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(54) Title: FORTIFICATION OF SUGAR CUBES

(57) Abstract: Method for preparing sugar cubes comprising the step of adding a sugar pre-form consisting of crystal sugar particles comprising a sugar core which is coated with a mixture of one or more polysaccharides and/or one or more oligosaccharides said coating further containing a stabilized nutrient - preferably Vitamin A esters - to bulk sugar directly before the forming of sugar cubes; and sugar cubes so obtained.



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Fortification of sugar cubes

The present invention relates to a process for the fortification of sugar cubes with nutrients, especially to a process for the fortification of sugar cubes with vitamin A, furthermore it relates to a process of manufacture of such sugar cubes by direct dosing of a special sugar
10 pre-form containing the nutrient(s) to the bulk sugar just before cube formation.

Vitamins and/or mineral nutrient deficiency, in particular vitamin A deficiency continues to be highly prevalent in developing countries. The World Health Organization (WHO) estimates that in at least 75 countries, the vitamin A deficiency is a problem of public health
15 importance. Of the many approaches that have been taken to control vitamin and/or mineral nutrient deficiency, sugar fortification seems to be one of the most effective, as sugar fulfils in most countries the criteria which marks it a good vehicle for fortification with specific nutrients, such as:

- being consumed in significant amounts by essentially all members of the targeted groups
20 of the population whereby the daily intake is essentially constant;
- not causing any imbalance of essential nutrients;
- There is reasonable assurance that no excess intake will be induced;
- Fortification does not alter the organoleptic characteristics of the vehicle;

25 Accordingly especially Vitamin A fortification of sugar has been done since several decades in various countries. Even the fortification of sugar cubes has already been done for several years (see e.g. WO-2007/012704-A1)

The fortification of sugar, as well as of sugar cubes is often carried out in two steps.
30 In a first step, a concentrated premix which contains vitamin A, an unsaturated oil and/or fat as a binder and an antioxidant to prevent peroxidation of the oil, is prepared by simple mixing. Most often retinyl palmitate is used, e.g. as a microencapsulated powdery preparation that contains a defined amount of vitamin A per gram and is water-dispersible. To avoid separation and in-homogeneity the nutrient (here vitamin A) has to be fixed on the
35 outside of the sugar crystal. This is achieved by the oil and/or fat which makes the sugar surface sticky so that finally a sugar /vitamin/oil agglomerate (in form of a concentrated premix) is created.

5

The concentration of vitamin A in the premix is usually 1,000 times that of the final fortified sugar, which must accordingly be diluted with more sugar up to 1,000-fold.

10

The procedure described above for the fortification of sugar and in an analogue way for sugar cubes is based on technology developed in the early 1970s and modified as needed over the following years. Problems that are generally encountered with this technology relate to poor conditions of preparation of premixes, low-quality oils with a high content of peroxides, and poor storage of the fortified sugar. The result, in spite of the use of antioxidants, is the slow development of rancidity of the added oil.

15

A further specific problem of the fortification of crystal sugar is that during and after addition of the premix to the bulk sugar a part of the nutrient which was already fixed on the sugar surface is removed from it resulting in separation and homogeneity problems. In sugar cubes a segregation as described for sugar crystals is not seen during storage. However, the process of cube forming involves a relatively high amount of water (1-3 % by weight) prior to moulding which also leads to an irregular distribution of vitamin A in the end product.

25

Adding more oil and/or fat to the premix does not solve this problem because if more oil/fat is added to the premix, the flowability of the premix is reduced which leads to difficulties with the incorporation of said premix in the sugar bulk causing also inhomogeneity problems. Furthermore the development of rancidity is enlarged when using more oil/fat and the turbidity of a sugar solution increases.

30

It was therefore an object of the following invention to create a new concept to overcome the drawbacks of the state of the art. Furthermore the resulting fortified sugar cubes should satisfy the usual demands of a food composition, such as being stable against oxidation, the nutrients being evenly distributed in the cubes and so on.

35

It has surprisingly been found that the objective of the present invention is achieved by a process for the manufacture of sugar cubes comprising the step of adding a sugar pre-form consisting of crystal sugar particles comprising a sugar core which is coated with a mixture of one or more polysaccharides and/or one or more oligosaccharides said coating further containing a stabilized nutrient to bulk sugar directly before the forming of sugar cubes.

40

5 It was not to be foreseen by the person skilled in the art that the process according to the present invention would solve the above mentioned issues, especially to produce sugar cubes with low production losses, high content uniformity and without the need of an oil containing premix.

10 The terms "sugar" and "crystal sugar" or "sugar cube" as used herein refer to commercially-produced "table sugar", which most commonly comes either from sugar-cane or from sugar-beet, including sugars in all degrees of purity and color ranging from raw sugar (brown sugar) to refined sugar (white sugar). Table sugar consists mainly of sucrose (also called saccharose).

15 The sugar pre-form according to the present invention preferably consists only of sugar, one or more nutrients and polysaccharide(s) and/or oligosaccharide(s) and optionally one or more antioxidant(s) (fat-soluble and/or water-soluble). It is especially preferred if antioxidants are already part of the sugar pre-form.

20 The desired mean particle size of sugar pre-form according to the invention is advantageously similar to mean particle size of the bulk sugar used in the process.

The term "polysaccharide" as used herein includes xanthan gum, acacia gum, pectins, guar, 25 caroub gums, alginates, celluloses, cellulose derivatives, such as carboxymethylcellulose, and/or modified polysaccharides, such as starch and starch derivatives. Preferred polysaccharides according to the present invention are acacia gum, starch, starch derivatives; especially preferred are gelatinized starch and modified food starch.

30 According to the present invention starch hydrolysates, such as dextrans and maltodextrins, are preferred oligosaccharides. Maltodextrins are especially preferred.

The sugar pre-form according to the present invention is obtainable by various processes, e.g. by a process for the manufacture of a sugar pre-form containing crystal sugar 35 particles comprising the steps of

- a) dissolving one or more polysaccharides and/or one or more oligosaccharides in water thus forming a glue;
- b) mixing the glue of step a) with sugar in order to coat said sugar with said glue;
- c) adding one or more nutrients to the mixture of step b);

- 5 d) if necessary drying the product of step c) until said product has a water content of less than 3 % by weight and
- e) optionally sieving and/or milling the so-derived sugar pre-form.

Step a) of this process can be conducted at any reasonable temperature to ensure a rapid
10 dissolution of the polysaccharide(s) and/or oligosaccharide(s) in water. Dissolving in water of a temperature from to about 20 to 60 °C is preferable.

Other possible processes for the manufacture of sugar pre-forms according to the present invention are described in WO-2009/000404-A1. A preferred sugar pre-form according to the
15 present invention is commercially available as "Dry Vitamin A 50 Palmitate" from DSM Nutritional Products.

- In a preferred embodiment of the present invention the process for the manufacture of sugar cubes comprises the steps of
- 20 a) dry mixing of a sugar pre-form with bulk sugar in order to prepare a homogeneous dry blend, wherein the blending ratio depends on the intended final nutrient concentration and will usually be in the range of 1 : 500 to 2 : 1000, preferably about 1 : 1000;
- b) afterwards adding water to the blend of step a) under continuous mixing, preferably in form of spraying water or water/steam in an amount of 0,5 to 5 % by weight of water
25 (humidity) based on the total weight of the blend, preferably in an amount of 1 to 3 % by weight; at temperatures of 20 °C to 90 °C, preferably of 30 to 50 °C;
- c) forming the cubes; and
- d) drying the product either in drying chambers at temperatures of about 75°C for several minutes (preferably for about 25 minutes) or by other suitable drying systems
30 like microwave or infrared etc.

- In another embodiment of the present invention the process for the manufacture of sugar cubes comprising the steps of
- a) mixing the majority of bulk sugar (about 90 % by weight based on the total weight
35 of the bulk) with water or water/steam amount of 0,5 to 6 % by weight water (humidity) based on the total weight of the mixture, preferably 1 to 4 % by weight under continuous mixing;
- b) separately mixing a sugar pre-form with the remaining minority of the bulk sugar (about 10% by weight based on the total weight of the bulk) in order to prepare a
40 homogeneous dry blend, wherein the blending ratio depends on the intended final

- 5 nutrient concentration and will usually be in the range of 1 : 500 to 2 : 1000,
preferably about 1 : 1000;
- c) adding the dry mixture of step b) to the wet bulk sugar of step a) under mixing
- d) forming the cubes; and
- e) drying the product either in drying chambers at temperatures of about 75°C for
- 10 several minutes (preferably about 25 minutes) or by other suitable drying systems.

According to the present invention it is further preferred if the residual moisture content in the final sugar cube is below 1% by weight, preferably below 0,5% by weight.

- 15 In this regard it does not make any difference if the residual moisture content is obtained by carrying out the drying step with hot air, microwave or infrared technology. The drying with hot air is preferably done at temperatures below 80 °C.

- 20 The water content of the final sugar cubes according to the present invention may be determined by Karl Fischer titration (e.g. described in Eugen Scholz *Karl-Fischer-Titration*, Springer-Verlag 1984 or the WHO Method WHO/M/7.R1)

- The term "nutrient" as used herein denotes physiologically essential components of the human diet such as vitamins, e.g., vitamin A, vitamin B1, Folic acid, Niacin, vitamin B12, vitamin B2, vitamin B6, vitamin E, C, Biotin, Pantothenates, vitamin K, vitamin D as well as derivatives and mixtures of these, as well as minerals and trace elements such as Iron, Selenium, Zinc and Calcium.

- Vitamin A and/or retinyl esters, such as e.g. retinyl palmitate and/or retinyl acetate are
- 30 especially preferred.

If vitamin A and/or vitamin A derivatives are used as nutrient it is according to the present invention advantageous if the amount of nutrients present in a sugar cube is about 10 IU – 100 IU Vitamin A / g , preferably 20 IU – 50IU Vitamin A / g.

- 35 A daily average serving of 20 g sugar cubes (about 4 sugar cubes) will then provide 15 – 37 % of the RDA (Recommended Daily Allowance for an adult).

In preferred embodiments of the process of the present invention no other ingredients than sugar, water or water/steam and the sugar pre-form are used.

- 5 The present invention is also directed to sugar cubes containing the sugar pre-form obtainable by the process.

The amount of sugar pre-form and bulk sugar according to the present invention which is to be blended in order to produce the sugar cubes depends on the potency of said sugar pre-
10 form and on the finally intended nutrient, especially Vitamin A level in the sugar cube.

The invention is further illustrated by the following examples.

5 **Examples:****Example 1**

Sugar crystal	999 g
Water	17 g
Sugar pre-form*	1 g

- Sugar and the "Dry Vitamin A 50 Palmitate" are mixed carefully (5 minutes)
- 10 • Warm Water ~40°C is added and continuously mixed
- After several minutes the cubes are formed in moulds /dies
- The wet cubes are dried with hot air at 75°C until water content <1%

15 **Example 2**

Sugar crystal	898 g
Water /Steam	17 g
Sugar pre-form*	2 g
Sugar crystal	100

- The majority of sugar and steam and water are mixed carefully (5 minutes)
- The minor part of sugar and the "Dry Vitamin A 50 Palmitate" are mixed separately and subsequently added to the wet and hot sugar blend and are mixed carefully.
- 20 • After several minutes the cubes are formed in moulds /dies
- The wet cubes are dried at 75°C until water content <1%

- * consisting of crystal sugar particles comprising a sugar core (82 % by weight based on the total weight of the particle) which is coated with 13 weight -% modified food starch, said
- 25 coating further containing 0.03 weight -% of stabilized Vitamin A Palmitate (Stabilizers are BHT, sodium ascorbate, sodium benzoate and sorbic acid). This sugar pre-form is commercially available as "Dry Vitamin A 50 Palmitate" from DSM Nutritional Products.

5 **Claims:**

1. Process for the manufacture of sugar cubes comprising the step of adding a sugar pre-form consisting of crystal sugar particles comprising a sugar core which is coated with a mixture of one or more polysaccharides and/or one or more oligosaccharides
10 said coating further containing a stabilized nutrient to bulk sugar directly before the forming of sugar cubes.
2. Process according to claim 1 characterized that no additional oil or any other binding agent than water or water/steam is added.
15
3. Process according to any of the preceding claims characterized that the sugar pre-form and the bulk sugar are blend before the addition of the water or water/steam.
4. Process according to any of the claims 1 or 2 characterized that the bulk sugar is first
20 mixed with water or water/steam and just before the formation of the cubes a dry pre-blend of sugar pre-form and a minor quantity of bulk sugar is added to this mixture.
5. Process according to any of the preceding claims characterized in that the nutrient is selected from vitamin A (retinyl) esters.
25
6. Process for the manufacture of sugar cubes comprising the steps of
 - a) dry mixing of a sugar pre-form with bulk sugar in order to prepare a homogeneous dry blend, wherein the blending ratio depends on the intended final nutrient concentration and will usually be in the range of 1 : 500 to 2 : 1000,
30 preferably about 1 : 1000;
 - b) afterwards adding water to the blend of step a) under continuous mixing, preferably in form of spraying water or water/steam in an amount of 0,5 to 5 % by weight of water (humidity) based on the total weight of the blend, preferably in an amount of 1 to 3 % by weight; at temperatures of 20 °C to 90 °C, preferably of 30
35 to 50 °C;
 - c) following by forming the cubes and
 - d) drying the product either in drying chambers at temperatures of about 75°C for several minutes (preferably for about 25 minutes) or by other suitable drying systems.

- 5 7. Process for the manufacture of sugar cubes comprising the steps of
- a) mixing the majority of bulk sugar (about 90 % by weight based on the total weight
 of the bulk) with water or water/steam amount of 0,5 to 6 % by weight water
 (humidity) based on the total weight of the mixture, preferably 1 to 4 % by weight
 under continuous mixing
- 10 b) separately mixing a sugar pre-form with the remaining minority of the bulk sugar
 (about 10% by weight based on the total weight of the bulk) in order to prepare a
 homogeneous dry blend, wherein the blending ratio depends on the intended final
 nutrient concentration and will usually be in the range of 1 : 500 to 2 : 1000,
 preferably about 1 : 1000;
- 15 c) adding the dry mixture of step b) to the wet bulk sugar of step a) under mixing
 d) following by forming the cubes and
 e) drying the product either in drying chambers at temperatures of about 75°C for
 several minutes (preferably about 25 minutes) or by other suitable drying systems.
- 20 8. Sugar cubes obtainable by a process according to one of the preceding claims.

INTERNATIONAL SEARCH REPORT

International application No

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A. CLASSIFICATION OF SUBJECT MATTER

INV. A23L1/00 C13F3/00 C13F5/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A23L C13F

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

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

EPO-Internal, FSTA, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2005/244568 A1 (GOKHAN CEM [DE]) 3 November 2005 (2005-11-03) paragraphs [0014], [0027], [0028], [0032], [0049], [0050], [0141], [0142]; claims 27,28,47; examples -----	1-8
Y	WO 2009/000404 A2 (DSM IP ASSETS BV [NL]; DIGUET SYLVAIN [FR]; STEIGER GEORG [AT]; WIEPRE) 31 December 2008 (2008-12-31) cited in the application page 1, last paragraph; claim 20 -----	1-8
A	EP 0 607 991 A2 (SUCROS OY [FI]) 27 July 1994 (1994-07-27) claims 6-8 -----	6,7



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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