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(54) Title: SILICA BASED SALT SOLUTION DELIVERY SYSTEM

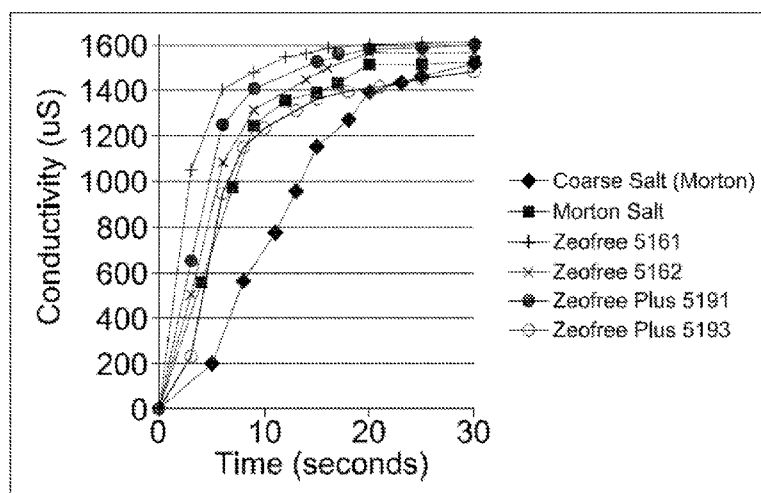


FIG. 1

(57) Abstract: Carrier materials and salt delivery compositions that can be useful in the delivery of a salt solution are disclosed, together with methods for the preparation and use thereof.



SILICA BASED SALT SOLUTION DELIVERY SYSTEM

BACKGROUND

TECHNICAL FIELD

5 The present disclosure relates to silica materials, and specifically to precipitated silica materials that can be useful for the delivery of salt in, for example, snacks and prepared foods.

TECHNICAL BACKGROUND

10 There is a need to improve the healthiness of snack and prepared foods. These foods commonly contain large quantities of salt and preservatives to achieve the desired taste, however, sodium has long been linked to health problems, especially those related to the cardiovascular system. As a result, there is pressure from governments around the world for producers to reduce the quantity of salt used in snack and prepared foods. Methods to reduce the quantity of salt in foods have been discussed in detail by Morley in “Novel Strategies for
15 Reducing Sodium”, Food Technology, January 2012, Volume 66, pages 53-62. Morley discusses several potential methods for achieving this goal. One possibility involves substituting the sodium ion in sodium chloride with another ion such as potassium chloride. Another option discussed was the addition of a salt enhancer, such as an amino acid that could boost the perception of taste when lower quantity of salt was used. Care must be taken
20 with these methods to insure a negative taste is not imparted into the food as a percentage of the salt is substituted with another ingredient. Alternatively, it was mentioned that physical modification of the sodium chloride salt by manipulation of the physical form and/or the size of the salt crystals can be performed. Since salt needs to dissolve in the mouth before it can be tasted, any salt that does not dissolve in the mouth as the food is consumed simply passes
25 to the stomach where it is absorbed into the body in its entirety. Changes to the salt crystal and/or salt particle size resulting in a faster dissolution rate could allow the quantity of the salt used in food to be reduced without negatively impacting taste, as long as the dissolution profiles are similar. Even with these manipulations of the salt crystal and/or salt particle size, it is likely that a percentage of salt still remains insoluble in the mouth during the limited
30 timeframe of which the food is consumed, and not contributing to taste.

Accordingly, there exists a general need to develop new methods and compositions that can allow for reduced levels of salt in foods without sacrificing the salty taste. This need and other needs are satisfied by the compositions and methods of the present disclosure.

SUMMARY

5 In accordance with the purpose(s) of the invention, as embodied and broadly described herein, this disclosure, in one aspect, relates to silica materials, and specifically to precipitated silica materials that can be useful for the delivery of salt in, for example, snacks and prepared foods.

10 In one aspect, the present disclosure provides compositions and methods that can allow for reduced levels of salt in foods without sacrificing the salty taste.

Additional aspects of the invention will be set forth in part in the description, examples, and figures which follow, and in part will be obvious from the description, or can be learned by practice of the invention. The advantages of the invention will be realized and attained by means of the elements and combinations particularly pointed out in the appended claims. It is 15 to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF THE FIGURES

20 The accompanying figures, which are incorporated in and constitute a part of this specification, illustrate several aspects and together with the description serve to explain the principles of the invention.

FIG. 1 is a graph of sodium release studies comparing two versions of commercially available salt to loaded carrier materials (i.e. silica samples) over a period of 30 seconds, in accordance with various aspects of the present disclosure.

25 FIG. 2 is a graph of sodium release studies comparing two versions of commercially available salt to loaded carrier materials (i.e. silica samples) over a period of 30 seconds, in accordance with various aspects of the present disclosure.

FIG. 3 is a graph of sodium release studies at reduced concentrations comparing commercially available salt samples with loaded carrier materials, in accordance with various aspects of the present disclosure.

Additional aspects of the invention will be set forth in part in the description which follows, and in part will be obvious from the description, or can be learned by practice of the invention. The advantages of the invention will be realized and attained by means of the elements and combinations particularly pointed out in the appended claims. It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

10

DESCRIPTION

The present invention can be understood more readily by reference to the following detailed description of the invention and the Examples and Figures included therein.

Before the present compounds, compositions, articles, systems, devices, and/or methods are disclosed and described, it is to be understood that they are not limited to specific synthetic methods unless otherwise specified, or to particular reagents unless otherwise specified, as such can, of course, vary. It is also to be understood that the terminology used herein is for the purpose of describing particular aspects only and is not intended to be limiting. Although any methods and materials similar or equivalent to those described herein can be used in the practice or testing of the present invention, example methods and materials are now described.

20

All publications mentioned herein are incorporated herein by reference to disclose and describe the methods and/or materials in connection with which the publications are cited.

Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. Although any methods and materials similar or equivalent to those described herein can be used in the practice or testing of the present invention, example methods and materials are now described.

25

As used herein, unless specifically stated to the contrary, the singular forms “a,” “an” and “the” include plural referents unless the context clearly dictates otherwise. Thus, for

example, reference to “a filler” or “a solvent” includes mixtures of two or more fillers, or solvents, respectively.

As used herein, the terms “optional” or “optionally” means that the subsequently described event or circumstance can or cannot occur, and that the description includes instances where
5 said event or circumstance occurs and instances where it does not.

The surface area of a silica material can be determined using conventional surface area analysis techniques, such as, for example, Brunauer, Emmett, and Teller (“BET”). BET surface area measurements are determined by measuring the amount of nitrogen adsorbed on a surface, as described in Brunaur et al., J. Am. Chem. Soc., 60, 309 (1938).

10 Oil Absorption, frequently expressed as the oil absorption number (“OAN”), of a silica material can be determined using a rubout method, wherein a quantity of linseed oil is mixed with a silica material by rubbing with a spatula on a smooth surface until a stiff putty-like paste is formed. The amount of oil needed to form a stiff paste that curls when spread out is measured. The OAN can then be expressed as the volume of oil required per unit weight of
15 silica material to saturate the silica material. A higher oil absorption level indicates a higher structure silica, for example, aggregates having a higher amount of void space between primary individual fused silica particles. Similarly, a low oil absorption value indicates a low structure silica, for example, aggregates having a smaller amount of void space between primary individual fused silica particles. In one aspect, linseed oil can be used to determine
20 the oil absorption value for a silica material.

Disclosed are the components to be used to prepare the compositions of the invention as well as the compositions themselves to be used within the methods disclosed herein. These and other materials are disclosed herein, and it is understood that when combinations, subsets, interactions, groups, etc. of these materials are disclosed that while specific reference of each
25 various individual and collective combinations and permutation of these compounds cannot be explicitly disclosed, each is specifically contemplated and described herein. For example, if a particular compound is disclosed and discussed and a number of modifications that can be made to a number of molecules including the compounds are discussed, specifically contemplated is each and every combination and permutation of the compound and the
30 modifications that are possible unless specifically indicated to the contrary. Thus, if a class of molecules A, B, and C are disclosed as well as a class of molecules D, E, and F and an

example of a combination molecule, A-D is disclosed, then even if each is not individually recited each is individually and collectively contemplated meaning combinations, A-E, A-F, B-D, B-E, B-F, C-D, C-E, and C-F are considered disclosed. Likewise, any subset or combination of these is also disclosed. Thus, for example, the sub-group of A-E, B-F, and C-
5 E would be considered disclosed. This concept applies to all aspects of this application including, but not limited to, steps in methods of making and using the compositions of the invention. Thus, if there are a variety of additional steps that can be performed it is understood that each of these additional steps can be performed with any specific embodiment or combination of embodiments of the methods of the invention.

10 Each of the materials disclosed herein are either commercially available and/or the methods for the production thereof are known to those of skill in the art.

It is understood that the compositions disclosed herein have certain functions. Disclosed herein are certain structural requirements for performing the disclosed functions, and it is understood that there are a variety of structures that can perform the same function that are
15 related to the disclosed structures, and that these structures will typically achieve the same result.

As briefly described above, the present disclosure provides a composition wherein a carrier material can be utilized to deliver a salt solution without adversely affecting the taste of a food product. In another aspect, the present disclosure provides a method wherein one or
20 more salts and/or solutions thereof can be contacted with a carrier material having a porous surface, such that the carrier material containing the one or more salts and/or solutions thereof can impart desirable taste characteristics to a subject upon ingestion or contact with taste buds, while retaining all or a portion of the salt in the carrier material. In another aspect, such a method can reduce and/or prevent the absorption of salt by the subject. In another
25 aspect, the present disclosure provides a method wherein a salt solution can be contacted with a carrier material, such as, for example, a silica or silicate material, such that at least a portion of the salt solution is absorbed or otherwise entrained in pores on the surface of the carrier particle. In such an aspect, the salt solution can be readily released upon contact with water or saliva, such that a salt taste can be imparted quickly and without the need to dissolve solid
30 salt particles.

The invention described below involves carrying a salt solution, such as, for example, a concentrated salt solution, on the surface of and/or in the pores of a carrier material, such as, for example, a silica or silicate based carrier, such that nearly the entire salt solution will exit the carrier particles when exposed to saliva and/or water. Since the salt is already dissolved,
5 nearly all of the salt contained within or on the surface of the carrier material can contribute to taste. This can allow for reduced levels of salt in foods without sacrificing a desirable salty taste.

In various aspects, the carrier material of the present disclosure can comprise a particulate material capable of holding and/or carrying salt solution. In one aspect, the carrier material
10 can comprise a silica material, a silicate material, or a combination thereof. In another aspect, the carrier material can comprise a precipitated silica. In yet another aspect, the carrier material can comprise a silicate material, such as, for example, a calcium silicate. In one aspect, a silica material can be prepared from any method suitable for preparing a silica material that can carry a salt solution. In various aspects, the carrier material can comprise a
15 ZEOFREE® precipitated silica, such as, for example, ZEOFREE® 5161, ZEOFREE® 5162, ZEOFREE® Plus 5191, ZEOFREE® Plus 5193, or ZEOFREE® 80 precipitated silica; a ZEOSYL® precipitated silica, such as, for example, ZEOSYL® 110SD precipitated silica; a ZEOTHIX® precipitated silica, such as, for example, ZEOTHIX® 177 or ZEOTHIX® 265 precipitated silica; a ZEOLEX® precipitated silica, such as, for example, ZEOLEX® 7A
20 precipitated silica; a HUBERSORB® calcium silicate, such as, for example, HUBERSORB® 250 or HUBERSORB® 600; or a combination thereof. Carrier materials, such as silica and/or silicate materials, are commercially available. Each of the exemplary carrier materials recited herein are available from J.M. Huber Corporation (Atlanta, Georgia, USA).

In one aspect, the carrier material can exhibit a particle size of up to about 50 μm , for
25 example, about 2, 3, 4, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, or 50 μm ; or up to about 30 μm , for example, about 2, 3, 4, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, or 30 μm . In another aspect, the carrier material can exhibit a particle size of from about 5 μm to about 45 μm , for example, about 5, 7, 9, 11, 13, 15, 17, 19, 21,
30 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, or 45 μm ; from about 3 μm to about 30 μm , for example, about 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, or 30 μm ; from about 5 μm to about 30 μm , for example, about 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, or 30 μm ; from about 10 μm to about 30 μm , for example, about 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, or 30

μm; or from about 15 μm to about 30 μm, for example, about 15, 16, 18, 20, 22, 24, 26, 28, or 30 μm. It should be understood that particle size of a carrier material, such as, for example, a silica and/or silicate material, can be a distributional property and that at least a portion of particles can have a particle size less than and/or greater than the recited value. In yet another aspect, any of the particle sizes recited herein can comprise a median particle size for a particular sample of carrier material.

In one aspect, the carrier material can exhibit moisture level prior to contact with a salt solution of less than about 10 wt.%, for example, about 0.1, 0.5, 1, 1.5, 2, 2.5, 3, 4, 5, 6, 7, 8, 9, 9.5, or 9.9 wt.%; of less than about 8 wt.%, for example, about 1, 2, 3, 4, 5, 6, 7, or 8 wt.%; or from about 4 wt.% to about 8 wt.%, for example, about 4, 4.5, 5, 5.5, 6, 6.7, 7, 7.5, or 8 wt.%. It should be understood that a carrier material having a high moisture level, for example, greater than about 10 wt.%, can, in various aspects, have a limited ability to carry a salt solution.

The carrier material of the present disclosure can exhibit a carrying capacity of at least about 50 %, as defined by the following equation:

$$\frac{g_{\text{salt solution}}}{(g_{\text{salt solution}} + g_{\text{carrier}})} \times 100,$$

for example, about 50, 55, 60, 65, 70, 75, 80, 85, 90, 95 % or more. In another aspect, the carrier material can exhibit a carrying capacity of from about 50 % to about 80 %, for example, about 50, 55, 60, 65, 70, 75, or 80 %; or from about 50 % to about 75 %, for example, about 50, 55, 60, 65, 70, or 75 %. In another aspect, the carrying capacities recited herein can also refer to a salt solution carrying capacity.

Determination of carrying capacity can be performed by preparing a concentrated salt solution, for example, by adding 400 g of sodium chloride to 1,000 ml of deionized water. It should be noted that the solubility of sodium chloride in room temperature water is about 36 g per 100 g of water). 2 g of the carrier material, such as, for example, a precipitated silica material, can then be placed in a container wherein the concentrated salt solution is added in 0.25 g increments. After each addition of the concentrated salt solution, the container can be capped and agitated, for example, with a test tube vibrator, until all of the water is absorbed and the powder is free flowing and free of lumps. This can be repeated until lumps are

present which do not disappear upon agitation. Once lumps appear, the previous measurement can be used to determine the carrying capacity.

A summary of exemplary carrier materials and their salt carrying capacities, are detailed in Table 1, below.

5 **Table 1.** A summary of salt carrying capacity on silica.

Product	NaCl Solution Carrying Capacity (%)	90% of Carrying Capacity (%)	Quantity of NaCl (%)	Quantity of Na (%)
ZEOFREE® 5161	66.6	64.3	17.0	6.7
ZEOFREE® 5162	60.0	57.4	15.2	6.0
ZEOFREE® Plus 5191	70.4	68.2	18.1	7.1
ZEOFREE® Plus 5193	65.9	62.8	16.6	6.5
ZEOFREE® 80	50.0	47.3	12.5	4.9
ZEOSYL® 110SD	66.6	64.3	17.0	6.7
ZEOTHIX® 177	52.9	50.4	13.3	5.2
ZEOTHIX® 265	52.9	50.4	13.3	5.2
ZEOLEX® 7A	42.9	40.2	10.7	4.2
HUBERSORB® 250	50.0	47.4	12.6	4.9

In another aspect, a carrier material can have a sulfate level suitable for use in carrying and delivering a salt solution. In various aspects, the carrier material can exhibit a sulfate level of from about 0 wt.% to about 5 wt.%, for example, about 0.1, 0.3, 0.5, 0.7, 0.9, 1, 1.3, 1.5, 1.7, 10 1.9, 2.1, 2.3, 2.5, 2.7, 2.9, 3.1, 3.5, 4, 4.5, or 5 wt.%; or from about 0 wt.% to about 3.5 wt.%, for example, about 0.1, 0.3, 0.5, 0.7, 0.9, 1, 1.3, 1.5, 1.7, 1.9, 2.1, 2.3, 2.5, 2.7, 2.9, 3.1, or 3.5 wt.%. In still other aspects, the carrier material can exhibit a sulfate level less than or greater than any value specifically recited herein and the present invention is not intended to be limited to any particular sulfate level.

15 In another aspect, a carrier material can have a BET surface area suitable for use in carrying and delivering a salt solution. In various aspects, the carrier material can exhibit a BET surface area of from about 50 m²/g to about 400 m²/g, for example, about 50, 60, 80, 100, 120, 140, 160, 180, 200, 220, 240, 260, 280, 300, 320, 340, 360, 380, or 400 m²/g; or from

about 75 m²/g to about 325 m²/g, for example, about 75, 100, 125, 150, 175, 200, 225, 250, 275, 300, or 325 m²/g.

In another aspect, a carrier material can have a pH suitable for use in carrying and delivering a salt solution. In various aspects, the carrier material can exhibit a pH of from about 6 to about 10, for example, about 6, 6.5, 7, 7.5, 8, 8.5, 9, 9.5, or 10; or from about 6 to about 8, for example, about 6, 6.25, 6.5, 6.75, 7, 7.25, 7.5, 7.75, or 8.

In another aspect, a carrier material can have an oil absorption number suitable for use in carrying and delivering a salt solution. In various aspects, the carrier material can exhibit an oil absorption number of from about 100 cc/100 g to about 300 cc/100 g, for example, about 100, 120, 140, 160, 180, 200, 220, 240, 260, 280, or 300 cc/100 g; or from about 130 cc/100g to about 270 cc/100 g, for example, about 130, 150, 170, 190, 210, 230, 250, or 270 cc/100 g. General physical properties of exemplary carrier materials are illustrated in Table 2, below.

Table 2. Physical properties of materials tested

Ex.	Description	Moisture (%)	Sulfate (%)	Oil (cc/100g)	BET (m ² /g)	pH	Median Particle Size (μm)
1	ZEOFREE® 5161	6.4	0.7	229	112	7.4	22.7
2	ZEOFREE® 5162	6.2	0.8	221	114	7.2	18.0
3	ZEOFREE® Plus 5191	6.7	0.8	261	362	6.1	28.4
4	ZEOFREE® Plus 5193	4.9	1.0	258	308	6.3	13.6
5	ZEOFREE® 80	6.0	3.4	193	81	7.1	14.2
6	ZEOSYL® 110SD	6.2	2.2	203	84	7.5	20.8
7	ZEOTHIX® 177	5.9	0.3	215	110	7.7	3.5
8	ZEOTHIX® 265	6.0	0.7	214	146	7.3	3.3
9	ZEOLEX® 7A	6.6	---	138	184	6.7	11.9
10	HUBERSORB® 250	6.3	0.5	259	109	9.9	18.5
11	HUBERSORB® 600	6.8	0.4	461	198	9.9	7.5

15 The salt of the present invention can comprise any salt intended for consumption with a food product. In various aspects, the salt can comprise sodium chloride, iodized sodium chloride, potassium chloride, sea salt, or a combination thereof. In other aspects, the salt can further comprise anti-caking agents, minerals, flow control additives, or other materials typically found in food products.

To prepare the loaded carrier material of the present invention, the carrier material can be contacted with a salt solution. In one aspect a salt solution can be prepared by dissolving a quantity of salt in water. In another aspect, the salt solution can comprise a concentrated salt solution that is saturated or partially saturated at room temperature. In another aspect, the salt solution can be a saturated or super-saturated solution at room temperature of one or more salt compounds. In an exemplary aspect, a saturated sodium chloride solution can be prepared by dissolving about 360 g of sodium chloride in 1,000 ml of deionized water. In another aspect, a super-saturated sodium chloride solution can be prepared by adding about 400 g of sodium chloride to 1,000 ml of deionized water and allowing the salt to dissolve. In another aspect, a higher concentration salt solution can allow higher loadings of salt for a given quantity of carrier material.

The salt solution, or a portion thereof, can then be contacted with the carrier material. In one aspect, a portion of the salt solution can be contacted with the carrier material and agitated or mixed prior to adding an additional quantity of salt solution.

In another aspect, the carrier material can be loaded up to, for example, about 70 %, 75 %, 80 %, 85 %, 90 %, or 95 % of the carrying capacity of the material. In a specific aspect, the carrier material can be loaded up to, for example, about 90 % of the carrying capacity of the material.

The loaded carrier material can, in various aspects, be dried after contact with a salt solution. In such an aspect, a salt solution can remain in the pores of the carrier material. In another aspect, the loaded carrier material comprises a free-flowing particulate material. In another aspect, the loaded carrier material is a flowable powder.

A loaded carrier material can release all or a portion of the carried salt quickly upon contact with saliva and/or water. In one aspect, a loaded carrier material can release at least about 75 % of the carried salt within about 10 seconds after contact with saliva and/or water.

The salt release rate of a loaded carrier material can be determined by measuring the conductivity of a volume of water upon addition of the loaded carrier material. In one aspect, the time needed to attain maximum conductivity can be an indicator of the salt release rate of the material. In one aspect, maximum conductivity can be attained within about 30 seconds after contact of the loaded carrier material with water.

In an exemplary salt release (i.e., conductivity) measurement, 120 g of deionized water can be added to a 150 ml beaker and stirred with a 1” stir bar at a rate sufficient to create a vortex approximately ½” higher than the stir bar. A conductivity probe can then be placed in the beaker at a depth sufficient to cover the electrode. 100 mg of salt, or the quantity of loaded carrier material needed to deliver 100 mg of salt, can then be added to the solution and the conductivity measured for 60 seconds. A description of samples prepared for salt release measurements is detailed in Table 3, below. The salt release profiles (conductivity vs. time) are illustrated in Figures 1-3.

Table 3. Samples for Salt Solution Release Measurement

Product	Deionized water (g)	Loaded Carrier Material added (g)	Equivalent NaCl added (mg)
MORTON® Coarse Salt	120.0	---	100
MORTON® Salt	120.0	---	100
ZEOFREE® 5161	120.0	588	100
ZEOFREE® 5162	120.0	657	100
ZEOFREE® Plus 5191	120.0	553	100
ZEOFREE® Plus 5193	120.0	601	100

10

The conductivity of the salt and loaded carrier material samples can be about 1,500 to 1,600 μ S at equilibrium. The equilibrium time for commercially available salt samples can be dependent upon, for example, the particle size of the salt, wherein a smaller particle size salt can be more rapidly dissolved. The loaded carrier material samples can exhibit conductivity values at least as high as a salt control for the 30 seconds of the experiment. As the particle size and the absorptive capacity of the carrier material increased (ex. ZEOFREE® Plus 5191 vs. ZEOFREE® Plus 5193 precipitated silica materials and ZEOFREE® 5161 vs. ZEOFREE® 5162 precipitated silica materials), conductivity values can increase. In one aspect, ZEOFREE® 5161 precipitated silica, with a large median particle size can exhibit a high conductivity in a conductivity based salt release test.

20

In another aspect, a concentrations study was performed (FIG. 3), wherein the quantity of salt for the loaded carrier material were adjusted to reach 75 mg salt (at 75%) and 50 mg salt (at 50%) in order to study the conductivity profile as a function of concentration. The loaded

carrier material samples all exhibited greater conductivity values as compared to the commercially available salt control samples at 75% and 50% concentrations. In one aspect, ZEOFREE® Plus 5191 precipitated silica at 75% exhibited the same conductivity profile through the first five seconds as a MORTON® Salt control at 100 %, indicating that the solution concentration of the salt during the first five seconds of the consumption of a food
5 would be the same. If the average time for the flavor experience for the consumption of a bite size snack food, for example, is five seconds, then the overall salt concentration can be reduced with the loaded carrier material without compromising taste. In another aspect, ZEOFREE® Plus 5191 and ZEOFREE® 5161 precipitated silica at a 50% concentration also
10 had a conductivity profile similar to the commercially available salt control at 75%.

In one aspect, the present invention allows for the delivery of a salt solution that can be readily released upon contact with, for example, saliva. Such a rapid release of salt can impart a higher degree of salt flavor to a subject's taste buds than, for example, a solid salt product that must dissolve. In another aspect, such a salt delivery system can impart a
15 desirable salt taste to food products, but does not leave significant amounts of salt not yet dissolved or in contact with taste buds, that can be absorbed by the subject. In one aspect, all or a portion of the salt solution disposed in the pores of the carrier material can be released quickly upon contact with water and/or saliva.

In another aspect, a taste test can be performed to determine efficacy and salt release of a loaded carrier material. In an exemplary taste test, 50 mg of table salt can be tasted and
20 judged for intensity of salt flavor and time to reach maximum intensity. The same test can be performed with a loaded carrier material, such as, for example, ZEOFREE® Plus 5191, such that an equal salt concentration can be delivered. In an exemplary experiment, two subjects felt that the loaded carrier material delivered a more rapid release of salt (i.e., by taste) than a
25 comparable salt material alone.

The present invention can be described in a variety of non-limiting aspects, such as, for example, those detailed below.

Aspect 1: A salt delivery composition comprising a carrier material having a porous surface and one or more salt solutions disposed in at least a portion of the pores thereof.

30 Aspect 2: The salt delivery composition of aspect 1, wherein the carrier material comprises a precipitated silica, a silicate, or a combination thereof.

Aspect 3: The salt delivery composition of aspect 1, wherein the carrier material comprises a precipitated silica.

Aspect 4: The salt delivery composition of any preceding aspect, wherein the carrier material has a median particle size of up to about 50 μm .

- 5 Aspect 5: The salt delivery composition of any preceding aspect, wherein the carrier material has a median particle size of from about 15 μm to about 30 μm .

Aspect 6: The salt delivery composition of any preceding aspect, wherein the carrier material has a moisture content, prior to contact with the one or more salt solutions of less than about 10 wt.%.

- 10 Aspect 7: The salt delivery composition of any preceding aspect, wherein the carrier material has a carrying capacity of at least about 50 %.

Aspect 8: The salt delivery composition of any preceding aspect, wherein the carrier material has a carrying capacity of from about 50 % to about 80 %.

- 15 Aspect 9: The salt delivery composition of any preceding aspect, wherein the carrier material is loaded with one or more salt solutions up to about 90 % of the carrier material's carrying capacity.

Aspect 10: The salt delivery composition of any preceding aspect, capable of releasing at least about 75 % of the one or more salt solutions within about 10 seconds after contact with water and/or saliva.

- 20 Aspect 11: The salt delivery composition of any preceding aspect, wherein the one or more salt solutions comprises sodium chloride, iodized sodium chloride, potassium chloride, sea salt, or a combination thereof.

Aspect 12: A food product comprising the salt delivery composition of any preceding aspect.

- 25 Aspect 13: A method comprising contacting a carrier material having a porous surface with one or more salt solutions, such that at least a portion of the one or more salt solutions is disposed in at least a portion of the pores of the carrier material.

Aspect 14: The method of aspect 13, wherein the carrier material comprises a precipitated silica, a silicate, or a combination thereof.

Aspect 15: A method comprising contacting the salt delivery composition of any of aspects 1-11 with a food product.

- 5 It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope or spirit of the invention. Other embodiments of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. It is intended that the specification and examples be considered as exemplary only, with a true
10 scope and spirit of the invention being indicated by the following claims.

CLAIMS

What is claimed is:

1. A salt delivery composition comprising a carrier material having a porous surface and one or more salt solutions disposed in at least a portion of the pores thereof.
- 5 2. The salt delivery composition of claim 1, wherein the carrier material comprises a precipitated silica, a silicate, or a combination thereof.
3. The salt delivery composition of any preceding claim, wherein the carrier material comprises a precipitated silica.
4. The salt delivery composition of any preceding claim, wherein the carrier material
10 has a median particle size of up to about 50 μm .
5. The salt delivery composition of any preceding claim, wherein the carrier material has a median particle size of from about 15 μm to about 30 μm .
6. The salt delivery composition of any preceding claim, wherein the carrier material has a moisture content, prior to contact with the one or more salt solutions, of less
15 than about 10 wt.%.
7. The salt delivery composition of any preceding claim, wherein the carrier material has a carrying capacity of at least about 50 %.
8. The salt delivery composition of any preceding claim, wherein the carrier material has a carrying capacity of from about 50 % to about 80 %.
- 20 9. The salt delivery composition of any preceding claim, wherein the carrier material is loaded with one or more salt solutions up to about 90 % of the carrier material's carrying capacity.
10. The salt delivery composition of any preceding claim, capable of releasing at least about 75 % of the one or more salt solutions within about 10 seconds after contact
25 with water and/or saliva.

11. The salt delivery composition of any preceding claim, wherein the one or more salt solutions comprises sodium chloride, iodized sodium chloride, potassium chloride, sea salt, or a combination thereof.
12. A food product comprising the precipitated silica composition of any preceding claim.
13. A method comprising contacting a carrier material having a porous surface with one or more salt solutions, such that at least a portion of the one or more salt solutions is disposed in at least a portion of the pores of the carrier material.
14. The method of claim 13, wherein the carrier material comprises a precipitated silica, a silicate, or a combination thereof.
15. A method comprising contacting the salt delivery composition of any of claims 1-11 with a food product.

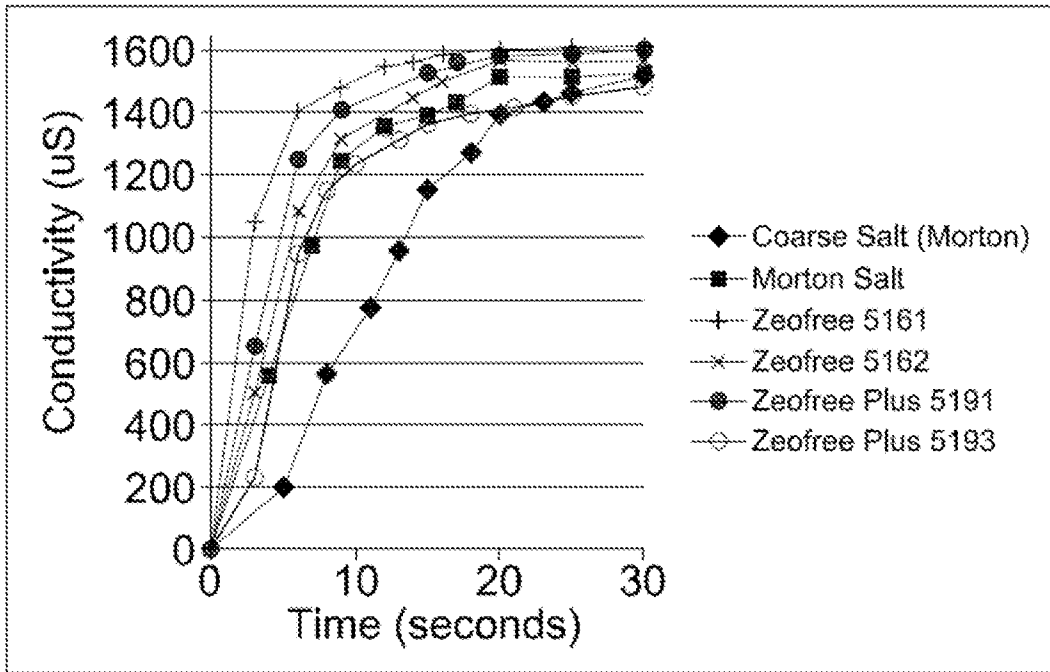


FIG. 1

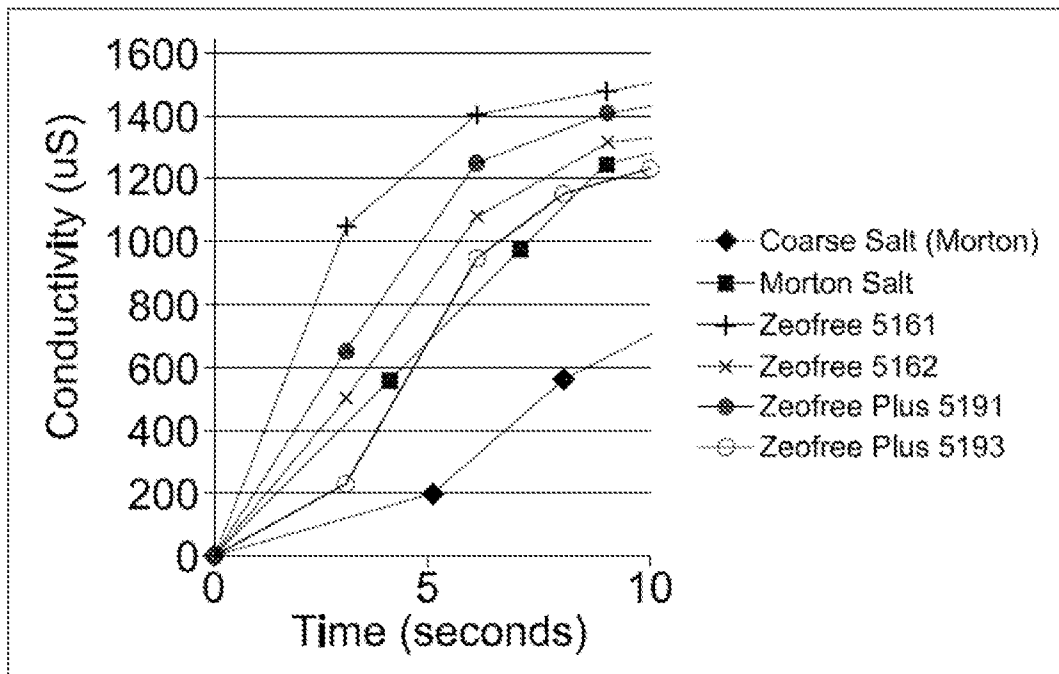


FIG. 2

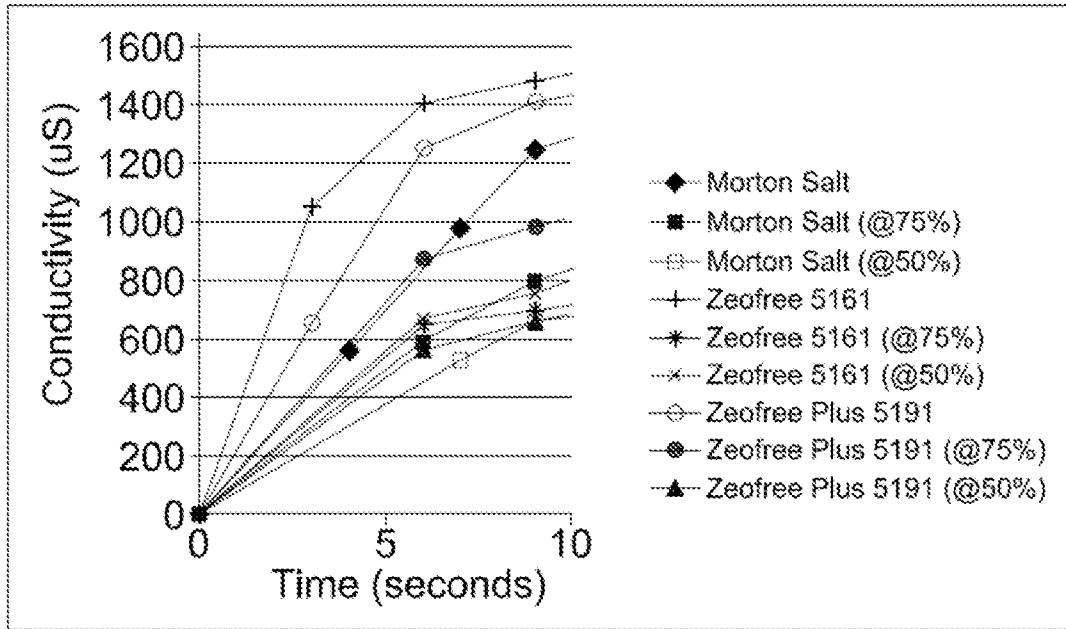


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No PCT/US2014/027677

A. CLASSIFICATION OF SUBJECT MATTER
 INV. A23L1/22 A23K1/175 A23L1/237 C01B33/12 C08K3/36
 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 A23K C01B C08K

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 practicable, search terms used)

EPO-Internal, WPI Data, FSTA

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011/082040 A1 (TREVINO RAMIRO [US] ET AL) 7 April 2011 (2011-04-07) paragraph [0046]; claims 29,35 paragraph [0028] -----	1-15
X	EP 0 937 755 A1 (DEGUSSA [DE]) 25 August 1999 (1999-08-25) paragraph [0071]; claim 6; table 9 paragraph [0011] -----	1-11,13,14
X	GB 1 588 405 A (YAKIMENKO L M) 23 April 1981 (1981-04-23) examples 6,10 -----	1,2,11,13,14
A	US 2010/028496 A1 (BARNEKOW SYLVIA [DE] ET AL) 4 February 2010 (2010-02-04) paragraph [0012] paragraph [0070] - paragraph [0073] -----	1-15

Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents :

<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&" document member of the same patent family</p>
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Date of the actual completion of the international search 16 July 2014	Date of mailing of the international search report 28/07/2014
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Groh, Björn
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INTERNATIONAL SEARCH REPORT

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