: 3-10% by weight of non-fat milk solids; 1-6% by weight of malt extract solids; 1-5% by weight of cocoa solids; 0.3-5% by weight of vegetable oil and/or milk fat; 0-5% by weight of sucrose; 0.4-1.5% by weight of glucose; 0.01-1% by weight of lactose; and 0.5-5% by weight of GOS.

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EXAMPLES

Example 1

Skimmed milk powder (MSK) was mixed with water to form a slurry with 60% total
25 solids content at 60°C. 1% of a beta-galactosidase with transgalactosylase activity was added to the MSK slurry. The reaction was allowed to proceed for duration of 60 min. Pasteurization at 85°C for 18 seconds was applied to pasteurize the milk and partially inactivate enzymes before spray-drying to form dried skimmed milk powder. It was demonstrated that with spray drying, it was possible to completely inactivate the
30 enzymes and no residual enzyme activity was detected in the final spray dried powder. The composition of the skim milk powder and the enzyme treated powder is shown in table 1.

Table 1. Composition of skim milk powder before and after treatment.

% by weight	MSK before treatment	Enzyme reacted MSK
Glucose	0	11.6
Lactose	52.4	3.0
Galactose	0	1.8
GOS	0	37.0
Total Sugars	52.4	16.4
Sugar Reduction	NA	68.7%

Example 2: Preparation of cocoa and malt beverage powder with enzyme-treated skimmed milk powder

- 5 The enzyme treated skimmed milk powder produced in example 1 was used in the preparation of a cocoa malt beverage powder comprising 20% skimmed milk powder, the composition is given in table 2. A reference cocoa and malt beverage powder was produced in the same way with the same composition, except that untreated skim milk powder was used instead of enzyme treated skim milk powder. The sugar composition
- 10 of the product and the reference is given in table 3.

Table 2. Composition of cocoa and malt beverage powder with enzyme-treated skimmed milk powder of example 2.

	% by weight of dry matter
Malt Extract	40
Palm Oil	12
Sucrose	15
Skimmed Milk Powder	20
Cocoa Powder	9.5
Dicalcium Phosphate	1

- 15 Table 3. Sugar composition of cocoa and malt beverage powder with enzyme-treated skimmed milk powder and reference of example 2.

% by weight of dry matter	Reference cocoa and malt beverage powder	Cocoa and malt beverage powder with enzyme-treated skimmed milk powder

Sucrose	15.6	15.6
Fructose	0.3	0.3
Glucose	2.9	5.4
Galactose	0	0.6
Lactose	10.7	0.6
Maltose	10.3	10.3
GOS	0.0	6.8
Total sugars	39.8	32.8

The cocoa and malt beverage powder with enzyme-treated skimmed milk powder and the reference cocoa and malt beverage powder were compared by a sensory panel. No significant differences in sweetness and body were found.

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Example 3: Liquid cocoa and malt beverage product

The enzyme treated skimmed milk powder produced in example 1 was used in the preparation of a liquid cocoa malt beverage product with the composition given in table 4. A reference liquid cocoa and malt beverage product was produced in the same way with the same composition, except that untreated skim milk powder was used instead of enzyme treated skim milk powder. The sugar composition of the product and the reference is given in table 5.

Table 4. Composition of cocoa and malt beverage powder with enzyme-treated skimmed milk powder of example 2.

	% by weight
Malt Extract	4
Palm Oil	3
Sucrose	4
Skimmed Milk Powder	4
Cocoa Powder	3
Stabilizer	0.5

Table 3. Sugar composition of cocoa and malt beverage powder with enzyme-treated skimmed milk powder and reference of example 2.

% by weight	Reference liquid cocoa and	Liquid cocoa and malt
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	malt beverage product	beverage powder with enzyme-treated skimmed milk powder
Sucrose	4.1	4.1
Fructose	0.0	0.0
Glucose	0.3	0.8
Galactose	0.0	0.1
Lactose	2.1	0.1
Maltose	1.0	1.0
GOS	0.0	1.4
Total sugars	7.5	6.1

The cocoa and malt beverage powder with enzyme-treated skimmed milk powder and the reference cocoa and malt beverage powder were compared by a sensory panel. No significant differences in sweetness and body were found.