

TITLE**CALCIUM FORMULATION AND METHODS OF FORMING AND USING THE SAME****REFERENCE TO RELATED APPLICATIONS**

- 5 **[0001]** This application claims the priority to Singapore patent application No. 10202009779Y, filed 1 October 2020, the contents of which are incorporated herein by reference.

TECHNICAL FIELD

- 10 **[0002]** The present disclosure relates generally to compositions for supplementing calcium intake, methods of making or using the compositions and products including the same.

BACKGROUND

- 15 **[0003]** The following discussion of the background to the invention is intended to facilitate an understanding of the present invention only. It should be appreciated that the discussion is not an acknowledgement or admission that any of the material referred to was published, known or part of the common general knowledge of the person skilled in the art in any jurisdiction as at the priority date of the invention.
- 20 **[0004]** Calcium is an important mineral needed by animals to build and maintain strong bones, send nerve signals, release hormones like insulin and regulate contraction and dilation of muscles and blood vessels. Calcium is obtained from daily dietary intake or when it is insufficient it is extracted from calcium stored in bones and teeth. Insufficient daily calcium intake, consequently, results in weakening of bones and teeth. Over the long term, 25 inadequate calcium intake causes osteopenia which, if untreated, can lead to osteoporosis. The risk of bone fractures may increase, especially in older individuals. Calcium deficiency can also cause rickets, although it is more commonly associated with vitamin D deficiency. Studies suggest that the risk of preeclampsia, that effects up to 14% of pregnancies worldwide and is the leading cause of maternal and neonatal morbidity and mortality, may be reduced in 30 populations with adequate calcium intake.

[0005] The recommended range of calcium intake is 1000-2500 mg per day. Many countries in Asia have reported an average national dietary calcium intake less than 500mg per day. Countries in Africa and South America have also reported low calcium intake

between about 400-700mg per day. In South, East and southeast Asia including China, India, Indonesia and Vietnam there are noticeably lower recorded average dietary calcium intake of less than 400-500mg per day. (Balk et al., Osteoporos Int. 28, 3315-3324 (2017)). Asia Pacific countries with low calcium intake also have suboptimal vitamin D status based on serum 25(OH)D levels. There is a deficiency of daily calcium intake in China and Singapore (Figure 1) and the typical method of ameliorating this is through calcium supplements.

[0006] Table salt or sea salt is predominantly sodium chloride. Excessive salt consumption from a high sodium diet is known to cause the body to excrete more calcium in addition to other health problems such as increasing the risk of hypertension and other heart diseases. Excretion of calcium due to a high sodium diet further results in calcium deficiencies that are often addressed with calcium supplements.

[0007] The most common calcium supplements are calcium citrate or calcium carbonate in tablet form. It is sometimes difficult to get patients to comply with a daily regimen of calcium supplements. There is a need for alternative calcium supplements to provide alternatives and/or increase patient compliance of taking an adequate amount of calcium.

SUMMARY

[0008] A calcium supplement formulated as a salt substitute and methods of making or using the same is envisaged.

[0009] Accordingly, a first aspect of the invention relates to a salt substitute formulation for use as a calcium supplement comprising a recrystallized composition comprising: 40 to 65 weight percent sodium chloride; 15 to 40 weight percent potassium chloride; 10 to 20 weight percent calcium chloride and optionally 0.1 to 3.5 weight percent of at least two taste enhancing compounds, the weight percentages being based on the total composition..

[0010] Another aspect of the invention relates to a method of manufacturing a salt substitute formulation comprising: (a) combining sodium chloride; potassium chloride; calcium chloride at a ratio in the range of 9:8:3 to 26:14:9 and optionally, at least two taste enhancing compounds in the range of 0.1 to 3.5 weight percent of the total combined composition; (b) adding an aqueous liquid to the composition to form a mixture; (c) heating the mixture to form a slurry; (d) drying the slurry to a crystal form; and (e) milling the crystals.

[0011] Another aspect of the invention relates to a calcium supplement in the form of a salt substitute obtained by the method described herein above.

[0012] Another aspect of the invention relates to a method of supplementing calcium comprising substituting the use of table salt in food with the salt substitute formulation as described herein above; or the calcium supplement as described herein above.

- 5 [0013] Another aspect of the invention relates to use of the salt substitute formulation as described herein above; or the calcium supplement as described herein above in the manufacture of a medicament for calcium deficiency.

[0014] Other aspects and features of the present invention will become apparent to those of ordinary skill in the art upon review of the following description of specific
10 embodiments of the invention in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] In the figures, which illustrate, by way of non-limiting examples only, embodiments of the present invention,

- 15 [0016] **Figure 1:** Results of a 2015 study of the average Daily Dietary Calcium Intake in China (A) and a 2010 study of the average Daily Dietary Calcium Intake in Singapore (B) for individuals aged between 18 to 49 year old and individuals aged between 50 to 64-69 years old compared to the recommended intake.

[0017] **Figure 2:** Schematic depiction of various embodiments for a method of
20 forming a calcium supplement in the form of a salt substitute.

[0018] **Figure 3:** A photograph comparing steamed egg made with (A) a control salt formulation without calcium chloride that has not been recrystallized; (B) a recrystallized composition 3 and a salt formulation made with recrystallized composition 4.

[0019] **Figure 4:** A photograph comparing grilled chicken breast fillets made with
25 (A) a control salt formulation without calcium chloride that has not been recrystallized; and (B) a salt formulation made with recrystallized composition 4.

[0020] **Figure 5:** A photograph comparing vegetable soup made with (A) a control salt formulation without calcium chloride that has not been recrystallized; and (B) a salt formulation made with recrystallized composition 4.

30 DETAILED DESCRIPTION

[0021] Throughout this document, unless otherwise indicated to the contrary, the terms “comprising”, “consisting of”, “having” and the like, are to be construed as non-exhaustive, or in other words, as meaning “including, but not limited to”.

[0022] Furthermore, throughout the document, unless the context requires otherwise, the word “include” or variations such as “includes” or “including” will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

[0023] According to various embodiments a salt substitute formulation for use as a calcium supplement comprising a recrystallized composition comprising: 40 to 65 weight percent sodium chloride; 15 to 40 weight percent potassium chloride; 10 to 20 weight percent calcium chloride and optionally 0.1 to 3.5 weight percent of at least two taste enhancing compounds, the weight percentages being based on the total composition.

[0024] The advantages of providing a calcium supplement formulated as a salt substitute composition is that it replaces salt and as such reduces the amount of sodium being taken in by an individual. As a high sodium diet causes the body to excrete more calcium. The replacement of salt with the calcium supplement further results in reducing calcium deficiencies. It is estimated that the composition would fulfil at least 40% of the Recommended Daily Allowance for calcium (1000mg) if taken in amounts of 10g per day, which corresponds with the average daily salt intake in Singapore and China. The recrystallizing process or method described herein above results in a calcium supplement that reduces off tastes, metallic tastes and bitter tastes originating from potassium and calcium and to some extent enhances the perception of saltiness.

[0025] The formulation reduces the amount of sodium, provides a sufficient amount of calcium but also ensures that there is not too much potassium in the salt substitute. The body needs a delicate balance of potassium to help the heart and other muscles work properly. But too much potassium in the blood can lead to dangerous, and possibly deadly, changes in heart rhythm.

[0026] In various embodiments, the at least two taste enhancing compounds in the formulation are selected from L-glutamine; L-theanine; disodium succinate; monopotassium succinate; dipotassium succinate; succinic acid; disodium succinate; fumarates; malonates; glutarates; tartrates and a combination thereof.

[0027] In various embodiments, the at least two taste enhancing compounds in the formulation are selected from L-glutamine; L-theanine; disodium succinate; monopotassium succinate; dipotassium succinate; succinic acid; disodium succinate. In various embodiments, the at least two taste enhancing compounds in the formulation
5 comprise L-theanine and anhydrous disodium succinate.

[0028] In various embodiments the at least two taste enhancing compounds in the formulation comprise a first taste enhancing compound and a second taste enhancing compound. In various embodiments the first taste enhancing compound comprises L-theanine, and L-glutamine;. In various embodiments the first taste enhancing compound
10 comprises L-theanine. In various embodiments the second taste enhancing compound comprises disodium succinate such as anhydrous disodium succinate or hexahydrate disodium succinate; monopotassium succinate; dipotassium succinate; succinic acid. In various embodiments the second taste enhancing compound comprises anhydrous disodium succinate; In various embodiments the first taste enhancing compound comprises
15 L-theanine and a second taste enhancing compound comprises anhydrous disodium succinate.

[0029] In various embodiments, the at least two taste enhancing compounds in the formulation comprise L-theanine and anhydrous disodium succinate.

[0030] Using at least two taste enhancing compounds in the formulation may
20 further enhance the perception of saltiness and/or reduce the off, bitter, metallic notes of potassium chloride and calcium chloride. This enhanced perception of saltiness may result in less of the salt substitute being used and may further reduce the amount of sodium intake in an individual. Additionally, using at least two taste enhancing compounds the tastiness of the salt substitute formulation will be further enhanced and may further increase compliance
25 for an adequate amount of calcium intake in individuals.

[0031] In various embodiments, the recrystallized composition in the formulation comprises sodium chloride; potassium chloride; calcium chloride L-theanine and anhydrous disodium succinate at a ratio in the range of 400:150:100:25:1:1 to 26:16:8:1:1. In various embodiments, the recrystallized composition in the formulation comprises about 40% to 65%
30 of sodium chloride; about 15% to 40% of potassium chloride and 10% to 20% of calcium chloride, about 0.1% to 3.5% L-theanine and about 0.1% to 2.5% anhydrous disodium succinate, whereby the percent refers to the weight percent of the total recrystallized composition.

[0032] In various embodiments, the formulation further comprising an anticaking agent.

[0033] In various embodiments, the anticaking agent comprises silicon dioxide. In various embodiments, the anticaking agent comprises silica. In various embodiments, the anticaking agent comprises sodium ferrocyanide. In various embodiments, the anticaking agent comprises any other suitable anticaking agent known in the art such as calcium silicate; sodium aluminosilicate; potassium ferrocyanide; calcium carbonate; magnesium carbonate or any other known anticaking agent provided it is able to prevent caking or clumping of the recrystallized salt composition and is approved for use in food. In various embodiments, the formulation comprises about 0.1% to about 2.5% of the anticaking agent, whereby the percent refers to the weight percent of the total formulation.

[0034] In various embodiments, the formulation comprises sodium chloride; potassium chloride; calcium chloride L-theanine anhydrous disodium succinate and the anticaking agent are in the ratio of 212:111:68:20:5:2. In various embodiments, the formulation comprises about 53% of sodium chloride; about 27.75% of potassium chloride and 17% of calcium chloride, about 1.25% L-theanine about 0.5% anhydrous disodium succinate, and an anticaking agent of about 0.5% whereby the percent refers to the weight percent of the total recrystallized composition.

[0035] In various embodiments, the formulation further comprises vitamin D. In various embodiments, the vitamin D comprises cholecalciferol (D₃); ergocalciferol (D₂) or a combination thereof. In various embodiments, the vitamin D comprises cholecalciferol (D₃). In various embodiments, the vitamin D comprises ergocalciferol (D₂). In various embodiments, the vitamin D comprises cholecalciferol (D₃) and ergocalciferol (D₂). In various embodiments, the formulation comprises about 0.00005% to about 0.0008% of vitamin D, whereby the percent refers to the weight percent of the total formulation.

[0036] In various embodiments, the formulation comprises about 40% to about 65% of sodium chloride; about 15% to about 40% of potassium chloride about 10% to about 20% of calcium chloride; about 0.1% to about 2.5% of a first taste enhancing compound; about 0.1% to about 3.5% of a second taste enhancing compound; about 0.1% to about 2.5% anticaking agent and about 0.00005 to about 0.0002% vitamin D, whereby the percent refers to the weight percent of the total formulation. In various embodiments, the formulation comprises about 40% to about 65% of sodium chloride; about 15% to about 40% of potassium chloride about 10% to about 20% of calcium chloride; about 0.1% to about 2.5%

of a first taste enhancing compound; about 0.1% to about 3.5% of a second taste enhancing compound; about 0.1% to about 2.5% anticaking agent and about 0.00005% to about 0.0008% of vitamin D, whereby the percent refers to the weight percent of the total formulation.

- 5 **[0037]** The addition of vitamin D to the formulation provides an improved salt substitute that allows for better calcium absorption and physiological utilization.

- 10 **[0038]** According to various embodiments a method of manufacturing a calcium supplement in the form of a salt substitute comprising: (a) combining sodium chloride; potassium chloride; calcium chloride at a ratio in the range of 9:8:3 to 26:14:9 and optionally,
at least two taste enhancing compounds in the range of 0.1 to 3.5 weight percent of the total combined composition; (b) adding an aqueous liquid to the composition to form a mixture; (c) heating the mixture to form a slurry; (d) drying the slurry to a crystal form; and (e) milling the crystals.

- 15 **[0039]** In various embodiments, this process is referred to as recrystallizing as depicted in Figure 2. The sodium chloride crystal salts (NaCl), potassium chloride crystal salts (KCL) and calcium chloride crystal salts (CaCl₂) are essentially combined, dissolved together in an aqueous liquid such as water at a ratio of about 1 part combined salts to about from 2 to 3 parts aqueous liquid, and the combined salt mixture is recrystallized to form a salt substitute. In various embodiments about 1-part combined salts is dissolved in about 2
20 parts aqueous liquid. In various embodiments about 1-part combined salts is dissolved in about 2.5 parts aqueous liquid. In various embodiments about 1-part combined salts is dissolved in about 3 parts aqueous liquid. In various embodiments, the salts are dissolved in water under heat to form the mixture. In various embodiments, the mixture is a dissolved salt solution.

- 25 **[0040]** The recrystallized compositions were found to be less harsh on the tongue than a simple combination of sodium chloride crystal salts, potassium chloride crystal salts and calcium chloride crystal salts. The recrystallization process appears to reduce the hygroscopicity of the mixture. Calcium chloride is more hygroscopic than sodium chloride and potassium chloride and the recrystallization process successfully retards the ability of
30 calcium chloride to absorb ambient water. Without being limited to any theory it may be speculated that the combination of all the salts and/or the reduction of the surface area to volume ratio of the new crystals formed in the recrystallization process creates a more palatable combination.

[0041] In various embodiments, about 43% to 55% of sodium chloride; about 28% to 42% of potassium chloride and 14% to 18% of calcium chloride is combined as part of the process for recrystallization, whereby the percent refers to the weight percent of the total combined composition. In various embodiments, about 44.3% of sodium chloride; about 41.7% of potassium chloride and 14% of calcium chloride is combined as part of the process for recrystallization, whereby the percent refers to the weight percent of the total combined composition. In various embodiments, about 54.2% of sodium chloride; about 28.4% of potassium chloride and 17.4% of calcium chloride is combined as part of the process for recrystallization, whereby the percent refers to the weight percent of the total combined composition.

[0042] In various embodiments, the at least two taste enhancing compounds are selected from L-glutamine; L-theanine; disodium succinate; monopotassium succinate; dipotassium succinate; succinic acid; disodium succinate; fumarates; malonates; glutarates; tartrates and a combination thereof. In various embodiments, the at least two taste enhancing compounds are selected from the group consisting of L-glutamine; L-theanine; disodium succinate; monopotassium succinate; dipotassium succinate; succinic acid; disodium succinate; fumarates; malonates; glutarates; tartrates and a combination thereof. In various embodiments, the at least two taste enhancing compounds are selected from L-glutamine; L-theanine; disodium succinate; monopotassium succinate; dipotassium succinate; succinic acid; disodium succinate. In various embodiments, the at least two taste enhancing compounds comprises L-theanine and anhydrous disodium succinate.

[0043] In various embodiments the at least two taste enhancing compounds comprise a first taste enhancing compound and a second taste enhancing compound. In various embodiments the first taste enhancing compound comprises L-theanine, and L-glutamine;. In various embodiments the first taste enhancing compound comprises L-theanine. In various embodiments the second taste enhancing compound comprises disodium succinate; monopotassium succinate; dipotassium succinate; succinic acid; disodium succinate. In various embodiments the second taste enhancing compound comprises anhydrous disodium succinate; In various embodiments the first taste enhancing compound comprises L-theanine and a second taste enhancing compound comprises anhydrous disodium succinate.

[0044] In various embodiments, step (a) comprises combining sodium chloride; potassium chloride; calcium chloride; L-theanine and anhydrous disodium succinate at a ratio in the range of 400:150:100:25:1:1 to 26:16:8:1:1. In various embodiments, about 40%

to 65% of sodium chloride; about 15% to 40% of potassium chloride and 10% to 20% of calcium chloride, about 0.1% to 3.5% L-theanine and about 0.1% to 2.5% anhydrous disodium succinate is combined as part of the process for recrystallization, whereby the percent refers to the weight percent of the total combined composition.

- 5 **[0045]** In various embodiments, the mixture is heated at or up to 80°C in step (b). In various embodiments the solution mixture with the salts dissolved therein is heated until enough water evaporates such that the salts therein exceed their solubilities and precipitate as fine crystals which eventually forms the slurry.

- 10 **[0046]** In various embodiments the slurry is dried to form dry crystals. In various embodiments, the slurry is dried at a temperature of 50°C to 90°C. In various embodiments, the slurry is dried at a temperature of 55°C to 90°C. In various embodiments, the slurry is dried at a temperature of 50°C to 85°C. In various embodiments, the slurry is dried at a temperature of 60°C to 90°C. In various embodiments, the slurry is dried at a temperature of 50°C to 80°C. In various embodiments, the slurry is dried at a temperature of 65°C to 90°C. In various embodiments, the slurry is dried at a temperature of 50°C to 75°C. In various embodiments, the slurry is dried at a temperature of 70°C to 90°C. In various embodiments, the slurry is dried at a temperature of 50°C to 70°C. In various embodiments, the slurry is dried at a temperature of 50°C. In various embodiments, the slurry is dried at a temperature of 55°C. In various embodiments, the slurry is dried at a temperature of 60°C. In various embodiments, the slurry is dried at a temperature of 65°C. In various embodiments, the slurry is dried at a temperature of 70°C. In various embodiments, the slurry is dried at a temperature of 75°C. In various embodiments, the slurry is dried at a temperature of 80°C. In various embodiments, the slurry is dried at a temperature of 85°C. In various embodiments, the slurry is dried at a temperature of 90°C.

- 25 **[0047]** In various embodiments, the slurry is dried under vacuum or continuous air flow. In various embodiments, the slurry may be dried in any way known in the art provided the moisture content of this intermediate slurry is below 5%. In various embodiments, the slurry is dried to a moisture content of about 4%. In various embodiments, the slurry is dried to a moisture content of about 3%. In various embodiments, the slurry is dried to a moisture content of about 2%. In various embodiments, the slurry is dried to a moisture content of about 1%.

[0048] In various embodiments, the crystals formed in step (d) may be referred to as a recrystallized composition. In various embodiments, the crystals/recrystallized composition is milled in a grinder such as any mills including ball mills, hammer mills, pin

mills, are jet mills, cone mills or any other grinding mill able to grind crystals including the recrystallized composition. In various embodiments, the crystals/recrystallized composition is milled in a food processor. In various embodiments, the crystals/recrystallized composition is milled in a mortar and pestle.

- 5 **[0049]** In various embodiments, the milled crystals may be referred to as a milled recrystallized composition. In various embodiments, the milled crystals/milled recrystallized composition is blended with an anticaking agent.

- [0050]** In various embodiments, the anticaking agent comprises silicon dioxide. In various embodiments, the anticaking agent comprises silica. In various embodiments, the anticaking agent comprises sodium ferrocyanide. In various embodiments, the anticaking agent comprises any other suitable anticaking agent known in the art such as calcium silicate; sodium aluminosilicate; potassium ferrocyanide; calcium carbonate; magnesium carbonate or any other known anticaking agent provided it is able to prevent caking or clumping of the recrystallized salt composition and is approved for use in food. In various
10 embodiments, about 0.1% to about 2.5% of the anticaking agent is blended with the milled crystals/milled recrystallized composition, whereby the percent refers to the weight percent of the total blended formulation.

- [0051]** In various embodiments, the total blended formulation comprises about 40% to about 65% of sodium chloride; about 15% to about 40% of potassium chloride about
20 10% to about 20% of calcium chloride; about 0.1% to about 2.5% of a first taste enhancing compound; about 0.1% to about 3.5% of a second taste enhancing compound; and about 0.1% to about 2.5% anticaking agent , whereby the percent refers to the weight percent of the total blended formulation. In various embodiments, the sodium chloride, potassium chloride, calcium chloride, the first taste enhancing compound and the second taste
25 enhancing compound are recrystallized as described herein above and the milled recrystallized composition is blended with the anticaking agent.

- [0052]** In various embodiments, the milled crystals may be referred to as a milled recrystallized composition. In various embodiments, the milled crystals/milled recrystallized composition is blended with vitamin D. In various embodiments, about 0.00005% to about
30 0.0002% of vitamin D is blended with the milled crystals/milled recrystallized composition.. In various embodiments 0,0002% (i.e. 0.2mg/100g) of vitamin D is blended with the milled crystals/milled recrystallized composition. whereby the percent refers to the weight percent of the total blended formulation. In various embodiments, the vitamin D comprised cholecalciferol (D₃); ergocalciferol (D₂) or a combination thereof.

[0053] In various embodiments, the milled crystals may be referred to as a milled recrystallized composition. In various embodiments, the milled crystals/milled recrystallized composition is blended with an anticaking agent as described herein above and vitamin D as described herein above.

5 **[0054]** In various embodiments, the total blended formulation comprises about 40% to about 65% of sodium chloride; about 15% to about 40% of potassium chloride about 10% to about 20% of calcium chloride; about 0.1% to about 2.5% of a first taste enhancing compound; about 0.1% to about 3.5% of a second taste enhancing compound; about 0.1% to about 2.5% anticaking agent and about 0.0002% vitamin D, whereby the percent refers to
10 the weight percent of the total blended formulation. In various embodiments, the sodium chloride, potassium chloride, calcium chloride, the first taste enhancing compound and the second taste enhancing compound are recrystallized as described herein above and the milled recrystallized composition is blended with the anticaking agent and vitamin D.

[0055] Vitamin D is known to be important for efficient absorption of calcium and
15 its physiological utilization. The addition of vitamin D to a calcium supplement composition provides an improved calcium supplement in the form of a salt substitute that allows for better calcium absorption and physiological utilization.

[0056] According to various embodiments a calcium supplement in the form of a salt substitute obtained by the method described herein above. In various embodiments, the
20 calcium supplement in the form of a salt substitute derived by the recrystallizing process as described herein above.

[0057] According to various embodiments a method of supplementing calcium comprising substituting the use of table salt in food with the calcium supplement as described herein above; or the salt substitute formulation as described herein above.

25 **[0058]** According to various embodiments, use of the calcium supplement as described herein above; or the salt substitute formulation as described herein above in the manufacture of a medicament for calcium deficiency.

[0059] Advantageously, the recrystallized composition of the formulation enhances the perception of saltiness and reduces the off, bitter, metallic notes of potassium
30 chloride and calcium chloride. Additionally, as the salt substitute formulation is tasty and is included as part of an individual's regular diet in a wide range of foods. This will increase

compliance allowing an adequate amount of calcium intake in individuals. Notably, the formulation has a lower sodium content than most salt products available.

[0060] It should be further appreciated by the person skilled in the art that variations and combinations of features described above, not being alternatives or substitutes, may be combined to form yet further embodiments falling within the intended scope of the invention.

[0061] As would be understood by a person skilled in the art, each embodiment, may be used in combination with other embodiment or several embodiments.

Examples

10 [0062] Example 1: Calcium chloride

[0063] To reduce high sodium intake and increase calcium intake calcium chloride by itself was used as a salt substitute. The taste was referred to as very harsh on the tongue. As calcium chloride is exothermic in solution it is to be expected that it would feel uncomfortable in the mouth due to the heat generated in the moist environment.

15 [0064] Example 2: Salt mixtures

[0065] Composition 1

[0066] In an attempt to make the calcium chloride more palatable it was mixed with sodium chloride to make a salt with calcium that could be used as a calcium supplement, composition 1 or a salt mixture that had less sodium by replacing about half of the sodium chloride with a potassium chloride, composition 2

[0067] Table 1: composition 1

Component	% by weight
Sodium chloride	85%
Calcium chloride	15%

[0068] Table 2: composition 2

Component	% by weight
Sodium chloride	44.3%
Potassium chloride	41.7%

Calcium chloride	14%
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[0069] Both Composition 1 and composition 2 were still described as being harsh by a taste test group.

[0070] Example 3: Recrystallized salt mixtures

[0071] In an attempt to overcome the harshness of the compositions on the tongue the individual salts in composition 1 and composition 2 were first dissolved together in an aqueous solution such as water at a ratio of 1-part mixture to 2 or 3 parts water. This mixture is heated to 80°C without agitation or gentle agitation until a slurry was formed when the majority of water had evaporated. The slurry of crystals was then transferred to a tray where it was dried under heat at 50°C to 90°C and in some cases under vacuum or continuous air flow. Based on a range of experiments the results were similar for compositions dissolved in water at a ratio of 1:2; 1:2.5; and 1:3; where the slurry of crystals are dried under at temperatures of 50°C, 65°C, 80°C and 90°C and both under vacuum or continuous air flow provided the moisture content of this intermediate was below 5%. These crystals are then milled before testing the recrystallized compositions 1 and 2.

[0072] To test the recrystallized compositions each were tested on grilled chicken fillets. Chicken fillets were grilled and cut into 3 equal portions. The grilled chicken fillet was coated with 1g of each test salt, i.e. test salt 1 was table salt, test salt 2 was recrystallized composition 1 and test salt 3 was recrystallized composition 2. A group of 5 testers tasted each test salt, cleaning their palette between each test with lukewarm water.

[0073] Table 3: test results for the different test salts on grilled chicken, n=5.

Test salt	1	2	3
type	Table Salt	Recrystallized composition 1	Recrystallized composition 2
Saltiness	46	47	48
Bitterness	8	11	15

[0074] The recrystallized compositions were found to be less harsh on the tongue. Without being limited to any theory as to why this occurred it may be that the combination of all the salts and/or the reduction of the surface area to volume ratio of the new crystals creates a more palatable combination. The crystallized composition 1 was the closest taste profile to table salt.

[0075] A new composition, recrystallized composition 3, was formulated to fall between recrystallized composition 1 and recrystallized composition 2.

[0076] Table 4: recrystallized composition 3

Component	% by weight
Sodium chloride	54.25%
Potassium chloride	28.75%
Calcium chloride	17%

[0077] The sodium chloride, potassium chloride and calcium chloride were first dissolved together in water at a ratio of 1:3. This mixture is heated to 80°C without agitation or gentle agitation until a slurry was formed when the majority of water had evaporated. The slurry of crystals was then transferred to a tray where it was dried under heat at 50°C to 90°C under vacuum. The crystals formed were then milled before testing.

[0078] This formulation was found to have a similar taste profile to recrystallized composition 1 while having a lower sodium content.

[0079] Example 4: taste enhancing formulations

[0080] In an attempt to move the taste profile closer to table salt, a selection experiment of a panel of taste-enhancing agents was conducted. L-glutamine, glutamic acid, L-theanine, Lysine HCl, Disodium succinate, monopotassium succinate, dipotassium succinate, succinic acid, and disodium succinate were all found to enhance the salty taste and reduce the bitter metallic notes of potassium chloride and calcium chloride. It may be anticipated that fumarates, malonates, glutarates and tartrates would similarly enhance the salty taste and reduce the bitter metallic notes of potassium chloride and calcium chloride. Eventually, anhydrous monosodium succinate and L-theanine were chosen and tuned in the formulation using crystallized composition 4.

[0081] Table 5: formulation using recrystallized composition 4

Component	% by weight
Sodium chloride	53%
Potassium chloride	27.75%
Calcium chloride	17%
Taste enhancer 1 (Anhydrous disodium succinate)	0.5%

Taste enhancer 2 (L-theanine)	1.25%
Anticaking agent (silicon dioxide)	0.5%

[0082] Referring to Figure 2, the sodium chloride, potassium chloride, calcium chloride, taste enhancer 1 and 2 were first combined and then dissolved together in water at a ratio of 1:2. This mixture was heated to 80°C without agitation until a slurry was formed when the majority of water had evaporated. The slurry of crystals was then transferred to a tray where it was dried under heat at 50°C to 90°C under vacuum. The crystals formed were then milled to form the recrystallized composition 4. The recrystallized composition 4 was physically blended with the anticaking agent before testing the formulation using recrystallized composition 4.

[0083] Recrystallized composition 3 and formulation using recrystallized composition 4 were tested with steamed egg and compared against a control formulation that did not include calcium chloride used only one taste enhancer and was not recrystallized (control formulation: 57% sodium chloride; 28% potassium chloride; 2% magnesium sulphate; 1% taste enhancer (lysine HCl); anticaking agent (silicon dioxide) that was not recrystallized). Referred to collectively as the test salts.

[0084] One egg was mixed with 50ml of water and 1g of the test salt until well combined. The mixture was left to sit until the bubbles were no longer visible and then steamed in a steamer. The resulting steamed egg are depicted in Figure 3. A group of 9 testers tasted each test salt, cleaning their palette between each test with lukewarm water.

[0085] Table 6: test results for the different test salts on steamed egg, n=7.

Test salt	1	2	3
type	Control formulation	Recrystallized composition 3	Formulation using recrystallized composition 4
Saltiest	0	2	5

[0086] It was found that the formulation using recrystallized composition 4 was saltier than the recrystallized composition 3 indicating that the taste enhancers contribute to enhance the salty taste. Further, it was found that both recrystallized composition 3 and the formulation using recrystallized composition 4 were both saltier than the control formulation that did not include calcium chloride indicating that the recrystallizing step not only significantly contributes to masking the calcium chloride harshness but also masks the taste of potassium chloride.

[0087] Formulation using recrystallized composition 4 was tested with grilled chicken and compared against a control formulation that did not include calcium chloride used only one taste enhancer and was not recrystallized (control formulation: 57% sodium chloride; 28% potassium chloride; 2% magnesium sulphate; 1% taste enhancer (lysine HCl);
 5 anticaking agent (silicon dioxide) that was not recrystallized). Referred to collectively as the test salts.

[0088] Chicken breast were grilled and cut into several portions. The resulting grilled chicken breasts are depicted in Figure 4. Each of the grilled chicken breast was coated with 1g of each test salt, i.e. test salt 1 was the control formulation and test salt 2 was the
 10 formulation with recrystallized composition 4. A group of 9 testers tasted each test salt, cleaning their palette between each test with lukewarm water.

[0089] Table 7: test results for the different test salts on grilled chicken breast, n=9.

Test salt	1	2
type	Control formulation	Formulation using recrystallized composition 4
Saltiest	0	9
Most bitter	7	2
Most preferred	0	9

[0090] It was found that the formulation using recrystallized composition 4 was
 15 saltier, predominantly less bitter and preferred over the control formulation that did not include calcium chloride or use the specific taste enhances anhydrous monosodium succinate and L-theanine. The results indicate that the perception of saltiness is the most important contributing factor when deciding which test salt was preferred. Both the recrystallizing step and the specific taste enhancers used in the formulation with the
 20 recrystallized composition 4 contributed to enhancing the salty taste and reducing the bitter metallic notes of potassium chloride and calcium chloride.

[0091] Formulation using recrystallized composition 4 was tested in vegetable soup and compared against a control formulation that did not include calcium chloride and was not recrystallized (control formulation: 57% sodium chloride; 28% potassium chloride;
 25 2% magnesium sulphate; 1% taste enhancer (lysine HCl); anticaking agent (silicon dioxide) that was not recrystallized). Referred to collectively as the test salts.

- [0092] 1 onion, 2 potatoes, 1 carrot were roughly chopped and stewed in 1 liter of tap water with carcass from 1 chicken (with most meat removed). The soup was stewed on low heat for 3 hours with topping up of water to maintain the water level. The soup was then sieved to remove the vegetables and chicken carcass. 0.9g of test salt was then added to 200ml of soup for serving. The resulting vegetable soups are depicted in Figure 5. A group of 9 testers tasted each test salt, cleaning their palette between each test with lukewarm water.

[0093] Table 8: test results for the different test salts in vegetable soup, n=9.

Test salt	1	2
type	Control formulation	Formulation using recrystallized composition 4
Saltiest	2	7
Most bitter	7	2
Most preferred	1	8

- [0094] It was found that the formulation using recrystallized composition 4 was predominantly saltier less bitter and preferred over the control formulation that did not include calcium chloride. The results again indicate that the perception of saltiness is the most important contributing factor when deciding which test salt was preferred. Further, vegetable soup being a liquid product is likely to dissolve the recrystallized components of composition 4 which would be expected to affect the taste profile to some extent, however, the formulation using recrystallized composition 4 was still saltier and more preferred than the control formulation that did not include calcium chloride and had not been recrystallized.

[0095] Example 4: improved formulations

- [0096] Vitamin D is known to be important for efficient absorption of calcium and its physiological utilization. Having prepared a calcium supplement composition that was suitable as a salt substitute. The addition of vitamin D was tested to provide an improved calcium supplement in the form of a salt substitute, formulation 2 with recrystallized composition 4.

Table 9: formulation 2 made with recrystallized composition 4 and vitamin D

Component	% by weight
Sodium chloride	53%
Potassium chloride	27.75%
Calcium chloride	17%

Taste enhancer 1 (Anhydrous disodium succinate)	0.5%
Taste enhancer 1 (L-theanine)	1.25%
Anticaking agent (silicon dioxide)	0.4998%
Vitamin D	0.0002%

[0097] Referring to Figure 2, the sodium chloride, potassium chloride, calcium chloride, taste enhancer 1 and 2 were first combined then dissolved together in water at a ratio of 2:3. This mixture was heated to 80°C without agitation or gentle agitation until a slurry was formed when the majority of water had evaporated. The slurry of crystals was then transferred to a tray where it was dried under heat at 50°C to 90°C under continuous air flow. The crystals formed were then milled to form the recrystallized composition 4. The recrystallized composition 4 was physically blended with the anticaking agent and vitamin D before testing the formulation 2 made with the recrystallized composition 4.

[0098] Formulation 1 and 2 made with recrystallized composition 4 were tested on grilled prawns and hummus and found to have a similar taste profile to composition 4.

[0099] Composition 5

[00100] The formulation was further adjusted to the final weight percentages listed in table 10 where sodium chloride, potassium chloride, calcium chloride, taste enhancer 1 and 2 were first dissolved together in water at a ratio of 1:3. This mixture is heated to 80°C without agitation or gentle agitation until a slurry was formed when the majority of water had evaporated. The slurry of crystals was then transferred to a tray where it was dried under heat at 50°C to 90°C under vacuum. The crystals formed were then milled before physically blending or mixing with the anticaking agent and vitamin D before testing.

Table 10: formulation of recrystallized composition 5 with taste enhancers, anticaking agent and vitamin D.

Component	% by weight
Sodium chloride	50.08
Potassium chloride	30.28
Calcium chloride	17.06
Taste enhancer 1 (Anhydrous disodium succinate)	0.83
Taste enhancer 2 (L-theanine)	1.25
Anticaking agent (Silicon dioxide)	0.50
Vitamin D3	0.000125

[00101] The Formulation made with recrystallized composition 5 were tested on grilled prawns and chicken and found to have a similar taste profile to composition 4.

[00102] The compositions should be applicable for use in any food product where table salt is used, including but not limited to protein meals such as grilled chicken, grilled prawns, steamed egg; liquid or semi liquid dishes such as steamed egg, soup or hummus; salt cured meats such as ham, or fish; salt cured condiments such as kimchi, or soy sauce; or any other food product where table salt (NaCl_2) is traditionally used.

[00103] In the foregoing manner, various embodiments of the disclosure are described for addressing at least one of the foregoing disadvantages. Such embodiments are intended to be encompassed by the following claims, and are not to be limited to specific forms or arrangements of parts so described and it will be apparent to one skilled in the art in view of this disclosure that numerous changes and/or modification can be made, which are also intended to be encompassed by the following claims.

Claims

1. A salt substitute formulation for use as a calcium supplement comprising a recrystallized composition comprising: 40 to 65 weight percent sodium chloride; 15 to 40 weight percent potassium chloride; 10 to 20 weight percent calcium chloride and optionally 0.1 to 3.5 weight percent of at least two taste enhancing compounds, the weight percentages being based on the total composition.
2. The formulation according to claim 1, wherein the at least two taste enhancing compounds are selected from L-glutamine; L-theanine; disodium succinate; monopotassium succinate; dipotassium succinate; succinic acid; disodium succinate; fumarates; malonates; glutarates; tartrates and a combination thereof.
3. The formulation according to claim 1, wherein the at least two taste enhancing compounds comprises L-theanine and anhydrous disodium succinate.
4. The formulation according to claim 1, wherein the recrystallized composition comprises sodium chloride; potassium chloride; calcium chloride; L-theanine and anhydrous disodium succinate at a ratio in the range of 400:150:100:25:1:1 to 26:16:8:1:1.
5. The formulation according to any one of claims 1 to 4, further comprising an anticaking agent.
6. The formulation according to claim 5, wherein the anticaking agent comprises silicon dioxide.
7. The formulation according to claim 5 or 6, wherein sodium chloride; potassium chloride; calcium chloride L-theanine anhydrous disodium succinate and the anticaking agent are in the ratio of 212:111:68:20:5:2.
8. The formulation according to any one of claims 1 to 7, further comprising vitamin D.
9. A method of manufacturing a salt substitute formulation according to any one of claims 1 to 8 comprising:
 - a. combining sodium chloride; potassium chloride; calcium chloride at a ratio in the range of 9:8:3 to 26:14:9 and optionally, at least two taste enhancing compounds in the range of 0.1 to 3.5 weight percent of the total combined composition;
 - b. adding an aqueous liquid to the composition to form a mixture;
 - c. heating the mixture to form a slurry;
 - d. drying the slurry to a crystal form; and
 - e. milling the crystals.

10. The method according to claim 9, wherein step (a) comprises combining sodium chloride; potassium chloride; calcium chloride; L-theanine and anhydrous disodium succinate at a ratio in the range of 400:150:100:25:1:1 to 26:16:8:1:1.
- 5 11. The method according to claim 9 or 10, wherein the mixture is heated at 80°C in step (b).
12. The method according to any one of claims 9 to 11, wherein the slurry is dried at a temperature of 50°C to 90°C.
13. The method according to any one of claims 9 to 12, wherein the slurry is dried under vacuum or continuous air flow.
- 10 14. The method according to any one of claims 9 to 13, wherein the milled crystals are blended with an anticaking agent.
15. The method according to claim 14, wherein the anticaking agent comprises silicon dioxide.
- 15 16. The method according to any one of claims 9 to 15, wherein the milled crystals are blended with vitamin D.
17. A calcium supplement in the form of a salt substitute obtained by the method according to any one of claims 9-17.
18. A method of supplementing calcium comprising substituting the use of table salt in food with the salt substitute formulation according to any one of claims 1 to 8; or the calcium supplement according to claim 17.
- 20 19. Use of the salt substitute formulation according to any one of claims 1 to 8; or the calcium supplement according to claim 17; in the manufacture of a medicament for calcium deficiency.