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(54) Title: D-PSICOSE IN ZERO OR LOW CALORIE FROZEN BEVERAGES

(57) Abstract: D-Psicose is included in a zero- or low-calorie frozen beverage to achieve a Brix and mouthfeel substantially similar to that of a full-calorie frozen beverage. It was further discovered that compositions containing D-Psicose provided improved performance in frozen beverage machines. Aspects and embodiments of the present invention are therefore directed to the use of D-Psicose in frozen beverages.

D-PSICOSE IN ZERO OR LOW CALORIE FROZEN BEVERAGES**CROSS-REFERENCE OF RELATED APPLICATIONS**

- [001] This application claims priority to provisional application Serial No. 61/894,102, filed October 22, 2013, hereby incorporated by reference in its entirety.

FIELD OF THE INVENTION

- [002] The invention relates to the use of D-Psicose as Brix and bulking agents in zero, low, and reduced calorie frozen carbonated and non-carbonated beverages.

BACKGROUND OF THE INVENTION

- [003] Among popular beverages are slushes and SLURPEES[®]. These frozen concoctions rely on ice and beverage syrup to create a drinkable frozen beverage. Such beverages may be carbonated or non-carbonated.
- [004] Frozen beverages require bulk solutes to stabilize small ice crystals and to trap carbon dioxide for a good taste and a smooth texture. The most commonly employed bulk solute is sugar. However, since sugar is caloric, it is not suitable for the formulation of zero- or low-calorie frozen beverages. Attempts have been made to prepare acceptable zero- or low-calorie frozen beverages; however, making such frozen beverages has been very difficult due to the need for effective bulk solutes for zero or low calorie beverages.
- [005] Some advances were made with the combination of erythritol and D-tagatose which provided the desired bulkiness to frozen carbonated beverages. These are the subject of U.S. Patents 7,579,032, 7,815,956, 8,221,815, and 8,227,006. The products described in these documents were successful in providing the desired bulkiness to the beverage, but the total Brix of the beverage remained low (~4.5 Brix) when compared to ~15 Brix in full calorie frozen carbonated beverages.

[006] Thus it is desired to provide zero- or low-calorie frozen beverages and reduced-calorie frozen beverages that provide not only the desired bulkiness but also a Brix closer to full calorie counterparts.

BRIEF SUMMARY OF THE INVENTION

[007] In one aspect, a zero- or low-calorie frozen beverage comprises (a) one or more non-nutritive sweeteners, and (b) D-Psicose. In a further aspect, the beverage further comprises erythritol, D-Tagatose or both erythritol and D-Tagatose.

[008] In another aspect, a reduced-calorie frozen beverage comprises (a) one or more non-nutritive sweeteners, (b) D-Psicose, and (c) one or more nutritive sweeteners. In a further aspect, the beverage further comprises erythritol, D-Tagatose or both erythritol and D-Tagatose.

[009] In another aspect a method of making a zero- or low-calorie frozen carbonated beverage comprises the steps of: (1) combining (a) at least one non-nutritive sweetener and (b) D-Psicose (and optionally erythritol and/or D-Tagatose) in a zero- or low-calorie frozen carbonated beverage syrup; (2) loading the zero- or low-calorie frozen carbonated beverage syrup into a dispensing machine; and (3) dispensing the zero- or low-calorie frozen carbonated beverage.

[010] In another aspect a method of making a reduced-calorie frozen carbonated beverage comprises the steps of: (1) combining (a) at least one non-nutritive sweetener, (b) D-Psicose and (c) nutritive sweeteners (and optionally erythritol and/or D-Tagatose) in a reduced-calorie frozen carbonated beverage syrup; (2) loading the reduced-calorie frozen carbonated beverage syrup into a dispensing machine; and (3) dispensing the reduced-calorie frozen carbonated beverage

DETAILED DESCRIPTION OF THE INVENTION

[011] It was discovered that D-Psicose can add both Brix and bulkiness to zero- or low-calorie frozen beverages as well as reduced-calorie beverages. It was further discovered that

compositions containing D-Psicose provided improved performance in frozen beverage machines. Aspects and embodiments of the present invention are therefore directed to the use of D-Psicose in frozen beverages.

[012] Various examples and embodiments of the inventive subject matter disclosed here are possible and will be apparent to persons of ordinary skill in the art, given the benefit of this disclosure. As used in this disclosure, the phrases “certain embodiments,” “certain exemplary embodiments,” “exemplary embodiments” and similar phrases mean that those embodiments are merely non-limiting examples of the inventive subject matter and that alternative or different embodiments are not being excluded. Unless otherwise indicated or unless otherwise clear from the context in which it is described, alternative elements or features in the embodiments and examples below and in the Summary above are interchangeable with each other. That is, an element described in one example or embodiment may be interchanged or substituted for one or more corresponding element(s) described in another example. Similarly, optional or non-essential features disclosed in connection with a particular embodiment or example should be understood to be disclosed for use in any other embodiments of the disclosed subject matter. More generally, the elements of the examples and exemplary embodiments should be understood to be disclosed generally for use with other aspects, embodiments and examples of the devices and methods disclosed herein. A reference to a component or ingredient being operative, i.e., able to perform one or more functions, tasks and/or operations or the like, is intended to mean that it can perform the expressly recited function(s), task(s) and/or operation(s) in at least certain embodiments, and may well be operative to perform also one or more other functions, tasks and/or operations.

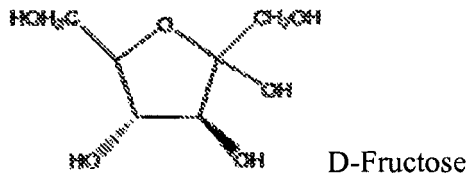
[013] While this disclosure includes specific examples, including presently preferred modes or embodiments, those skilled in the art will appreciate that there are numerous variations and modifications within the spirit and scope of the invention as set forth in the appended claims. Each word and phrase used in the claims is intended to include all its dictionary meanings consistent with its usage in this disclosure and/or with its technical and industry usage in any relevant technology area. It should be understood that the term “about” is used throughout this disclosure and the appended claims to account for ordinary

inaccuracy and variability, such as in measurement, testing and the like, in product production, etc.

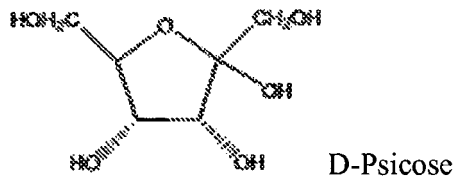
- [014] As used in this disclosure, unless otherwise specified, the term “added” or “combined” and like terms means that the multiple ingredients or components referred to (e.g., oil, emulsifier, preservative, etc.) are combined in any manner and in any order, with or without stirring or the like, with or without heating, etc. For example, one or more ingredients can be dissolved into one or more other ingredients, or sprayed together, etc. As used here, a solution may be a true solution, a slurry, a suspension, or other form of liquid or flowable material. In certain embodiments, for example, materials may be said to be combined to form a homogenous solution. Certain aspects of the present invention pertain to stirring the liquids, beverages, beverage products and various other components described herein. The term “mixing,” as used herein includes, but is not limited to, beating, blending, stirring, high shear stirring, low shear stirring, whipping, folding in, sonicating, sifting, pureeing, and the like.
- [015] Those of ordinary skill in the art will understand that in certain cases, for convenience, some ingredients are referred to or described here (including in the appended claims) by reference to the industry name for the product or to the original form of the ingredient in which it is used in formulating or producing the beverage or other food product. Such original form of the ingredient may differ from the form in which the ingredient is found in the finished beverage product. For example, the ingredient may be referred to in the form it is originally added during production of the food product rather than by the form it has in the finished food product, such as a dissolved or dissociated form or as a reaction product or complex with one or more of the other ingredients in the finished food product (or in an intermediate product in the course of producing the finished food product. Thus, for example, in certain exemplary embodiments of the beverage products according to this disclosure, sucrose and liquid sucrose would typically be substantially homogeneously dissolved and dispersed in the comestible products. Likewise, other ingredients identified as a solid, concentrate (e.g., juice concentrate), etc. would typically be homogeneously dispersed throughout the beverage or throughout the beverage concentrate, rather than remaining in their original form. As another example, an

ingredient described as a salt may exist in a beverage in dissolved form. Thus, reference to the form of an ingredient of a beverage product formulation should not be taken as a limitation on the form of the ingredient in the beverage product, but rather as a convenient means of describing the ingredient as an isolated component of the product formulation.

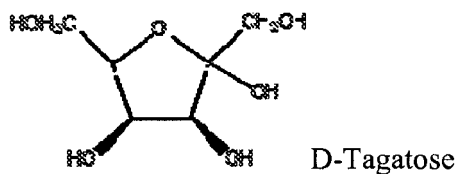
- [016] Certain aspects of this disclosure relate to the “concentration” of a solution, which is taken to mean the amount of solute in a given amount of solvent or solution. There are many ways to express concentration. For example, concentration may be defined in units of mass per unit volume (e.g., mg/mL, mg/cm³ and the like), percent by mass (which is simply the mass of the solute divided by the total mass of the solution multiplied by 100% (e.g., weight percent, percent by weight, wt. percent, wt. %, w/w, and the like)), percent by volume (which is simply the volume of the solute divided by the sum of the volumes of the other components multiplied by 100% (e.g., volume percent, percent by volume, v/v, and the like)), molarity (which is the number of moles of solute dissolved in one liter of solution), molality (which is the number of moles of solute dissolved in one kilogram of solvent), and parts per million (milligrams per liter).
- [017] As used herein, “taste” refers to a combination of sweetness perception, temporal effects of sweetness perception, i.e., on-set and duration, off-tastes, e.g. bitterness and metallic taste, residual perception (aftertaste) and tactile perception, e.g. body and thickness.
- [018] Aspects of the invention are directed to the use of D- Psicose to increase Brix in zero- or low-calorie frozen beverages. D- Psicose is a non-caloric monosaccharide sugar. D- Psicose is desirable as it does not provide additional calories to a beverage composition. The invention is discussed generally in terms of zero- or low-calorie frozen beverages although the invention also relates to reduced calorie beverages which contain nutritive sweeteners in higher amounts than generally used in lower calorie beverages.
- [019] Desired Brix in zero- and low-calorie frozen beverages is generally 1 to 15, preferably or 10 to 15.
- [020] D- Psicose and D- tagatose are stereoisomers of D- fructose:



D-Fructose has a sweet intensity of 1.5x, provides 4 cal/g, and is FDA approved.



D-Psicose has a sweetness intensity of 0.6x, provides 0.2 cal/g, and is GRASed at a beverage max of 2.1 %.



- [021] D-Tagatose has a sweetness intensity of 0.9x, provides 1.5 cal/g, and is GRASed at a beverage max of 1 %.
- [022] D-Psicose provides a zero- or low-calorie frozen beverage composition that can be used successfully in frozen beverage machines. That is, frozen beverages can be prepared using the frozen beverage machine with more reliable performance and less maintenance.
- [023] For example, D-Psicose is currently GRASed with a 2.1 wt% max level. The inclusion of 2.1% D-Psicose in zero- or low-calorie frozen beverage compositions can increase the total Brix level of the frozen composition to 6.6% Brix without adding more calories. The increase in Brix allows the frozen beverage machine to work more reliably with less maintenance.
- [024] The amount of D-Psicose added to a frozen beverage composition depends in part of the non-nutritive sweetener and whether either erythritol or D-Tagatose are present in the

composition. Generally D-Psicose is added to the composition in an amount from 1 wt% to 10 wt% or 2 wt% to 5 wt% based on total weight of the finished frozen beverage.

- [025] D-Psicose may be used alone or together with erythritol, D-Tagatose, or both. Erythritol is generally added to the frozen beverage composition in an amount from 0.1 wt% to 4 wt% or 2 wt% to 3.5 wt%, based on total weight of the finished frozen beverage. D-Tagatose is generally added to the frozen beverage composition in an amount of from 0.1 wt% to 1.0 wt% or 0.3 wt% to 0.6 wt% based on total weight of the finished frozen beverage.
- [026] Frozen carbonated beverages in accordance with aspects of the present disclosure can be prepared directly as ready-to-drink frozen beverages or as syrup to be held in frozen beverage machines. For example, D-Psicose can be added to a sweetened or unsweetened base with stirring to achieve some or complete dissolution.
- [027] To prepare frozen beverages containing D-Psicose from a concentrate syrup, the pre-made syrup can be diluted with water, e.g. in a 1-plus-5 throw, to produce a beverage mixture. The beverage mixture can be poured into the hopper of a frozen beverage unit (e.g. a Taylor 428 or 430 frozen beverage unit or an Ultra I or Ultra II frozen beverage unit) to generate and dispense frozen beverage. Alternatively, the water and syrup can be combined at the point of dispensing. Optionally the frozen beverage can be flavored after being dispensed by adding flavored syrup.
- [028] Other types of frozen beverage machines include frozen carbonated beverage machines (optionally referred to here as an "FCB Dispenser") configured to hold syrup at reduced temperature and to add carbonated water to the syrup and dispense ready-to-drink frozen carbonated beverage at the time of consumption. Suitable FCB Dispensers are known to those skilled in the art and include, for example, the Cornelius V3 model and newer versions available from IMI Cornelius, Inc., a subsidiary of IMI plc.
- [029] For example, beverage syrup for frozen carbonated beverages can be prepared by adding D-Psicose to a sweetened or unsweetened carbonated soft drink ("CSD") base (e.g., cola CSD base or lemon-lime CSD base) or other beverage base with stirring to achieve some

or complete dissolution. The D-Psicose is added at any suitable point, e.g., prior to or after adding other ingredients (such as sweeteners, acidulants, and preservatives) with stirring for partial or complete dissolution. The resulting syrup can be placed into a frozen carbonated beverage machine ("FCB Dispenser") configured to add carbonated water to the syrup before or at the time of dispensing servings of finished ready-to-drink frozen carbonated beverage. Ready-to-drink servings of finished frozen carbonated beverage should have good carbon dioxide overrun, smooth, creamy mouthfeel and good taste profile. Optionally frozen carbonated beverage syrup can be successively run through the FCB Dispenser to achieve consistently high quality ready-to-drink servings of finished frozen carbonated beverage.

- [030] The frozen beverage compositions in accordance with aspects of the invention contain D-Psicose and other suitable ingredients to form the frozen beverage compositions such as, but not limited to, water, nutritive and non-nutritive (natural or artificial) sweeteners, flavoring(s), acidulant(s), and preservative(s). Reduced calorie beverages may be prepared with higher quantities of nutritive sweeteners than zero calorie or lower calorie beverages.
- [031] The term "nutritive sweetener" refers generally to sweeteners which provide significant caloric content in typical usage amounts, e.g., more than about 5 calories per 8 oz. serving of beverage. As used herein, a "non-nutritive sweetener" is one which does not provide significant caloric content in typical usage amounts, i.e., is one which imparts less than 5 calories per 8 oz. serving of beverage to achieve the sweetness equivalent of 10 Brix of sugar.
- [032] As used herein, a "full-calorie" beverage formulation is one fully sweetened with a nutritive sweetener. As used herein, "reduced calorie beverage" means a beverage having at least a 25% reduction in calories per 8 oz. serving of beverage as compared to the full calorie version, typically a previously commercialized full-calorie version. In at least certain embodiments, a reduced calorie beverage has about a 50% reduction in calories per 8 oz. serving as compared to the full calorie version. As used herein, a "low-calorie beverage" has fewer than 40 calories per 8 oz. serving of beverage. As used herein,

“zero-calorie” or “diet” means having less than 5 calories per serving, e.g., per 8 oz. for beverages.

- [033] As used herein, a “potent sweetener” means a sweetener which is at least twice as sweet as sugar, that is, a sweetener which on a weight basis requires no more than half the weight of sugar to achieve an equivalent sweetness. For example, a potent sweetener may require less than one-half the weight of sugar to achieve an equivalent sweetness in a beverage sweetened to a level of 10 degrees Brix with sugar. Potent sweeteners include both nutritive (e.g., Lo Han Guo juice concentrate) and non-nutritive sweeteners (e.g., typically, Lo Han Guo powder). In addition, potent sweeteners include both natural potent sweeteners (e.g., steviol glycosides, Lo Han Guo, etc.) and artificial potent sweeteners (e.g., neotame, etc.). However, for natural beverage products disclosed here, only natural potent sweeteners are employed.
- [034] Non-nutritive sweeteners suitable for use in the present invention include, without limitation, peptide based sweeteners, for example, aspartame, neotame, and alitame, and non-peptide based sweeteners, for example, sodium saccharin, calcium saccharin, acesulfame potassium, sodium cyclamate, calcium cyclamate, neohesperidin dihydrochalcone, and sucralose. Natural non-nutritive sweeteners suitable for use in at least certain embodiments as a supplementary sweetener for the D-Psicose include, for example, other steviol glycosides (e.g., stevioside, steviolbioside, dulcoside A, rebaudioside A, rebaudioside B, rebaudioside C, rebaudioside D, rebaudioside E, rebaudioside M, mixtures of any of them, etc.), Lo Han Guo and related compounds. Other sweeteners include glycyrrhizin, neohesperidin dihydrochalcone, monatin, thaumatin, monellin, brazzein, L-alanine, glycine, hernandulcin, phyllodulcin, trilobatin, or a combinations of any two or more of them.
- [035] Steviol glycosides include rebaudiosides, e.g., rebaudioside A, rebaudioside D, rebaudioside M, stevioside, steviolbioside, dulcoside A, or mixtures of any two or more of them can be used for sweetening in combination with D-Psicose in the zero- or low-calorie frozen beverage products disclosed here. These compounds may be synthetically produced (e.g., chemically or by fermentation of genetically modified organisms, etc.) or obtained by extraction or the like from the stevia plant (e.g., by extraction followed by

enzymatic conversion). Stevia (e.g., *Stevia rebaudiana* Bertoni) is a commercially cultivated, sweet-tasting plant. The leaves contain a complex mixture of natural sweet diterpene glycosides. Steviol glycosides and rebaudiosides are components of Stevia that contribute various degree of sweetness. A, rebaudioside B, rebaudioside C, rebaudioside D, rebaudioside E, stevioside.

- [036] Processes for the preparation of certain rebaudiosides, including, e.g., rebaudioside D, rebaudioside M, and others, is shown in PCT patent application No. 104002121 filed December 10, 2012 by Su Zhou Jing Hong Biotech Co., Ltd. (Wujiang, Jiangsu Province, People's Republic Of China) and corresponding U.S. provisional patent application No. 61/579,016 filed December 22, 2011, the entire contents of which are hereby incorporated by reference herein.
- [037] One of ordinary skill in this art will readily appreciate that non-nutritive sweeteners may be used or combined in various ratios to form a non-nutritive sweetener blend suitable for use in the present invention. Precise ratios of non-nutritive sweeteners depend on the combination of sweeteners used in a given blend and the desired overall sweetness for a given application. Appropriate ratios can be readily determined by one of ordinary skill in this art. One of ordinary skill in this art will also readily appreciate that the amount of the non-nutritive sweetener in a finished frozen beverage will vary depending on a variety of factors such as the desired overall sweetness for a given application. Appropriate amounts can be readily determined by one of ordinary skill in this art.
- [038] It is additionally possible to include in a beverage, a combination of D-Psicose and at least one nutritive sweetener in order to achieve good tasting reduced-calorie frozen beverage. Any nutritive sweetener is suitable for use; as used herein, a "nutritive" sweetener is one which provides significant caloric content in typical usage amounts, i.e., more than about 1 calorie per serving (8 oz. for beverages). Such sweeteners include, without limitation, fructose, sucrose, dextrose, maltose, trehalose, rhamnose, corn syrups (e.g. high fructose corn syrup) and fructo-oligosaccharides.
- [039] It should be understood that compositions and beverages in accordance with this disclosure may have any of numerous different specific formulations or constitutions.

The formulation may vary depending upon such factors as the product's intended market segment, its desired nutritional characteristics, flavor profile and the like. Flavorings, electrolytes, vitamins, fruit juices or other fruit products, tastents, masking agents and the like, flavor enhancers, and/or carbonation typically may be added to any such formulations to vary the taste, mouthfeel, nutritional characteristics, etc.

- [040] In general, a frozen beverage product in accordance with this disclosure typically comprises at least water, D-Psicose, acidulant and flavoring. Exemplary flavorings which may be suitable for at least certain formulations in accordance with this disclosure include cola flavoring, citrus flavoring, spice flavorings and others. Carbonation in the form of carbon dioxide may be added for effervescence. Preservatives may be added if desired, depending upon the other ingredients, production technique, desired shelf life, etc. Optionally, caffeine may be added. Certain exemplary embodiments of the beverages disclosed here are cola-flavored carbonated beverages, characteristically containing carbonated water, sweetener, kola nut extract and/or other flavoring, caramel coloring, at least one acid, and optionally other ingredients. Additional and alternative suitable ingredients will be recognized by those skilled in the art given the benefit of this disclosure.
- [041] In the frozen beverages of the present invention, it is possible to include other ingredients typically found in such beverages. Such other ingredients include, without limitation, soluble low-calorie fibers such as polydextrose, Fibersolg, or arabinogalactan, chitosan, chitin, xanthan, pectin, cellulose, konjac, gum arabic, modified starch, soy fiber, inulin, inulose, hydrolyzed guar, guar gum, beta-glucan, carageenan, locust bean gum, alginate, polyglycol alginate, foam stabilizing agents such as yucca or yucca/quillaia extracts, salts such as sodium, calcium and potassium chlorides, food grade surfactants such as monoglycerides, diglycerides, lecithin and fractions thereof, and synthetic surfactants such as Tweens.RTM., Spans.RTM., diacetyltartaric esters, citric acid esters, etc.
- [042] Natural embodiments of the beverage products disclosed here are natural in that they do not contain anything artificial or synthetic (including any color additives regardless of source) that would not normally be expected to be in the food. As used herein, therefore, a "natural" beverage composition is defined in accordance with the following guidelines:

Raw materials for a natural ingredient exists or originates in nature. Biological synthesis involving fermentation and enzymes can be employed, but synthesis with chemical reagents is not utilized. Artificial colors, preservatives, and flavors are not considered natural ingredients. Ingredients may be processed or purified through certain specified techniques including at least: physical processes, fermentation, and enzymolysis. Appropriate processes and purification techniques include at least: absorption, adsorption, agglomeration, centrifugation, chopping, cooking (baking, frying, boiling, roasting), cooling, cutting, chromatography, coating, crystallization, digestion, drying (spray, freeze drying, vacuum), evaporation, distillation, electrophoresis, emulsification, encapsulation, extraction, extrusion, filtration, fermentation, grinding, infusion, maceration, microbiological (rennet, enzymes), mixing, peeling, percolation, refrigeration/freezing, squeezing, steeping, washing, heating, mixing, ion exchange, lyophilization, osmose, precipitation, salting out, sublimation, ultrasonic treatment, concentration, flocculation, homogenization, reconstitution, enzymolysis (using enzymes found in nature). Processing aids (currently defined as substances used as manufacturing aids to enhance the appeal or utility of a food component, including clarifying agents, catalysts, flocculants, filter aids, and crystallization inhibitors, etc. See 21 CFR § 170.3(o)(24)) are considered incidental additives and may be used if removed appropriately.

- [043] Substantially clear embodiments of the beverage products disclosed here are substantially clear in that the beverages have substantially no turbidity and substantially no color.
- [044] Water is a basic ingredient in the products disclosed here typically being the vehicle or primary liquid portion in which the D-Psicose is provided and the remaining ingredients in the beverage products are dissolved, emulsified, suspended or dispersed. Purified water can be used in the manufacture of certain embodiments of the beverage products disclosed here, and water of a standard beverage quality can be employed in order not to adversely affect beverage taste, odor, or appearance. The water typically will be clear, colorless, free from objectionable minerals, tastes and odors, free from organic matter, low in alkalinity and of acceptable microbiological quality based on industry and government standards applicable at the time of producing the beverage. In certain typical embodiments of beverage products, water is present at a level of from about 80% to about

99.9% by weight of the beverage. In at least certain exemplary embodiments the water used in beverages and concentrates disclosed here is “treated water,” which refers to water that has been treated to reduce the total dissolved solids of the water prior to optional supplementation, e.g., with calcium as disclosed in U.S. Patent No. 7,052,725. Methods of producing treated water are known to those of ordinary skill in the art and include deionization, distillation, filtration and reverse osmosis (“r-o”), among others. The terms “treated water,” “purified water,” “demineralized water,” “distilled water,” and “r-o water” are understood to be generally synonymous in this discussion, referring to water from which substantially all mineral content has been removed, typically containing no more than about 500 ppm total dissolved solids, e.g. 250 ppm total dissolved solids.

- [045] As discussed above, sweeteners suitable for combination with D-Psicose in at least certain exemplary embodiments of beverage products disclosed here include natural nutritive sweeteners, natural non-nutritive potent sweeteners, and artificial sweeteners. Also, in at least certain exemplary embodiments of the beverage products disclosed here, combinations of one or more natural nutritive sweeteners, one or more artificial sweeteners and/or one or more natural non-nutritive potent sweeteners are used to provide the sweetness and other aspects of desired taste profile and nutritive characteristics. It should also be recognized that certain such sweeteners will, either in addition or instead, act as tastents, masking agents or the like in various embodiments of the beverages disclosed here, e.g., when used in amounts below its (or their) sweetness perception threshold in the beverage in question.
- [046] The sweeteners included in the formulations of the beverage products disclosed here, including are edible consumables suitable for consumption and for use in beverages. By “edible consumables” is meant a beverage or an ingredient of a beverage for human or animal consumption. The sweetener or sweetening agent used here and in the claims may be a nutritive or non-nutritive, natural or synthetic beverage ingredient or additive (or mixtures of them) which provides sweetness to the beverage, i.e., which is perceived as sweet by the sense of taste. The perception of flavoring agents and sweetening agents may depend to some extent on the interrelation of elements. Flavor and sweetness may

also be perceived separately, i.e., flavor and sweetness perception may be both dependent upon each other and independent of each other. For example, when a large amount of a flavoring agent is used, a small amount of a sweetening agent may be readily perceptible and vice versa. Thus, the oral and olfactory interaction between a flavoring agent and a sweetening agent may involve the interrelationship of elements.

- [047] pH is a measure of the acidity or basicity of a solution. As used herein, the term “low pH” refers to an acidic pH below pH 6, such as in the range of about 1 to about 6. Certain exemplary embodiments of the beverages disclosed here (e.g., cola beverage products) have a pH in the range of about 2.0 to 5.0, or in the range of about 2.5 to 4.0, or in the range of about 2.8 to 3.3 or in the range of about 3.0 to 3.2. As used herein, the term “high pH” refers to a basic pH in the range of about 8 to about 14. As used herein, the term “neutral pH” refers to a pH of about 7 (e.g., from about 6.0 to 8.0., or in the range of about 6.5 to about 7.5). Certain exemplary embodiments of the beverages disclosed here have a high pH, e.g., a pH in the range of about pH 8 to 14. Certain exemplary embodiments of the beverage products disclosed here have a neutral pH, e.g., a pH in the range of about pH 6 to pH 8, or in the range of about pH 6.5 to 7.5.
- [048] An acidulant comprising at least one edible acid is used in certain embodiments of the beverage products disclosed herein and may serve any one or more of several functions, including, for example, lending tartness to the taste of the beverage, enhancing palatability, increasing thirst quenching effect, modifying sweetness and acting as a mild preservative. Suitable acids are known and will be apparent to those skilled in the art given the benefit of this disclosure. Exemplary acids suitable for use in some or all embodiments of the beverage products disclosed here include phosphoric acid, citric acid, malic acid, tartaric acid, lactic acid, fumaric acid, ascorbic acid, gluconic acid, succinic acid, maleic acid, adipic acid, cinnamic acid, glutaric acid, and mixtures of any of them. Typically, the acid is phosphoric acid, citric acid, malic acid, or combinations of any of them, such as, e.g., phosphoric acid and citric acid. In embodiments comprising natural beverage products (e.g., natural cola beverage products), the acid can be selected, e.g., from the group consisting of citric acid, malic acid, tartaric acid, formic acid, gluconic acid, lactic acid, fumaric acid, adipic acid, succinic acid, maleic acid, cinnamic acid,

, glutaric acid, and mixtures of any of them. For instance, in certain embodiments the acid comprises or consists essentially of lactic acid, tartaric acid and citric acid, and in certain embodiments the acid comprises or consists essentially of lactic acid and at least one of tartaric and citric acids.

- [049] Titratable acidity is an indication of the total acidity of a beverage product. Titratable acidity measures the amount of alkali required to neutralize the acid of a given volume of beverage. The titratable acidity is the milliliter of 0.1 N NaOH required to titrate 100 ml of beverage to a pH 8.75 end point with a potentiometer. The titratable acidity of certain embodiments of the beverage products disclosed here (e.g., cola beverage products) and at least one acid is typically about 8.75 to about 12.5, or from about 9 to about 11. Suitable titratable acidities include, e.g., about 9, 9.25, 9.5, 9.75, 10, 10.25, or 10.9.
- [050] The acid may be used in solution form, for example, and in an amount sufficient to provide the desired pH of the beverage. The particular acid or acids chosen and the amount used will depend, in part, on the other ingredients, the desired shelf life of the beverage product, as well as effects on the beverage pH, titratable acidity, and taste. Typically, for example, the one or more acids of the acidulant are used in an amount, collectively, of from about 0.01% to about 1.0% by weight of the beverage, e.g., from about 0.01% to about 0.5% by weight, from about 0.05% to about 0.5% by weight, from about 0.05% to about 0.25% by weight, from about 0.1% to about 0.25% by weight, depending upon the acidulant used, desired pH, other ingredients used, etc., of the beverage product (e.g., a cola beverage product). The pH of at least certain exemplary embodiments of the beverages disclosed here may be a value within the range of from about 2.0 to 5.0, about 2.5 to 4.0, about 2.8 to 3.3 or about 3.0 to 3.2., e.g., 3.1. The acid in certain exemplary embodiments enhances beverage flavor. Too much acid may impair the beverage flavor and result in tartness or other off-taste, while too little acid may make the beverage taste flat.
- [051] Those skilled in the art, given the benefit of this disclosure, will recognize that when preparing beverage products containing sweeteners such as peptide-based artificial sweeteners, such as aspartame, the resulting beverage composition is best maintained at a suitable pH. Specifically, the pH/stability curve for aspartame is a bell curve with pH 4.2

generally providing the best stability or shelf life. More specifically, such pH values are generally found to best retain the sweetening effect of the artificial sweetener.

- [052] In the formation of calcium-supplemented beverages, the presence of calcium salt(s) may require additional acids to both assist the dissolution of the salt and maintain a desirable pH for stability of the artificial sweetener. The presence of the additional acid in the beverage composition, which increases the titratable acidity of the composition, will result in a more tart or sour taste to the resulting beverage. It will be within the ability of those skilled in the art, given the benefit of this disclosure, to select a suitable acid or combination of acids and the amounts of such acids for the acidulant component of any particular embodiment of the beverage products disclosed here.
- [053] Certain exemplary embodiments of the beverage products disclosed here also may contain small amounts of alkaline agents, e.g., to adjust pH or for other purposes. Such agents include, e.g., potassium citrate and sodium citrate. For example, the alkaline agent potassium hydroxide may be used in an amount of from about 0.005 wt.% to about 0.02 wt.% (by weight of the beverage), with an amount of about 0.01% being typical for certain beverages. The amount will depend, of course, on the type of alkaline agents and on the degree to which the pH is to be adjusted.
- [054] The beverage products disclosed here optionally contain a flavor composition, for example, natural and synthetic fruit flavors, botanical flavors, other flavors, and mixtures thereof. As used here, the term "fruit flavor" refers generally to those flavors derived from the edible reproductive part of a seed plant. Included are both those wherein a sweet pulp is associated with the seed, e.g., banana, tomato, cranberry and the like, and those having a small, fleshy berry. The term berry also is used here to include aggregate fruits, i.e., not "true" berries, but fruit commonly accepted as such. Also included within the term "fruit flavor" are synthetically prepared flavors made to simulate fruit flavors derived from natural sources. Examples of suitable fruit or berry sources include whole berries or portions thereof, berry juice, berry juice concentrates, berry purees and blends thereof, dried berry powders, dried berry juice powders, and the like.
- [055] Exemplary fruit flavors include the citrus flavors, e.g., orange, lemon, lime grapefruit, tangerine, mandarin orange, tangelo, and pomelo, and such flavors as apple, grape,

cherry, and pineapple flavors and the like, and mixtures thereof. In certain exemplary embodiments the beverage concentrates and other beverage products comprise a fruit flavor component, e.g., a juice concentrate or juice. As used here, the term "botanical flavor" refers to flavors derived from parts of a plant other than the fruit. As such, botanical flavors may include those flavors derived from essential oils and extracts of nuts, bark, roots and leaves. Also included within the term "botanical flavor" are synthetically prepared flavors made to simulate botanical flavors derived from natural sources. Examples of such flavors include cola flavors, tea flavors, and the like, and mixtures thereof. The flavor component may further comprise a blend of several of the above-mentioned flavors. In certain exemplary embodiments of the beverage concentrates and beverages a cola flavor component is used or a tea flavor component. The particular amount of the flavor component useful for imparting flavor characteristics to the beverage products of the present invention will depend upon the flavor(s) selected, the flavor impression desired, and the form of the flavor component. Those skilled in the art, given the benefit of this disclosure, will be readily able to determine the amount of any particular flavor component(s) used to achieve the desired flavor impression.

[056] Juices suitable for use in at least certain exemplary embodiments of the beverage products disclosed here include, e.g., fruit, vegetable and berry juices. Juices may be employed in the present invention in the form of a concentrate, puree, single-strength juice, or other suitable forms. The term "juice" as used here includes single-strength fruit, berry, or vegetable juice, as well as concentrates, purees, milks, and other forms. Multiple different fruit, vegetable and/or berry juices may be combined, optionally along with other flavorings, to generate a beverage having the desired flavor. Examples of suitable juice sources include plum, prune, date, currant, fig, grape, raisin, cranberry, pineapple, peach, banana, apple, pear, guava, apricot, Saskatoon berry, blueberry, plains berry, prairie berry, mulberry, elderberry, Barbados cherry (acerola cherry), choke cherry, date, coconut, olive, raspberry, strawberry, huckleberry, loganberry, currant, dewberry, boysenberry, kiwi, cherry, blackberry, quince, buckthorn, passion fruit, sloe, rowan, gooseberry, cashew apple, pomegranate, persimmon, mango, rhubarb, papaya, litchi, lemon, orange, lime, tangerine, mandarin and grapefruit etc. Numerous additional and alternative juices suitable for use in at least certain exemplary embodiments will be

apparent to those skilled in the art given the benefit of this disclosure. In the beverages of the present invention employing juice, juice may be used, for example, at a level of at least about 0.2% by weight of the beverage. In certain exemplary embodiments juice is employed at a level of from about 0.2% to about 40% by weight of the beverage. Typically, juice may be used, if at all, in an amount of from about 1% to about 20% by weight.

- [057] Certain such juices which are lighter in color may be included in the formulation of certain exemplary embodiments to adjust the flavor and/or increase the juice content of the beverage without darkening the beverage color. Examples of such juices include apple, pear, pineapple, peach, lemon, lime, orange, apricot, grapefruit, tangerine, rhubarb, cassis, quince, passion fruit, papaya, mango, guava, litchi, kiwi, mandarin, coconut, and banana. De-flavored and decolored juices may be employed if desired.
- [058] Other flavorings suitable for use in at least certain exemplary embodiments of the beverage products disclosed here include, e.g., spice flavorings, such as cassia, clove, cinnamon, pepper, ginger, vanilla spice flavorings, cardamom, coriander, root beer, saffron, ginseng, and others. Numerous additional and alternative flavorings suitable for use in at least certain exemplary embodiments will be apparent to those skilled in the art given the benefit of this disclosure. Flavorings may be in the form of an extract, oleoresin, juice concentrate, bottler's base, or other forms known in the art. In at least certain exemplary embodiments, such spice or other flavors complement that of a juice or juice combination.
- [059] The one or more flavorings may be used in the form of an emulsion. A flavoring emulsion may be prepared by mixing some or all of the flavorings together, optionally together with other ingredients of the beverage, and an emulsifying agent. The emulsifying agent may be added with or after the flavorings mixed together. In certain exemplary embodiments the emulsifying agent is water-soluble. Exemplary suitable emulsifying agents include gum acacia, modified starch, carboxymethylcellulose, gum tragacanth, gum ghatti and other suitable gums. Additional suitable emulsifying agents will be apparent to those skilled in the art of beverage formulations, given the benefit of this disclosure. The emulsifier in exemplary embodiments comprises greater than about

3% of the mixture of flavorings and emulsifier. In certain exemplary embodiments the emulsifier is from about 5% to about 30% of the mixture.

- [060] Carbon dioxide is used to provide effervescence to certain exemplary embodiments of the beverages disclosed here. Any of the techniques and carbonating equipment known in the art for carbonating beverages may be employed. Carbon dioxide may enhance the beverage taste and appearance and may aid in safeguarding the beverage purity by inhibiting and destroying objectionable bacteria. In certain embodiments, for example, the beverage has a CO₂ level up to about 4.0 volumes carbon dioxide. Typical embodiments may have, for example, from about 0.5 to 5.0 volumes of carbon dioxide. As used here and independent claims, one volume of carbon dioxide is defined as the amount of carbon dioxide absorbed by any given quantity of liquid, e.g., water at 60° F (16° C) and one atmospheric pressure. A volume of gas occupies the same space as does the liquid by which it is dissolved. The carbon dioxide content may be selected by those skilled in the art based on the desired level of effervescence and the impact of the carbon dioxide on the taste or mouthfeel of the beverage. The carbonation may be natural or synthetic.
- [061] Optionally, caffeine may be added to various embodiments of the beverage products disclosed here. The amount of caffeine added is determined by the desired beverage properties, any applicable regulatory provisions of the country where the beverage is to be marketed, etc. In certain exemplary embodiments caffeine is included at a level of 0.02 percent or less by weight of the beverage. The caffeine must be of purity acceptable for use in foods and beverages. The caffeine may be natural or synthetic in origin.
- [062] The frozen beverage compositions disclosed here may contain additional ingredients compatible with D-Psicose, including, generally, any of those typically found in comestible formulations. These additional ingredients, for example, may typically be added to a stabilized beverage composition. Examples of such additional ingredients include, but are not limited to, caffeine, caramel and other coloring agents or dyes, antifoaming agents, gums, emulsifiers, tea solids, cloud components, and mineral and non-mineral nutritional supplements. Examples of non-mineral nutritional supplement ingredients are known to those of ordinary skill in the art and include, for example,

antioxidants and vitamins, including Vitamins A, D, E (tocopherol), C (ascorbic acid), B (thiamine), B₂ (riboflavin), B₆, B₁₂, and K, niacin, folic acid, biotin, and combinations of any of them. The optional non-mineral nutritional supplements are typically present in amounts generally accepted under good manufacturing practices. Exemplary amounts are between about 1% and about 100% RDV (recommended daily value), where such RDV are established. In certain exemplary embodiments the non-mineral nutritional supplement ingredient(s) are present in an amount of from about 5% to about 20% RDV, where established.

[063] Preservatives may be used in at least certain embodiments of the frozen beverage products disclosed here. That is, at least certain exemplary embodiments contain an optional preservative system. For example, solutions with a pH below 4 and especially those below 3 typically are “microstable,” i.e., they resist growth of microorganisms, and so are suitable for longer term storage prior to consumption without the need for further preservatives. However, an additional preservative system may be used if desired. If a preservative system is used, it may be added to the beverage product at any suitable time during production, e.g., in some cases prior to the addition of d-Psicose. As used here, the terms “preservation system” or “preservatives” include all suitable preservatives approved for use in food and beverage compositions, including, without limitation, such known chemical preservatives as benzoates, e.g., sodium, calcium, and potassium benzoate, sorbates, e.g., sodium, calcium, and potassium sorbate, citrates, e.g., sodium citrate and potassium citrate, polyphosphates, e.g., sodium hexametaphosphate (SHMP), and mixtures thereof, and antioxidants such as ascorbic acid, EDTA, BHA, BHT, TBHQ, dehydroacetic acid, dimethyldicarbonate, ethoxyquin, heptylparaben, and combinations of any of them. Preservatives may be used in amounts not exceeding mandated maximum levels under applicable laws and regulations. The level of preservative used typically is adjusted according to the planned final product pH, as well as an evaluation of the microbiological spoilage potential of the particular beverage formulation. The maximum level employed typically is about 0.05% by weight of the beverage. It will be within the ability of those skilled in the art, given the benefit of this disclosure, to select a

suitable preservative or combination of preservatives for beverages according to this disclosure.

[064] Other methods of food or beverage preservation suitable for at least certain exemplary embodiments of the beverage products disclosed here (e.g., cola beverage products) include, e.g., aseptic packaging and/or heat treatment or thermal processing steps, such as hot filling and tunnel pasteurization. Such steps can be used to reduce yeast, mold and microbial growth in the beverage products. For example, U.S. Patent No. 4,830,862 to Braun et al. discloses the use of pasteurization in the production of fruit juice beverages as well as the use of suitable preservatives in carbonated beverages. U.S. Patent No. 4,925,686 to Kastin discloses a heat-pasteurized freezable fruit juice composition which contains sodium benzoate and potassium sorbate. In general, heat treatment includes hot fill methods typically using high temperatures for a short time, e.g., about 190° F for 10 seconds, tunnel pasteurization methods typically using lower temperatures for a longer time, e.g., about 160° F for 10-15 minutes, and retort methods typically using, e.g., about 250° F for 3-5 minutes at elevated pressure, i.e., at pressure above 1 atmosphere.

[065] The examples which follow are intended as an illustration of certain preferred embodiments of the invention, and no limitation of the invention is implied.

[066] Example 1

[067] To a gallon of unsweetened Diet Pepsi base, D- Psicose (10% by weight of finished drink) is added, and the solution is stirred until complete dissolution occurs. Rebaudioside M (400 ppm per finished drink) is then added, and again the solution is stirred until complete dissolution. The syrup thus prepared is placed into a frozen carbonated beverage machine (for example, Cornelius V3) in a 1 plus 5 throw (1 part syrup with 5 parts carbonated water). The resulting FCB has good carbon dioxide overrun, smooth, creamy mouthfeel and great taste. In addition, the syrup can be successively run through the FCB machine to consistently achieve a high quality FCB.

[068] Example 2

[069] Example 1 is repeated with the following: D-Psicose is 5%, erythritol is 3.5%, Rebaudioside M is 200 ppm.

[070] Example 3

[071] Example 1 is repeated with the following: D-Psicose 2.1%, erythritol 3.5%, sugar 3%, and Rebaudioside M is 200 ppm.

[072] While the invention has been described with respect to specific examples including presently preferred modes of carrying out the invention, those skilled in the art will appreciate that there are numerous variations and permutations of the above described systems and techniques that fall within the spirit and scope of the invention as set forth in the appended claims.

We Claim:

1. A zero- or low-calorie frozen beverage comprising (a) one or more non-nutritive sweeteners and (b) D- Psicose.
2. A reduced-calorie frozen beverage comprising (a) one or more non-nutritive sweeteners, (b) D- Psicose, and (c) one or more nutritive sweeteners.
3. The frozen beverage according to claim 1 or claim 2 further comprising erythritol, D- Tagatose, or both erythritol and D- Tagatose.
4. The frozen beverage according to any one of claims 1-3, comprising D- Psicose in an amount of from 1 wt% to 10 wt% based on total weight of the frozen beverage,
5. The frozen beverage according to any one of claims 1-3, comprising D- Psicose in an amount of from 2 wt% to 5 wt% based on total weight of the frozen beverage.
6. The frozen beverage according to any one of claims 1-5, comprising the erythritol in an amount from 0.1 wt% to 4 wt% based on total weight of the frozen beverage and/or the D- tagatose in an amount from 0.1 wt% to 1 wt% based on total weight of the frozen beverage.
7. The frozen beverage according to any one of claims 1-6, wherein the non-nutritive sweeteners are selected from the group consisting of steviol glycosides, aspartame, acesulfame salts, saccharins, cyclamates, sucralose, alitame, neotame, glycyrrhizin, Lo Han Guo, neohesperidin dihydrochalcone, monatin, monellin, thaumatin and brazzein.
8. The frozen beverage according to any one of claims 1-6, wherein the non-nutritive sweeteners are selected from the group consisting of Rebaudioside A, Rebaudioside D, or Rebaudioside M.

9. The frozen beverage according to any one of claims 1-8, wherein the frozen beverage is a frozen carbonated beverage, a frozen soft drink, a frozen fruit juice, or a frozen fruit juice flavored beverage.
10. The frozen beverage according to any one of claims 1-9, wherein the frozen beverage is a cola or lemon-lime soft drink.
11. The beverage according to any one of claims 1 or 3-10 having a calorie content of less than 5 calories per 8 oz serving of the beverage or having a calorie content of less than 40 calories per 8 oz serving of the beverage.
12. The beverage according to any one of claims 2 and 4-11 wherein the nutritive sweetener is sucrose or high fructose corn syrup.
13. A method of making a zero- or low-calorie frozen carbonated beverage comprising the steps of: (1) combining (a) one or more non-nutritive sweeteners and (b) D-Psicose in a zero- or low-calorie frozen carbonated beverage syrup; (2) loading the zero- or low-calorie frozen carbonated beverage syrup into a dispensing machine; and (3) dispensing the zero- or low-calorie frozen carbonated beverage.
14. A method of making a reduced-calorie frozen carbonated beverage comprising the steps of: (1) combining (a) one or more non-nutritive sweeteners, (b) D-Psicose, and (c) one or more nutritive sweeteners in a reduced-calorie frozen carbonated beverage syrup; (2) loading the reduced-calorie frozen carbonated beverage syrup into a dispensing machine; and (3) dispensing the reduced-calorie frozen carbonated beverage.
15. The method according to claim 13 and claim 14, further comprising running the frozen carbonated beverage through the frozen carbonated beverage machine at least three times.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2014/059326

A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - A23L 1/236 (2014.01) CPC - A23G 9/045 (2014.10) 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) IPC(8) - A23L 1/236, 1/307, 2/38; A23G 9/06 (2014.01) CPC - A23G 3/346, 9/045, 9/52, 2200/06; A23L 1/236, 1/2363, 2/60 (2014.10) (keyword delimited)		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched USPC - 426/62, 477, 509, 548, 565, 569, 590, 658, 804 (keyword delimited)		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) Orbit, Google Patents, Google Scholar Search terms used: zero or low calorie, frozen, D-Psicose, fructose, aspartame, sweetener, D-Tagatose, erythritol, cola, dispenser, machine		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/0076908 A1 (FUJIHARA et al) 29 March 2012 (29.03.2012) entire document	1,2
Y		3, 13, 14
Y	US 7,579,032 B2 (LEE et al) 25 August 2009 (25.08.2009) entire document	3, 13, 14
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/>		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "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) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "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 "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 "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 "&" document member of the same patent family		
Date of the actual completion of the international search 10 December 2014		Date of mailing of the international search report 12 JAN 2015
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201		Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2014/059326

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claims Nos.: 4-12, 15
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

- Remark on Protest**
- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
 - The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
 - No protest accompanied the payment of additional search fees.

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权利要求书1页 说明书11页

(54)发明名称

零热量或低热量冷冻饮料中的D-阿洛酮糖

(57)摘要

将D-阿洛酮糖包括在零热量或低热量冷冻饮料中,以获得与全热量冷冻饮料基本上相似的白利糖度和口感。进一步发现了含有D-阿洛酮糖的组合物在冷冻饮料机中提供了改善的性能。因此本发明的各个方面和实施方案涉及D-阿洛酮糖在冷冻饮料中的使用。

1. 零热量或低热量冷冻饮料,其包含(a)一种或多种非营养性甜味剂和(b)D-阿洛酮糖。
2. 热量降低了的冷冻饮料,其包含(a)一种或多种非营养性甜味剂,(b)D-阿洛酮糖和(c)一种或多种营养性甜味剂。
3. 根据权利要求1或权利要求2的冷冻饮料,进一步包含赤藓糖醇、D-塔格糖,或赤藓糖醇和D-塔格糖两者。
4. 根据权利要求1-3任一项的冷冻饮料,其包含基于冷冻饮料总重计含量为1wt%至10wt%的D-阿洛酮糖。
5. 根据权利要求1-3任一项的冷冻饮料,其包含基于冷冻饮料总重计含量为2wt%至5wt%的D-阿洛酮糖。
6. 根据权利要求1-5任一项的冷冻饮料,其包含基于冷冻饮料总重计含量为0.1wt%至4wt%的赤藓糖醇和/或基于冷冻饮料总重计含量为0.1wt%至1wt%的D-塔格糖。
7. 根据权利要求1-6任一项的冷冻饮料,其中非营养性甜味剂选自甜菊醇糖苷、阿斯巴甜、乙酰磺胺酸盐、糖精、环己氨磺酸盐、三氯蔗糖、阿力甜、纽甜、甘草皂苷、罗汉果、新橙皮苷二氢查耳酮、莫纳甜、应乐果甜蛋白、奇异果甜蛋白和甜味蛋白。
8. 根据权利要求1-6任一项的冷冻饮料,其中非营养性甜味剂选自莱鲍迪苷A、莱鲍迪苷D或莱鲍迪苷M。
9. 根据权利要求1-8任一项的冷冻饮料,其中冷冻饮料是冷冻碳酸饮料、冷冻软饮料、冷冻果汁或冷冻果汁调味饮料。
10. 根据权利要求1-9任一项的冷冻饮料,其中冷冻饮料是可乐或柠檬-酸橙软饮料。
11. 根据权利要求1或3-10任一项的饮料,具有低于5卡路里/8oz份饮料的卡路里含量或具有低于40卡路里/8oz份饮料的卡路里含量。
12. 根据权利要求2和4-11任一项的饮料,其中营养性甜味剂是蔗糖或高果糖玉米糖浆。
13. 制备零热量或低热量冷冻碳酸饮料的方法,其包括下列步骤:(1)将(a)一种或多种非营养性甜味剂和(b)D-阿洛酮糖在零热量或低热量冷冻碳酸饮料糖浆中混合;(2)将零热量或低热量冷冻碳酸饮料糖浆添加到分配器中;和(3)分配零热量或低热量冷冻碳酸饮料。
14. 制备热量降低了的冷冻碳酸饮料的方法,其包括下列步骤:(1)将(a)一种或多种非营养性甜味剂、(b)D-阿洛酮糖和(c)一种或多种营养性甜味剂在热量降低了的冷冻碳酸饮料糖浆中混合;(2)将热量降低了的冷冻碳酸饮料糖浆添加到分配器中;和(3)分配热量降低了的冷冻碳酸饮料。
15. 根据权利要求13和权利要求14的方法,进一步包括将冷冻碳酸饮料通过冷冻碳酸饮料机运行至少三次。

零热量或低热量冷冻饮料中的D-阿洛酮糖

[0001] 相关申请的交叉参考

[0002] 本申请要求2013年10月22日提交的临时申请系列No.61/894,102的优先权,由此将其全部按引用并入。

发明领域

[0003] 本发明涉及D-阿洛酮糖在零热量、低热量和热量降低了的冷冻碳酸和非碳酸饮料中作为白利糖度和填充剂的用途。

[0004] 发明背景

[0005] 流行饮料之一是雪泥(slushes)和**SLURPEES**®。这些冷冻调制品依赖冰和饮料糖浆形成可饮用的冷冻饮料。这样的饮料可以是碳酸饮料或非碳酸饮料。

[0006] 为了良好的味道和顺滑的质地,冷冻饮料需要大量的溶质来稳定小的冰晶和保持二氧化碳。然而,由于糖是有热量的,其不适用于配制零热量或低热量冷冻饮料。已经进行了尝试来制备可接受的零热量或低热量冷冻饮料;然而,由于需要有效的用于零热量或低热量饮料的填充溶质,所以制备这样的冷冻饮料一直非常困难。

[0007] 使用赤藓糖醇和D-塔格糖的组合获得了一些进展,所述组合给冷冻碳酸饮料提供了所需的膨松性。这些是美国专利7,579,032、7,815,956、8,221,815和8,227,006的主题。这些文献中描述的产物在给饮料提供所需的蓬松性中是成功的,但与全热量(full calorie)冷冻碳酸饮料中~15的白利糖度相比,饮料的总白利糖度仍然低(~4.5白利糖度)。

[0008] 因此,希望提供零热量或低热量冷冻饮料和热量降低了的冷冻饮料,其不仅提供所需的膨松性,而且还提供与全热量对应物更接近的白利糖度。

[0009] 发明简述

[0010] 在一个方面中,零热量或低热量冷冻饮料包含(a)一种或多种非营养性甜味剂,和(b)D-阿洛酮糖。在进一步的方面中,该饮料进一步包含赤藓糖醇、D-塔格糖或赤藓糖醇和D-塔格糖两者。

[0011] 在另一个方面中,热量降低了的冷冻饮料包含(a)一种或多种非营养性甜味剂,(b)D-阿洛酮糖,和(c)一种或多种营养性甜味剂。在进一步的方面中,该饮料进一步包含赤藓糖醇、D-塔格糖或赤藓糖醇和D-塔格糖两者。

[0012] 在另一个方面中,制备零热量或低热量冷冻碳酸饮料的方法包括下列步骤:(1)将(a)至少一种非营养性甜味剂和(b)D-阿洛酮糖(和任选的赤藓糖醇和/或D-塔格糖)在零热量或低热量冷冻碳酸饮料糖浆中混合;(2)将零热量或低热量冷冻碳酸饮料糖浆添加到分配器中;和(3)分配零热量或低热量冷冻碳酸饮料。

[0013] 在另一个方面中,制备热量降低了的冷冻碳酸饮料的方法包括下列步骤:(1)将(a)至少一种非营养性甜味剂,(b)D-阿洛酮糖和(c)营养性甜味剂(和任选的赤藓糖醇和/或D-塔格糖)在热量降低了的冷冻碳酸饮料糖浆中混合;(2)将热量降低了的冷冻碳酸饮料糖浆添加到分配器中;和(3)分配热量降低了的冷冻碳酸饮料。

[0014] 发明详述

[0015] 发现了D-阿洛酮糖可以给零热量或低热量冷冻饮料以及热量降低了的饮料同时增加白利糖度和膨松性。进一步发现了含有D-阿洛酮糖的组合物在冷冻饮料机中提供了改善的性能。因此,本发明的各个方面和实施方案涉及D-阿洛酮糖在冷冻饮料中的用途。

[0016] 鉴于本发明公开内容的益处,本文公开的本发明主题的各个实施例和实施方案是可能的并且是本领域普通技术人员显而易见的。如本发明公开内容中使用的,短语“某些实施方案”、“某些示例性实施方案”、“示例性实施方案”和相似短语表示那些实施方案只是本发明主题的非限制性实例并且不排除备选的或不同的实施方案。除非另外指出或除非另外从描述的内容中清楚看出,否则以下实施方案和实施例以及以上概述中的备选元素或特征可以彼此互换。即,一个实施例或实施方案中描述的元素可以换成或替代另一个实施例中描述的一个或多个相应的元素。相似地,结合某些实施方案或实施例公开的任选或非必需特征应当明白为是为了用于所公开主题的其他实施方案或实施例的任一个中而公开的。一般而言,实施例和示例性实施方案的元素应当明白为是为了与本文中公开的设备和方法的其他方面、实施方案和实施例一起使用而概括地公开的。关于可操作的组分或成分,即能够执行一个或多个功能、任务和/或操作等,旨在表示其可以执行至少某些实施方案中特意描述的功能、任务和/或操作,并且有可能可操作地也执行其他的一个或多个其他功能、任务和/或操作。

[0017] 尽管本发明公开内容包括特定的实施例,包括本发明优选的方式或实施方案,但是本领域技术人员将认识到在所附权利要求列出的本发明的精神和范围内存在无数变化和改变。权利要求中使用的每个单词和短语旨在包括与其在本发明公开内容中的使用一致和/或与其在任何相关技术领域中的技术和工业使用一致的所有字典含义。应当明白术语“约”用于整个发明公开内容和所附权利要求中说明平常的误差和可变性,如在测量、测试等,产品生产等中的误差和可变性。

[0018] 如本发明公开内容中使用的,除非另外指出,术语“添加的”或“组合的”等术语表示提及的多种成分或组分(例如,油、乳化剂、防腐剂等)以任何方式和任何顺序组合,使用或未用搅拌等,使用或未用加热等。例如,可以将一种或多种成分溶解于一种或多种其他成分中,或一起喷雾等。如本文使用的,溶液可以是真实的溶液、浆液、悬浮液或液体或可流动材料的其他形式。在某些实施方案中,例如,可以将所述材料组合形成均匀的溶液。本发明的某些方面涉及搅拌本文中所述的液体、饮料、饮料产品和各种其他组分。如本文中使用的术语“混合”包括,但不限于,搅打、混和、搅拌、高剪切搅拌、低剪切搅拌、搅打、折叠、超声波处理、过筛、做成泥等。

[0019] 本领域普通技术人员将理解在某些情况下,为了方便,本文(包括所附权利要求)通过提及所述产品的工业名称或在配制或生产所述饮料或其他食品中使用的成分的初始形式来提及或描述一些成分。这样的成分的初始形式可能不同于在最终饮料产品中发现的成分的形式。例如,可以以食品的生产过程中最初添加的形式来提及所述成分,而不是通过最终食品中具有的形式,如溶解或分散的形式或作为与在最终食品中(或在生产最终食品过程中的中间产物中)的一种或多种其他成分的反应产物或复合物。因此,例如,在根据本发明的饮料产品的某些示例性实施方案中,蔗糖和液体蔗糖通常将会基本上均匀地溶解和分散于可食用产品中。同样,其他确定为固体、浓缩物(例如,汁液浓缩物)的其他成分等通

常将会均匀地分散于整个饮料或整个饮料浓缩物中,而不是保持其初始形式。作为另一个实例,描述为盐的成分可以以溶解形式存在于饮料中。因此,关于饮料产品配方的成分的形式不应当作为对饮料产品中的成分的形式限制,而是作为将成分描述为产品配方的分离组分的便利方式。

[0020] 本发明的某些方面涉及溶液的“浓度”,其用来表示给定量的溶剂或溶液中的溶质的量。存在许多方式来表述浓度。例如,可以以每单位体积的单位质量(例如,mg/mL,mg/cm³等),质量百分比(其简单地是将溶质质量除以溶液的总质量,再乘以100%(例如,重量百分比,百分比重量,wt.百分比,wt.%,w/w等)),体积百分比(其简单地是将溶质体积除以其他组分的体积总和,再乘以100%(例如,体积百分比,百分比体积,v/v等)),摩尔浓度(其是溶解于一升溶液中的溶质摩尔数),重量摩尔浓度(其是溶解于一千克溶剂中的溶质摩尔数)和百万分之几(每升的毫克数)来限定浓度。

[0021] 如本文中使用的,“味道”是指甜味感知,甜味感知的瞬时效应,即,开始和持续时间,异味,例如,苦味和金属味,残留感知(回味)和触觉感知,例如,形体和厚度的组合。

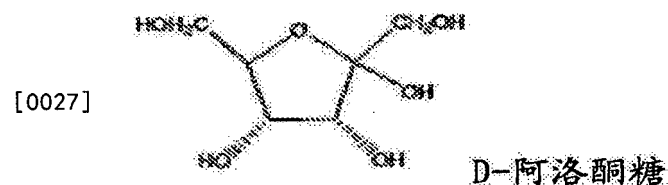
[0022] 本发明的各个方面涉及D-阿洛酮糖提高零热量或低热量冷冻饮料中的白利糖度的用途。D-阿洛酮糖是一种无热量的单糖。因为其不给饮料组合物提供额外的热量,因此D-阿洛酮糖是理想的。就零热量或低热量冷冻饮料概括地论述了本发明,尽管本发明还涉及热量降低了的饮料,但是其含有高于低热量饮料中通常使用量的营养性甜味剂。

[0023] 零热量和低热量冷冻饮料中所需的白利糖度通常为1至15,优选或10至15。

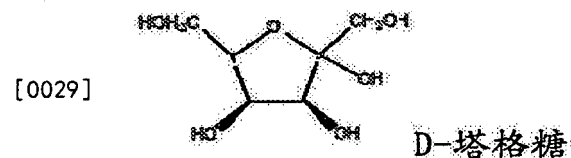
[0024] D-阿洛酮糖和D-塔格糖是D-果糖的立体异构体:



[0026] D-果糖具有1.5x的甜味强度,提供4cal/g,并且是FDA批准的。



[0028] D-阿洛酮糖具有0.6x的甜味强度,提供0.2cal/g,并且在饮料最大2.1%下是GRASed。



[0030] D-塔格糖具有0.9x的甜味强度,提供1.5cal/g,并且在饮料最大1%下是GRASed。

[0031] D-阿洛酮糖提供可以成功地用于冷冻饮料机中的零热量或低热量冷冻饮料组合物。即,可以性能更可靠地且需要较少维护地使用冷冻饮料机来制备冷冻饮料。

[0032] 例如,D-阿洛酮糖目前是具有2.1wt%最大水平是GRASed。在零热量或低热量冷冻

饮料组合物中包含2.1%D-阿洛酮糖可以将冷冻组合物的总白利糖度水平提高至6.6%白利糖度,而没有增加更多热量。白利糖度的提高允许冷冻饮机更可靠地工作,并且需要较少维护。

[0033] 添加到冷冻饮料组合物中的D-阿洛酮糖的量部分取决于非营养性甜味剂以及组合物中是否存在赤藓糖醇或D-塔格糖。通常,将D-阿洛酮糖以基于最终冷冻饮料的总重1wt%至10wt%或2wt%至5wt%的量添加到组合物中。

[0034] D-阿洛酮糖可以单独使用或与赤藓糖醇、D-塔格糖或两者一起使用。赤藓糖醇通常以基于最终冷冻饮料的总重0.1wt%至4wt%或2wt%至3.5wt%的量添加到冷冻饮料组合物中。D-塔格糖通常以基于最终冷冻饮料的总重0.1wt%至1.0wt%或0.3wt%至0.6wt%的量添加到冷冻饮料组合物中。

[0035] 根据本发明各个方面的冷冻碳酸饮料可以直接制成即饮冷冻饮料或制成放在冷冻饮料机中的糖浆。例如,D-阿洛酮糖可以边搅拌边添加到加甜或未加甜的基料中,以获得一些或完全溶解。

[0036] 为了从浓缩糖浆制备含有D-阿洛酮糖的冷冻饮料,可以用水稀释预先制得的糖浆,例如,以1份糖浆加5份水,以产生饮料混合物。可以将饮料混合物倒入冷冻饮料装置(例如,Taylor 428或430冷冻饮料装置或Ultra I或Ultra II冷冻饮料装置)的料斗中,以产生和分配冷冻饮料。或者,可以将水和糖浆在分配点混和。任选地,可以通过添加调味糖浆,在分配后给冷冻饮料调味。

[0037] 其他类型的冷冻饮料机包括冷冻碳酸饮料机(任选地在本文中称为“FCB”分配器),其配置成在降低的温度下容纳糖浆并将碳酸水添加到糖浆中,以及在饮用时分配即饮冷冻碳酸饮料。合适的FCB分配器是本领域技术人员已知的,并且包括,例如,Cornelius V3型和较新版本,可从IMI Cornelius,Inc.获得,IMI plc的子公司。

[0038] 例如,可以通过边搅拌边将D-阿洛酮糖添加到加甜或未加甜的碳酸软饮料(“CSD”)基料(例如,可乐CSD基料或柠檬-酸橙CSD基料)或其他饮料基料中,获得一些或完全溶解,从而制备用于冷冻碳酸饮料的饮料糖浆。在任何合适的点,例如,添加其他成分(如甜味剂、酸化剂和防腐剂)之前或之后,添加D-阿洛酮糖,使用搅拌,使得部分或完全溶解。可以将所得到的糖浆添加到冷冻碳酸饮料机(“FCB”分配器)中,其配置成在分配最终即饮冷冻碳酸饮料产品之前或之时,将碳酸水添加到糖浆中。最终冷冻碳酸饮料的即饮产品应当具有良好的二氧化碳膨胀率、顺滑、奶油状口感和良好的味道特征。任选地,冷冻碳酸饮料糖浆可以接连地通过FCB分配器运行,以获得始终高品质的最终冷冻碳酸饮料的即饮产品。

[0039] 根据本发明各个方面的冷冻饮料组合物含有D-阿洛酮糖和其他合适的成分,以形成冷冻饮料组合物,所述其他合适的成分如,但不限于,水、营养性和非营养性(天然或人造)甜味剂、调味剂、酸化剂和防腐剂。热量降低了的饮料可以使用高于零热量或低热量饮料量的营养性甜味剂来制备。

[0040] 术语“营养性甜味剂”通常是指在常用量下提供显著热量的甜味剂,例如,每8oz.份饮料超过约5卡路里。如本文中使用的,“非营养性甜味剂”是在常用量下不提供显著热量的甜味剂,即,为了获得10白利糖度糖的甜度当量,每8oz.份饮料给予低于5卡路里的甜味剂。

[0041] 如本文中使用的,“全热量”饮料配方是完全用营养性甜味剂加甜的饮料配方。如本文中使用的,“热量降低了的饮料”意思是与全热量形式(通常是之前商业化的全热量形式)相比,每8oz.份饮料热量降低至少25%的饮料。在至少某些实施方案中,与全热量形式相比,热量降低了的饮料每8oz.份降低至少50%热量。如本文中使用的,“低热量饮料”每8oz.份饮料具有低于40卡路里。如本文中使用的,“零热量饮料”或“减肥饮料”表示每份(例如,每8oz.)饮料具有低于5卡路里。

[0042] 如本文中使用的,“强效甜味剂”意思是甜度为糖的至少两倍的甜味剂,即,为了获得相等甜度,基于重量需要不超过糖重量一半的甜味剂。例如,强效甜味剂需要少于糖的一半重量来获得用糖加甜至10度白利糖度的水平的饮料中相等的甜度。强效甜味剂包括营养性(例如,罗汉果汁浓缩物)和非营养性甜味剂(例如,通常,罗汉果粉)。此外,强效甜味剂包括天然强效甜味剂(例如,甜菊醇糖苷、罗汉果等)和人造强效甜味剂(例如,纽甜等)。然而,对于本文中公开的天然饮料产品,只使用天然强效甜味剂。

[0043] 适用于本发明的非营养性甜味剂包括,不限于,基于肽的甜味剂,例如,阿斯巴甜、纽甜和阿力甜,以及非基于肽的甜味剂,例如,糖精钠、糖精钙、乙酰磺胺酸钾、环己氨基磺酸钠、环己氨基磺酸钙、新橙皮苷二氢查耳酮和三氯蔗糖。适用于至少某些实施方案中的作为D-阿洛酮糖的补充甜味剂的天然非营养性甜味剂包括,例如,其他甜菊醇糖苷(例如,甜菊苷、甜菊双糖苷、杜克苷A、莱鲍迪苷A、莱鲍迪苷B、莱鲍迪苷C、莱鲍迪苷D、莱鲍迪苷E、莱鲍迪苷M,其任意混合物等)、罗汉果和相关化合物。其他甜味剂包括甘草皂苷、新橙皮苷二氢查耳酮、莫纳甜、奇异果甜蛋白、应乐果甜蛋白、甜味蛋白、L-丙氨酸、甘氨酸、hernandulcin、叶甜素、三叶苷,或其任意两种或多种的组合。

[0044] 甜菊醇糖苷包括莱鲍迪苷,例如,莱鲍迪苷A、莱鲍迪苷D、莱鲍迪苷M、甜菊糖、甜菊双糖苷、杜克苷A,或其任意两种或多种的混合物,可以结合D-阿洛酮糖用于本文中公开的零热量或低热量冷冻饮料产品中的加甜。这些化合物可以合成产生(例如,通过化学或通过遗传修饰的生物体的发酵等)或通过提取等从甜菊植物获得(例如,通过提取,接着酶转化)。甜菊(例如, *Stevia rebaudiana* Bertoni)是商业上栽培的甜味植物。叶子含有天然甜味双萜糖苷的复合混合物。甜菊醇糖苷和莱鲍迪苷是甜菊引起各种程度的甜味的组分。A、莱鲍迪苷B、莱鲍迪苷C、莱鲍迪苷D、莱鲍迪苷E、甜菊苷。

[0045] 用于制备某些莱鲍迪苷(包括,例如,莱鲍迪苷D、莱鲍迪苷M等)的方法显示于2012年12月10日由Su Zhou Jing Hong Biotech Co.,Ltd.(吴江,江苏省,中国)提交的PCT专利申请No.104002121和2011年12月22日提交的相应的美国临时专利申请No.61/579,016中,将其完整内容按引用并入本文中。

[0046] 本领域普通技术人员将容易地认识到可以使用非营养性甜味剂或以不同比例组合,以形成适用于本发明中的非营养性甜味剂混合物。非营养性甜味剂的精确比例取决于给定混合物中使用的甜味剂的组合和针对给定应用所需的整体甜度。合适的比例可以通过本领域普通技术人员容易地确定。本领域普通技术人员还将容易地认识到最终冷冻饮料中的非营养性甜味剂的量将根据各种因素而改变,所述因素如针对给定应用所需的整体甜度。合适的量可以通过本领域普通技术人员容易地确定。

[0047] 另外可以在饮料中包括D-阿洛酮糖和至少一种营养性甜味剂的组合,以获得良好味道的热量降低了的冷冻饮料。任何营养性甜味剂都适用;如本文中使用的,“营养性”甜味

剂是在常用量下提供显著热量的甜味剂,即,每份(对于饮料为8oz.)超过约1卡路里。这样的甜味剂包括,不限于,果糖、蔗糖、右旋糖、麦芽糖、海藻糖、鼠李糖、玉米糖浆(高果糖玉米糖浆)和低聚果糖。

[0048] 应当明白根据本发明的组合物和饮料可以具有各种不同特定配方或组成中的任何一种。配方可以根据如产品计划的市场分割、所需的营养特征、风味特征等这样的因素而改变。调味剂、电解质、维生素、果汁或其他水果产品、呈味剂、掩蔽剂等、风味增强剂和/或碳酸化,通常可以添加到任何这样的配方中,以改变味道、口感、营养特征等。

[0049] 通常,根据本发明的冷冻饮料产品通常至少包含水、D-阿洛酮糖、酸化剂和调味剂。适用于根据本发明的至少某些配方的示例性调味剂包括可乐调味剂、柑橘类调味剂、香辛调味剂等。为了起泡,可以增加二氧化碳形式的碳酸化。根据其他成分、生产技术、所需的货架期等,如果需要,可以添加防腐剂。任选地,可以添加咖啡因。本文公开的饮料的某些示例性实施方案是可乐味的碳酸饮料,特征性地含有碳酸水、甜味剂、可乐坚果提取物和/或其他调味剂、焦糖色素、至少一种酸和任选的其他成分。鉴于本发明公开内容的益处,其他和备选的合适成分将是本领域技术人员可知的。

[0050] 在本发明的冷冻饮料中,可以包括通常在这样的饮料中发现的其他成分。这样的其他成分包括,不限于,可溶性低热量纤维,如聚右旋糖、Fibersol^g或阿拉伯半乳聚糖、壳聚糖、几丁质、黄原胶、果胶、纤维素、魔芋、阿拉伯树胶、改性淀粉、大豆纤维、菊粉、菊糖(inulose)、水解瓜尔豆胶、瓜尔豆胶、 β -葡聚糖、卡拉胶、刺槐豆胶、海藻酸盐、聚乙二醇海藻酸盐、泡沫稳定剂(如丝兰或丝兰/皂树)提取物)、盐(如氯化钠、氯化钙和氯化钾)、食品级表面活性剂,如甘油一酸酯、甘油二酯、卵磷脂及其级分,和合成的表面活性剂,如Tween、RTM、Spans、RTM、二乙酰酒石酸酯、柠檬酸酯等。

[0051] 本文公开的饮料产品的天然实施方案是天然的,因为它们不含任何人造或合成的(包括任何颜色添加剂,与来源无关)通常不会预期在食品中的成分。因此,如本文中使用的,根据以下准则来限定“天然”饮料组合物:用于天然成分的原料存在于自然界或源于自然界。可以使用涉及发酵的生物合成和酶,但不利用使用化学试剂的合成。人造色素、防腐剂和香精不认为是天然成分。成分可以通过特定的专业技术加工或纯化,所述技术至少包括:物理加工、发酵和酶解。合适的加工和纯化技术至少包括:吸收、吸附、聚集、离心、破碎、烹调(烘焙、油炸、煮沸、烧烤)、冷却、切割、色谱、涂层、结晶、消化、干燥(喷雾、冷冻干燥、真空)、蒸发、蒸馏、电解、乳化、包胶、提取、挤出、过滤、发酵、研磨、灌注、浸渍、微生物(凝乳酶、酶)、混和、剥皮、渗滤、冷藏/冷冻、挤压、浸泡、洗涤、加热、混和、离子交换、冻干、渗透、沉淀、盐析、升华、超声波处理、浓缩、絮凝、均质、重建、酶解(使用自然界中发现的酶)。加工助剂(目前限定为为了增强食品组分的吸引力或实用性而用作制造助剂的物质,包括澄清剂、催化剂、絮凝剂、过滤助剂和结晶抑制剂等。参见21CFR§170.3(o)(24))认为是附带的添加剂并且如果合适地除去则可以使用。

[0052] 本文中公开的饮料产品的基本上清澈的实施方案是基本上清澈的,因为饮料基本上没有浊度并且基本上没有颜色。

[0053] 水是本文中公开的产品中的基础成分,通常是其中提供D-阿洛酮糖的载体或主要的液体部分,并且饮料产品中的剩余成分在其中溶解、乳化、悬浮或分散。纯水可以用于本文公开的饮料产品的某些实施方案的制造中,并且可以使用标准饮料质量的水,使得不会

不利地影响饮料味道、气味或外观。基于生产饮料时适用的工业和政府标准,水通常是清澈的、无色的、无可观察到的矿物质、味道和气味、无有机物质、弱碱性和可接受的微生物质量。在饮料产品的某些典型实施方案中,水以约80%至约99.9%饮料重量的水平存在。在至少某些示例性实施方案中,本文中公开的饮料和浓缩物中使用的水是“处理过的水”,这指的是在任意的补充(例如,美国专利no.7,052,725中公开的补充钙)之前已经进行过处理以降低水的总溶解固体的水。产生处理过的水的方法是本领域普通技术人员已知的,并且其中包括去离子、蒸馏、过滤和反向渗透(“r-o”)。术语“处理过的水”、“净化水”、“去矿物质的水”、“蒸馏水”和“r-o水”在本发明讨论中通常理解为同义的,指的是已经从其中基本上除去了所有矿物质内含物的水,通常含有不超过约500ppm总溶解固体,例如,250ppm总溶解固体。

[0054] 如以上讨论的,在本文公开的饮料产品的至少某些示例性实施方案中,适用于与D-阿洛酮糖组合的甜味剂包括天然营养性甜味剂、天然非营养性强效甜味剂和人造甜味剂。此外,在本文公开的饮料产品的至少某些示例性实施方案中,将一种或多种天然营养性甜味剂、一种或多种人造甜味剂和/或一种或多种天然非营养性强效甜味剂的组合用于提供甜度以及所需味道特征和营养特征的其他方面。还应当认识到特定的这样的甜味剂,另外地或替代地,在本文公开的饮料的不同实施方案中,例如,当在所讨论的饮料中以低于它的(或它们的)甜味感知阈值的量使用时,将作为呈味剂、掩蔽剂等。

[0055] 本文中公开的饮料产品的配方中包括的甜味剂,包括适用于食用和用于饮料中的可食用消费品。“可食用消费品”表示用于人或动物食用的饮料或饮料的成分。本文和权利要求中使用的甜味剂或增甜剂可以是营养性的或非营养性的,天然或合成的饮料成分或添加剂(或其混合物),其给饮料提供甜味,即,通过味觉感知其是甜的。调味剂和增甜剂的感知可能一定程度上取决于元素的相互关系。风味和甜味也可以分开感知,即,风味和甜味感知可能既彼此依赖,又彼此独立。例如,当使用大量调味剂时,少量增甜剂可以容易地感知,反之亦然。因此,调味剂和增甜剂之间的口腔和嗅觉相互作用可能涉及到元素的相互关系。

[0056] pH是溶液酸度或碱度的量度。如本文中使用的,术语“低pH”是指低于pH6的酸性pH,如约1至约6的范围中。本文公开的饮料的某些示例性实施方案(例如,可乐饮料产品)具有约2.0至5.0范围,或约2.5至4.0范围,或约2.8至3.3范围或约3.0至3.2范围的pH。如本文中使用的,术语“高pH”是指约8至约14范围中的碱性pH。如本文中使用的,术语“中性pH”是指约7的pH(例如,约6.0至8.0,或在约6.5至约7.5的范围中)。本文公开的饮料的某些示例性实施方案具有高pH,例如,约pH8至14范围中的pH。本文公开的饮料产品的某些示例性实施方案具有中性pH,例如,约pH6至pH8范围或约pH6.5至7.5范围的pH。

[0057] 将包含至少一种食用酸的酸化剂用于本文中公开的饮料产品的某些实施方案中,并且可以起到几个功能中的任何一个或多个,包括,例如,给饮料的味道提供酸味、增强适口性、提高解渴作用、修饰甜味和作为温和防腐剂。合适的酸是已知的并且将是本领域技术人员鉴于本发明公开内容的益处而显而易见的。适用于本文公开的饮料产品的一些或全部实施方案中的示例性酸包括磷酸、柠檬酸、苹果酸、酒石酸、乳酸、富马酸、抗坏血酸、葡糖酸、琥珀酸、马来酸、己二酸、肉桂酸、戊二酸,及其任意的混合物。通常,酸是磷酸、柠檬酸、苹果酸,或其任意组合,如,例如,磷酸和柠檬酸。在包含天然饮料产品(例如,天然可乐饮料产品)的实施方案中,酸可以选自例如柠檬酸、苹果酸、酒石酸、甲酸、葡糖酸、乳酸、富马酸、

己二酸、琥珀酸、马来酸、肉桂酸、戊二酸及其任意混合物。例如,在某些实施方案中,酸包含乳酸、酒石酸和柠檬酸,或酸基本上由乳酸、酒石酸和柠檬酸组成,并且在某些实施方案中,酸包含乳酸以及酒石酸和柠檬酸中的至少一种或酸基本上由乳酸以及酒石酸和柠檬酸中的至少一种组成。

[0058] 可滴定的酸度是饮料产品的总酸度的指示。可滴定酸度测量中和给定体积的饮料的酸需要的碱的量。可滴定酸度是将100ml饮料滴定至pH8.75终点需要的0.1N NaOH的毫升数,所述pH用电位计测量。本文公开的饮料产品(例如,可乐饮料产品)的某些实施方案和至少一种酸的可滴定酸度通常为约8.75至约12.5,或约9至约11。合适的可滴定酸度包括,例如,约9、9.25、9.5、9.75、10、10.25或10.9。

[0059] 例如,酸可以以溶液形式来使用,并且以足以提供所述饮料pH的量来使用。选择的特定的一种或多种酸和使用的量将部分取决于其他成分、所需的饮料产品货架期以及对饮料pH、可滴定酸度和味道的作用。通常,例如,酸化剂中的一种或多种酸以总地约0.01%至约1.0%饮料重量的量来使用,例如,约0.01%至约0.5%重量,约0.05%至约0.5%重量,约0.05至约0.25%重量,约0.1%至约0.25%重量,这取决于饮料产品(例如,可乐饮料产品)所用的酸化剂、所需的pH、所用的其他成分等。本文公开的饮料的至少某些示例性实施方案的pH可以在约2.0至5.0,约2.5至4.0,约2.8至3.3或约3.0至3.2范围内的值,例如,3.1。某些示例性实施方案中的酸增强了饮料风味。太多的酸会影响饮料风味,并导致酸味或其他异味,而太少的酸会使得饮料淡而无味。

[0060] 本领域技术人员鉴于本发明公开内容的益处将认识到当制备含有甜味剂(如基于肽的人造甜味剂,如阿斯巴甜)的饮料产品时,所得到的饮料组合物最好维持在合适的pH。具体地,针对阿斯巴甜的pH/稳定性曲线是钟形曲线,pH4.2通常提供最佳稳定性或货架期。更具体地,通常发现这样的pH值最佳地保留了人造甜味剂的增甜作用。

[0061] 在补充钙的饮料的形成中,一种或多种钙盐的存在可能需要额外的酸来帮助盐的溶解和维持人造甜味剂稳定性所需的pH。饮料组合物中额外的酸的存在,提高了组合物的可滴定酸度,将导致所得到的饮料更酸(tart或sour)的味道。鉴于本发明公开内容的益处,选择用于本文公开的饮料产品的某些实施方案的任一个的酸化剂的合适酸或酸的组合以及这样的酸组分的量将在本领域技术人员的能力范围之内。

[0062] 本文公开的饮料产品的某些示例性实施方案还可以含有少量的碱剂,例如,用于调节pH或用于其他目的。这样的试剂包括,例如,柠檬酸钾和柠檬酸钠。例如,碱剂氢氧化钾可以以约0.005wt.%至约0.02wt.%(饮料的重量)的量来使用,对于某些饮料通常为约0.01%的量。该量当然将取决于碱剂的类型和待调节的pH的程度。

[0063] 本文公开的饮料产品任选地含有香精组合物,例如,天然和合成的水果香精、植物香精、其他香精及其混合物。如本文中使用的,术语“水果香精”通常是指源自种子植物可食繁殖部分的那些香精。包括其中甜果肉与种子相连的那些,例如,香蕉、西红柿、酸果蔓等,和具有小的肉质浆果的那些。在此还将术语浆果用于包括聚合果,即,不是“真实的”浆果,但通常认为是浆果。术语“水果香精”内还包括合成制得以模拟源自天然来源的水果香精的香精。合适的水果或浆果来源的实例包括完整的浆果或其一部分、浆果汁、浆果汁浓缩物、浆果泥及其混合物、干的浆果粉、干的浆果果汁粉等。

[0064] 示例性水果香精包括柑桔类水果香精,例如,橙子、柠檬、酸橙、葡萄柚、橘子、柑

桔、橘柚和柚子,以及如苹果、葡萄、樱桃和菠萝香精等的香精,及其混合物。在某些示例性实施方案中,饮料浓缩物和饮料包含水果香精成分,例如,果汁浓缩物或果汁。如本文使用的,术语“植物香精”指的是源自水果以外的植物部分的香精。因此,植物香精可以包括源自精油和坚果、树皮、根和叶子的提取物的那些香精。术语“植物香精”内还包括合成制得以模拟源自天然来源的植物香精的香精。这样的香精的实例包括可乐香精、茶香精等,及其混合物。香精成分可以进一步包含上述香精的混合物。在饮料浓缩物和饮料的某些示例性实施方案中,使用可乐香精成分或茶香精成分。用于将香味特征给予本发明饮料产品的香精成分的特定量将取决于所选的香精、所需的香味印象和香精成分的形式。鉴于本发明公开内容的益处,本领域技术人员将容易地确定用于获得所需香味印象的任何特定香精成分的量。

[0065] 适用于本文公开的饮料产品的至少某些示例性实施方案的汁液包括,例如,果汁、蔬菜汁和浆果汁。汁液可以以浓缩物、果泥、一倍强度汁液或其他合适的形式用于本发明中。如在此所用的术语“汁液”包括一倍强度果汁、浆果汁或蔬菜汁,以及浓缩物、泥、奶和其他形式。可以将多种不同的水果、蔬菜和/或浆果汁混合,任选地与其他调味剂一起,以产生具有所需风味的饮料。合适的汁液来源的实例包括李子、洋李子、枣、黑醋栗、无花果、葡萄、葡萄干、酸果蔓、菠萝、桃子、香蕉、苹果、梨子、番石榴、杏、萨斯卡通莓、蓝莓、plains莓、prairie莓、桑葚、接骨木、西印度樱桃(阿西罗拉樱桃)、野樱桃、枣、椰子、橄榄、树莓、草莓、越橘、罗甘莓、黑醋栗、露莓、波森莓、奇异果、樱桃、黑莓、温梓、鼠李、西番莲果、黑刺李、欧洲花楸、醋栗、腰果苹果、石榴、柿子、芒果、大黄、番木瓜、荔枝、柠檬、橙子、酸橙、橘子、桔子和葡萄柚等。鉴于本发明公开内容的益处,本领域技术人员将清楚适用于至少某些示例性实施方案的各种其他和替换的汁液。在本发明使用汁液的饮料中,例如,可以以至少约0.2%饮料重量的水平来使用汁液。在某些示例性实施方案中,以约0.2%至约40%饮料重量的水平来使用汁液。通常,如果有,以约1%至约20%重量的量来使用汁液。

[0066] 某些这样的颜色较浅的汁液可以包括在某些示例性实施方案的配制中以调节香味和/或提高饮料的汁液含量而不使饮料颜色变暗。这样的汁液实例包括苹果、梨、菠萝、桃、柠檬、酸橙、橙子、杏、葡萄柚、橘子、大黄、黑醋栗、温柏、西番莲果、番木瓜果、芒果、番石榴、荔枝、猕猴桃、柑橘、椰子和香蕉。如果需要可以使用去香味的和脱色的汁液。

[0067] 适用于本文公开的饮料产品的至少某些示例性实施方案中的其他调味剂包括,例如,香辛调味剂,如桂皮、丁香、肉桂、胡椒、生姜、香草香辛调味剂、小豆蔻、芫荽、根汁汽水、橡木、人参等。鉴于本发明公开内容的益处,本领域技术人员将清楚适用于至少某些示例性实施方案的多种附加和备选调味剂。调味剂可以是提取物、油性树脂、汁液浓缩物、bottler's base的形式或其他本领域已知的形式。在至少某些示例性实施方案中,这些香辛料或其他香精补充了汁液或汁液组合。

[0068] 一种或多种调味剂可以以乳液形式来使用。可以通过将一些或全部调味剂与乳化剂,混合在一起来制备调味剂乳液,任选地与饮料的其他成分混合在一起。可以与调味剂混合的同时或之后添加乳化剂。在某些示例性实施方案中,乳化剂是水溶性的。示例性的合适乳化剂包括阿拉伯树胶、改性淀粉、羧甲基纤维素、黄芪胶、茄替胶和其他合适的树胶。鉴于本发明公开内容的益处,其他合适的乳化剂是本领域技术人员显而易见的。示例性实施方案中的乳化剂包含高于约3%的调味剂和乳化剂的混合物。在某些示例性实施方案中,乳化

剂为混合物的约5%至约30%。

[0069] 二氧化碳用于给本文公开的饮料的某些示例性实施方案提供起泡。可以使用本领域中已知的用于碳酸化饮料的任何技术和碳酸化设备。二氧化碳可以增强饮料味道和外观,并通过抑制和破坏令人讨厌的细菌而有助于维护饮料纯度。在某些实施方案中,例如,饮料具有高约4.0体积二氧化碳的CO₂水平。例如,典型的实施方案可以具有约0.5至5.0体积的二氧化碳。如本文和独立权利要求中使用的,将一体积二氧化碳限定为在60°F(16°C)温度和大气压下由任何给定量的水吸收的二氧化碳的量。气体的体积占据与吸收其的水相同的空间。可以基于所需的起泡水平和二氧化碳对饮料味道或口感的影响由本领域技术人员来选择二氧化碳的量。碳酸化可以是天然或合成的。

[0070] 任选地,可以将咖啡因添加到本文公开的饮料产品的各种实施方案中。添加的咖啡因的量由所需的饮料特性、饮料待销售国家的任何适用的监管规定等来决定。在某些示例性实施方案中,以0.02%或更低饮料重量的水平来包括咖啡因。咖啡因必须是用于食品和饮料中可接受纯度的。咖啡因可以是天然或合成来源的。

[0071] 本文公开的冷冻饮料组合体可以含有与D-阿洛酮糖相容的附加成分,一般包括饮料配方中通常发现的那些。例如,这些附加成分通常可以添加到稳定的饮料浓缩物中。这些附加成分的实例包括,但不限于,咖啡因、焦糖和其他着色剂或染料、消泡剂、树胶、乳化剂、茶固体、起云剂,以及矿物质和非矿物质营养补充剂。非矿物质营养补充成分的实例是本领域普通技术人员已知的,并且包括,例如,抗氧化剂和维生素,包括维生素A、D、E(生育酚)、C(抗坏血酸)、B(硫胺素)、B₂(核黄素)、B₆、B₁₂和K、烟酸、叶酸、生物素,及其组合。任选的非矿物质营养补充剂通常以依据良好的制造实践通常可接受的量存在。示例性的量为约1%至约100%RDV(推荐日值),其中这样的RDV是确定的。在某些示例性实施方案中,非矿物质营养补充剂成分以约5%至约20%RDV存在,其中RDV是确定的。

[0072] 防腐剂可以用于本文公开的冷冻饮料产品的至少某些实施方案中。即,至少某些示例性实施方案含有任选的防腐剂系统。例如,具有低于4的pH的溶液,尤其是低于3的那些,通常是“微生物稳定的”,即,它们抵抗微生物的生长,并且因此在食用前适于长期存储,而不需要更多的防腐剂。然而,如果需要,可以使用其他的防腐剂系统。如果使用防腐剂系统,可以在生产过程中的任何合适时间将其添加到饮料产品中,例如,在一些情况下,在添加d-阿洛酮糖之前。如本文使用的,术语“防腐剂系统”或“防腐剂”包括所有批准用于食品和饮料组合体中的合适防腐剂,包括但不限于,这些已知的化学防腐剂,如苯甲酸盐(例如,苯甲酸钠、苯甲酸钙和苯甲酸钾)、山梨酸盐(例如,山梨酸钠、山梨酸钙和山梨酸钾)、柠檬酸盐(例如,柠檬酸钠和柠檬酸钾)、多磷酸盐(例如,六偏磷酸钠(SHMP))及其混合物,以及抗氧化剂,如抗坏血酸、EDTA、BHA、BHT、TBHQ、脱氢乙酸、二甲基二羧酸酯、促长啉、对羟基苯甲酸庚酯,及其任意组合。可以依据适用的法律和法规,以不超过标准最大水平的量来使用防腐剂。通常根据计划的最终产品pH以及特定饮料配方的微生物腐败可能的评价来调节所用的防腐剂水平。所用的最大水平通常为约0.05%饮料重量。鉴于本发明公开内容的益处,选择合适的防腐剂或防腐剂组合用于根据本发明公开内容的饮料在本领域技术人员的能力范围内。

[0073] 适用于本文公开的饮料产品(例如,可乐饮料产品)的至少某些示例性实施方案的食品或饮料的其他防腐方法包括,例如,无菌包装和/或热处理或热加工步骤,如热灌装和

隧道巴氏杀菌。这些步骤可以用于减少饮料产品中的酵母、霉菌和微生物生长。例如, Braun等的美国专利No. 4,830,862公开了在果汁饮料的生产中使用巴氏杀菌,以及在碳酸饮料中使用合适的防腐剂。Kastin的美国专利No. 4,925,686公开了热巴氏杀菌的可冷冻果汁组合物,其含有苯甲酸钠和苯甲酸钾。通常,热处理包括热灌装方法,通常使用高温短时,例如,约190°F,10秒,隧道巴氏杀菌方法,通常使用低温长时,例如,约160°F,10-15分钟,以及罐蒸馏法,通常在升高的压力下(即,在高于1个大气压的压力下)使用例如约250°F,3-5分钟。

[0074] 以下的实施例旨在作为本发明的某些优选实施方案的说明,而不是意味本发明的限制。

[0075] 实施例1

[0076] 向1加仑未加甜的减肥百事基料中,添加D-阿洛酮糖(10%最终饮料重量),并且搅拌溶液,直至完全溶解。然后添加莱鲍迪苷M(400ppm/最终的饮料),并再次搅拌溶液,直至完全溶解。将由此制得的糖浆以1比5的稀释(1份糖浆加5份碳酸水)放入冷冻碳酸饮料机(例如,Cornelius V3)中。所得的FCB具有良好的二氧化碳膨胀率、顺滑、奶油状口感和很好的味道。此外,糖浆可以通过FCB机连续运行,以始终如一地获得高品质FCB。

[0077] 实施例2

[0078] 使用以下重复实施例1:D-阿洛酮糖为5%,赤藓糖醇为3.5%,莱鲍迪苷M为200ppm。

[0079] 实施例3

[0080] 使用以下重复实施例1:D-阿洛酮糖为2.1%,赤藓糖醇为3.5%,糖3%,且莱鲍迪苷M为200ppm。

[0081] 尽管针对特定的实施例,包括目前实施本发明的优选方式描述了本发明,但本领域技术人员将认识到存在许多落入所附权利要求列出的本发明的精神和范围内的上述系统和技术的改变和置换。