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(54) Title: DIET BEVERAGE PRODUCTS COMPRISING REBAUDIOSIDE A, ERYTHRITOL OR TAGATOSE AND AN
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(57) **Abrégé/Abstract:**

Beverage products and methods for making the same are disclosed. The beverage products comprise a non-nutritive sweetener comprising rebaudioside A and at least one of tagatose, and erythritol, and an acidulant comprising lactic, tartaric, and citric acids.



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(54) Title: DIET BEVERAGE PRODUCTS COMPRISING REBAUDIOSIDE A, ERYTHRITOL OR TAGATOSE AND AN
ACIDULANT

(57) Abstract: Beverage products and methods for making the same are disclosed. The beverage products comprise a non-nutritive
sweetener comprising rebaudioside A and at least one of tagatose, and erythritol, and an acidulant comprising lactic, tartaric, and
citric acids.

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DIET BEVERAGE PRODUCTS COMPRISING REBAUDIOSIDE A, ERYTHRITOL OR TAGATOSE AND AN ACIDULANT

FIELD OF THE INVENTION

- [01] This invention relates to beverages and other beverage products, such as beverage concentrates, etc. In particular, this invention relates to beverages and other beverage products having formulations incorporating non-nutritive sweeteners and being suitable to meet market demand for natural ingredients and alternative nutritional characteristics or flavor profiles in beverages.

BACKGROUND OF THE INVENTION

- [02] It has long been known to produce beverages of various formulations. Improved and new formulations are desirable to meet changing market demands. In particular, there is perceived market demand for beverages having alternative nutritional characteristics, including, for example, alternative calorie content. Also, there is perceived market demand for beverages having alternative flavor profiles, including good taste, mouthfeel, etc. In addition, there is consumer interest in beverages and other beverage products, such as beverage concentrates, etc. whose formulations make greater use of natural ingredients, that is, ingredients distilled, extracted, concentrated or similarly obtained from harvested plants and other naturally occurring sources, with limited or no further processing.
- [03] The development of new beverage formulations, for example, new beverage formulations employing alternative sweeteners, flavorants, flavor enhancing agents and the like, presents challenges in addressing associated bitterness and/or other off-tastes. In addition, such challenges typically are presented in new beverage formulations developed for alternative nutritional characteristics and/or flavor profiles. There is need for new beverage formulations which can satisfactorily meet the combination of objectives including nutritional, flavor, shelf life, and other objectives.

- [04] Development of new beverage formulations has faced obstacles. For example, U.S. patent No. 4,956,191 suggests that carbonated beverages which contain blends of saccharin or the Stevia extract with aspartame tend to be less organoleptically pleasing than those containing sugar.
- [05] It is therefore an object of the present invention to provide beverages and other beverage products. It is an object of at least certain embodiments of the invention (that is, not necessarily all embodiments of the invention) to provide beverages and other beverage products having desirable taste properties. It is an object of at least certain (but not necessarily all) embodiments of the invention to provide beverages and other beverage products having improved formulations, such as all natural ingredients. These and other objects, features and advantages of the invention or of certain embodiments of the invention will be apparent to those skilled in the art from the following disclosure and description of exemplary embodiments.

BRIEF SUMMARY OF THE INVENTION

- [06] In accordance with a first aspect, a beverage product, such as a beverage or beverage concentrate or other product, is provided which comprises a non-nutritive sweetener comprising rebaudioside A and at least one of tagatose and erythritol, and an acidulant comprising lactic, tartaric, and citric acids.
- [07] In accordance with another aspect, a method of preparing a beverage product is provided which comprises including in the beverage product a non-nutritive sweetener comprising rebaudioside A and at least one of tagatose and erythritol, and an acidulant comprising lactic, tartaric, and citric acids.
- [08] In accordance with another aspect, a clear beverage is provided comprising a non-nutritive sweetener comprising rebaudioside A and at least one of tagatose and erythritol, and an acidulant comprising lactic, tartaric, and citric acids. As used here, substantially clear means that the beverages have substantially no turbidity and substantially no color.

[09] It will be appreciated by those skilled in the art, given the benefit of the following description of certain exemplary embodiments of the beverage and other beverage products disclosed here, that at least certain embodiments of the invention have improved or alternative formulations suitable to provide desirable taste profiles, nutritional characteristics, etc. These and other aspects, features and advantages of the invention or of certain embodiments of the invention will be further understood by those skilled in the art from the following description of exemplary embodiments.

DETAILED DESCRIPTION OF CERTAIN EXEMPLARY EMBODIMENTS

[10] It should be understood that beverages and other beverage products in accordance with this disclosure may have any of numerous different specific formulations or constitutions. The formulation of a beverage product in accordance with this disclosure can vary to a certain extent, depending upon such factors as the product's intended market segment, its desired nutritional characteristics, flavor profile and the like. For example, it will generally be an option to add further ingredients to the formulation of a particular beverage embodiment, including any of the beverage formulations described below. Additional (i.e., more and/or other) sweeteners may be added, flavorings, electrolytes, vitamins, fruit juices or other fruit products, tastants, masking agents and the like, flavor enhancers, and/or carbonation typically can be added to any such formulations to vary the taste, mouthfeel, nutritional characteristics, etc. In general, a beverage in accordance with this disclosure typically comprises at least water, sweetener, 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 can be added if desired, depending upon the other ingredients, production technique, desired shelf life, etc. Optionally, caffeine can 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 cola flavoring, caramel coloring, and optionally other ingredients. Additional and alternative suitable

ingredients will be recognized by those skilled in the art given the benefit of this disclosure.

[11] The beverage products disclosed here include beverages, i.e., ready to drink liquid formulations, beverage concentrates and the like. Beverages include, e.g., carbonated and non-carbonated soft drinks, fountain beverages, frozen ready-to-drink beverages, coffee beverages, tea beverages, dairy beverages, powdered soft drinks, as well as liquid concentrates, flavored waters, enhanced waters, fruit juice and fruit juice-flavored drinks, sport drinks, and alcoholic products. The terms "beverage concentrate" and "syrup" are used interchangeably throughout this disclosure. At least certain exemplary embodiments of the beverage concentrates contemplated are prepared with an initial volume of water to which the additional ingredients are added. Full strength beverage compositions can be formed from the beverage concentrate by adding further volumes of water to the concentrate. Typically, for example, full strength beverages can be prepared from the concentrates by combining approximately 1 part concentrate with between approximately 3 to approximately 7 parts water. In certain exemplary embodiments the full strength beverage is prepared by combining 1 part concentrate with 5 parts water. In certain exemplary embodiments the additional water used to form the full strength beverages is carbonated water. In certain other embodiments, a full strength beverage is directly prepared without the formation of a concentrate and subsequent dilution.

[12] Water is a basic ingredient in the beverages disclosed here, typically being the vehicle or primary liquid portion in which the remaining ingredients are dissolved, emulsified, suspended or dispersed. Purified water can be used in the manufacture of certain embodiments of the beverages 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, 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.

[13] Those of ordinary skill in the art will understand that, for convenience, some ingredients are described here in certain cases by reference to the original form of the ingredient in which it is added to the beverage product formulation. Such original form may differ from the form in which the ingredient is found in the finished beverage product. Thus, for example, in certain exemplary embodiments of the natural cola beverage products according to this disclosure, sucrose and liquid sucrose would typically be substantially homogeneously dissolved and dispersed in the beverage. 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. 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.

[14] Various sweeteners are included in the formulations of the beverages disclosed here. The sweeteners are edible consumables suitable for consumption and for use in beverages. By "edible consumables" is meant a food or beverage or an ingredient of a food or beverage for human or animal consumption. The sweetener or sweetening agent used here and in the claims is preferably a non-nutritive, natural 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.

- [15] 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. As used herein, a “full-calorie” beverage formulation is one fully sweetened with a nutritive sweetener. 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 “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. Commonly accepted potency figures for certain potent sweeteners include, for example,

Cyclamate	30 times as sweet as sugar
Stevioside	100-250 times as sweet as sugar
Mogroside V	100-300 times as sweet as sugar
Rebaudioside A	150-300 times as sweet as sugar
Acesulfame-K	200 times as sweet as sugar
Aspartame	200 times as sweet as sugar
Saccharine	300 times as sweet as sugar
Neohesperidin dihydrochalcone	300 times as sweet as sugar
Sucralose	600 times as sweet as sugar
Neotame	8,000 times as sweet as sugar

[16] 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. 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. 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.

[17] 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.

- [18] Sweeteners suitable for use in various embodiments of the beverage products disclosed here are preferably natural sweeteners. Suitable sweeteners and combinations of sweeteners are selected for the desired nutritional characteristics, taste profile, beverage mouthfeel and other organoleptic factors. Natural sweeteners suitable for at least certain exemplary embodiments include, for example, sucrose, liquid sucrose, fructose, liquid fructose, glucose, liquid glucose, honey, glucose-fructose syrup from natural sources such as apple, chicory, honey, etc., e.g., high fructose corn syrup, invert sugar, sorbitol, mannitol, xylitol, glycyrrhizin, d-tagatose, erythritol, meso-erythritol, malitol, maltose, lactose, fructo-oligosaccharides, Lo Han Guo extracts, Lo Han Guo juice concentrate, Lo Han Guo powder of mogroside v content from 2 to 99%, rebaudioside a, stevioside, other steviol glycosides, stevia

rebaudiana extracts, xylose, arabinose, isomalt, lactitol, maltitol, trehalose, rhamnose, and ribose, and protein sweeteners such as monatin, thaumatin, monellin, brazzein, l-alanine and glycine. As further discussed below, exemplary natural nutritive sweeteners suitable for some or all embodiments of the beverages disclosed here, specifically, full calorie or reduced calorie beverage products include, for example, crystalline or liquid sucrose, fructose, glucose, glucose-fructose syrup from natural sources such as apple, chicory, honey, etc., e.g., high fructose corn syrup, invert sugar, honey and the like and mixtures of any of them. Exemplary natural, non-nutritive, high potency sweeteners suitable for some or all diet or reduced calorie embodiments of the beverages disclosed here include rebaudioside a, stevioside, other steviol glycosides, stevia rebaudiana extracts, Lo Han Guo juice concentrate, Lo Han Guo powder of mogroside v content from 2 to 99% monatin, thaumatin, monellin, brazzein, and mixtures of any of them. Also, in at least certain exemplary embodiments of the beverages disclosed here, combinations of one or more natural nutritive sweeteners and/or one or more natural non-nutritive 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 tastants, 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.

- [19] In at least certain exemplary embodiments of the beverages disclosed here, the sweetener component can include nutritive, natural crystalline or liquid sweeteners such as sucrose, liquid sucrose, fructose, liquid fructose, glucose, liquid glucose, glucose-fructose syrup from natural sources such as apple, chicory, honey, etc., e.g., high fructose corn syrup, invert sugar, maple syrup, maple sugar, honey, brown sugar molasses, e.g., cane molasses, such as first molasses, second molasses, blackstrap molasses, and sugar beet molasses, sorghum syrup, Lo Han Guo juice concentrate, and/or others. Such sweeteners are present in at least certain exemplary embodiments in an amount of from about 0.1% to about 20% by weight of the beverage, such as from about 6% to about 16% by weight, depending upon the desired

level of sweetness for the beverage. To achieve desired beverage uniformity, texture and taste, in certain exemplary embodiments of the natural beverage products disclosed here, standardized liquid sugars as are commonly employed in the beverage industry can be used. Typically such standardized sweeteners are free of traces of nonsugar solids which could adversely affect the flavor, color or consistency of the beverage.

[20] Natural non-nutritive high potency sweeteners are suitable for use in at least certain exemplary embodiments of the beverages disclosed here. The natural non-nutritive high potency sweeteners include, for example, Lo Han Guo powder of mogroside V content from 2 to 99%, and rebaudioside A, stevioside, other steviol glycosides, as discussed further below. The sweetener component preferably includes natural low potency sweeteners, for example, erythritol and tagatose. Non-nutritive, high potency sweeteners typically are employed at a level of milligrams per fluid ounce of beverage, according to their sweetening power, any applicable regulatory provisions of the country where the beverage is to be marketed, the desired level of sweetness of the beverage, etc. It will be within the ability of those skilled in the art, given the benefit of this disclosure, to select suitable additional or alternative sweeteners for use in various embodiments of the beverage products disclosed here.

[21] As mentioned above, at least certain exemplary embodiments of the beverages disclosed here employ steviol glycosides, e.g., steviosides, rebaudiosides and related compounds for sweetening. These sweeteners can be obtained, for example, by extraction or the like from the stevia plant. Stevia (e.g., *Stevia rebaudiana bectoni*) is a sweet-tasting plant. The leaves contain a complex mixture of natural sweet diterpene glycosides. Steviosides and rebaudiosides are components of Stevia that contribute sweetness. Typically, these compounds are found to include stevioside (4-13% dry weight), steviolbioside (trace), the rebaudiosides, including rebaudioside A (2-4%), rebaudioside B (trace), rebaudioside C (1-2%), rebaudioside D (trace), and rebaudioside E (trace), and dulcoside A (0.4-0.7%). The following nonsweet constituents also have been identified in the leaves of stevia plants: labdane,

diterpene, triterpenes, sterols, flavonoids, volatile oil constituents, pigments, gums and inorganic matter.

[22] The sweetener Lo Han Guo, which has various different spellings and pronunciations and is abbreviated here in some instances as LHG, can be obtained from fruit of the plant family Cucurbitaceae, tribe Jollifieae, subtribe Thladianthinae, genus *Siraitia*. LHG often is obtained from the genus/species *S. grosvenorii*, *S. siamensis*, *S. silomaradjae*, *S. sikkimensis*, *S. africana*, *S. borneensis*, and *S. taiwaniana*. Suitable fruit includes that of the genus/species *S. grosvenorii*, which is often called Luo Han Guo. LHG contains triterpene glycosides or mogrosides, preferably mogroside V, mogroside IV(11-oxomogroside V), siamenoside and mixtures therefore, which constituents may be used as LHG sweeteners. Lo Han Guo juice concentrate, Lo Han Guo-powder of mogroside V content from 2 to 99%, LHG juice concentrate can be produced, for example, as discussed in U.S. patent No. 5,411,755. Sweeteners from other fruits, vegetables or plants also may be used as natural or processed sweeteners or sweetness enhancers in at least certain exemplary embodiments of the beverages disclosed here.

[23] Acid used in beverage products disclosed here can 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. Phosphoric acid, an artificial compound, is commonly included in cola and other beverage formulations. Replacing phosphoric acid with a natural acid has been a challenge. We have now discovered that by replacing phosphoric acid with an acidulant comprising lactic, tartaric, and citric acids, the bitter and tart aftertaste associated with beverages sweetened with natural non-nutritive sweetener(s) is greatly reduced. Additional optional exemplary acids suitable for use in some or all embodiments of the beverage products disclosed here include malic, ascorbic, cinnamic, glutaric, fumaric, gluconic, succinic, maleic and adipic acids and mixtures of any of them. The acid can be used in solution form, for example, and in an amount sufficient to provide the desired pH of the beverage.

Typically, for example, the one or more acids of the acidulant are used in amount, collectively, of from about 0.01% to about 1.0% by weight of the beverage, e.g., from about 0.05% to about 0.5% by weight of the beverage, such as 0.1% to 0.25% by weight of the beverage, depending upon the acidulant used, desired pH, other ingredients used, etc. The pH of at least certain exemplary embodiments of the beverages disclosed here can be a value within the range of from about 2.0 to about 5.0. The acid in certain exemplary embodiments enhances beverage flavor. Too much acid can impair the beverage flavor and result in sourness or other off-taste, while too little acid can make the beverage taste flat.

[24] 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. In the formation of calcium-supplemented beverages, the presence of calcium salts increases the pH which requires 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.

[25] Cola beverages typically exhibit a dark brown color derived from caramel coloring. Caramel is the dark brown material resulting from carefully controlled heat treatment of food grade carbohydrates, and therefore is known as "burnt sugar color." There are four classes of caramel, classified by the inclusion of or processing with additional reactants. Caramel class I is plain caramel with no added reactants, so it is natural. In order to darken the color of caramel, artificial reactants such as caustic sulfite and/or ammonia can be added. Caramel class II is caramel that has been processed with caustic sulfite. Caramel class III is caramel that has been processed with ammonia. Caramel class IV is caramel that has been processed with both caustic sulfite and

ammonia, and is currently used in the beverage industry to impart a dark brown color to cola beverages. Of the four classes of caramel, currently only caramel class I can be used as a colorant in natural cola beverages, but for at least certain exemplary embodiments of the natural cola beverages disclosed here, caramel class I by itself impart a color which may be found insufficiently dark brown to meet the desired cola appearance. A natural colorant comprising caramel class I and concentrated apple extract has been found to provide sufficiently dark brown color to impart a satisfactory cola appearance. Thus, colorant suitable for certain embodiments of the cola beverages disclosed here comprises caramel class I and concentrated apple extract. In certain exemplary embodiments, the concentrated apple extract comprises coloring compounds and sugar extracted from apples. Preferably, such concentrated apple extract comprises a dark brown viscous liquid having a minimum color index of about 1.2 (420 nm, d = 10 mm, 0.4%), a pH of about 4 to about 6, and a Brix value of about 65 to about 72. In at least certain exemplary embodiments, the weight ratio of caramel class I to concentrated apple extract is from about 1:3 to about 1:5, and preferably is about 1:3.8. In at least certain exemplary embodiments, the total concentration of colorant is from about 5.0 to about 10.0 g/L of the beverage, and preferably is about 6.5 g/L of the beverage. It will be within the ability of those skilled in the art, given the benefit of this disclosure, to select suitable additional or alternative colorants for use in various embodiments of the beverage products disclosed here.

- [26] Certain exemplary embodiments of the beverage products disclosed here also may contain small amounts of buffering agents to adjust pH. Such agents include, e.g., the potassium, sodium, or calcium salts of citric, malic, tartaric, lactic, ascorbic, cinnamic, glutaric, fumaric, gluconic, succinic, maleic and adipic acids, and mixtures of any of them. The amount included will depend, of course, on the type of buffering agents and on the degree to which the pH is to be adjusted.
- [27] The beverage products disclosed here optionally contain additional ingredients, including, for example, flavorings such as natural 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. 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.

[28] Exemplary fruit flavors include the citrus flavors, e.g., orange, lemon, lime, tangerine, mandarin orange, tangelo, pomelo, and grapefruit, and such flavors as apple, grape, cherry, and pineapple flavors and the like, and mixtures thereof. In certain exemplary embodiments the beverage concentrates and beverages 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 can include those flavors derived from essential oils and extracts of nuts, bark, roots and leaves. Examples of such flavors include cola flavors, tea flavors, coffee flavors and the like, and mixtures thereof. The flavor component can further comprise a blend of various 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 beverages 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.

[29] 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 can 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 can 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, pomegranate, persimmon, mango, rhubarb, papaya, litchi, lemon, orange, lime, tangerine, mandarin orange, tangelo, pomelo, 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 can be used, if at all, in an amount of from about 1% to about 20% by weight.

[30] Certain such juices which are lighter in color can 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. Deflavored and decolored juices can be employed if desired.

[31] 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, sassafras, 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 can 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.

- [32] The one or more flavorings can be used in the form of an emulsion. A flavoring emulsion can 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.
- [33] 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 can be employed. Carbon dioxide can enhance the beverage taste and appearance and can 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 6.0, e.g. about 4.7 volumes carbon dioxide. Typical embodiments may have, for example, from about 0.5 to 5.0, e.g. 4.0 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 water at 60° F (16° C) and atmospheric pressure. A volume of gas occupies the same space as does the water by which it is absorbed. The carbon dioxide content can 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 can be natural or synthetic.

- [34] Optionally, caffeine can be added to various embodiments of the beverages 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 a purity acceptable for use in foods and beverages. Preferably, the caffeine is natural in origin.
- [35] The beverage concentrates and beverages disclosed here optionally may contain other additional ingredients, including, generally, any of those typically found in beverage formulations. These additional ingredients, for example, can typically be added to a stabilized beverage concentrate. Examples of such additional ingredients include, but are not limited to, 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 thereof. 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, 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.
- [36] Preservatives may be used in at least certain embodiments of the beverages disclosed here. That is, at least certain exemplary embodiments contain an optional dissolved preservative system. Natural beverage product embodiments employ only natural preservatives. Solutions with a pH below 4.0 and especially those below 3.0, e.g., 2.5 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 can be used if desired. If a preservative system is used, it can be added to the beverage product at any suitable

time during production, e.g., in some cases prior to the addition of the sweetener. As used here, the terms "preservation system" or "preservatives" include all suitable natural preservatives approved for use in food and beverage compositions, including, without limitation, such known preservatives as nisin, cinnamic acid, sorbates, e.g., sodium, calcium, and potassium sorbate, citrates, e.g., sodium citrate and potassium citrate, and antioxidants such as ascorbic acid, and combinations thereof. Preservatives can 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.

- [37] Other methods of beverage preservation suitable for at least certain exemplary embodiments of the beverage products disclosed here 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.

EXAMPLES

[38] The following examples are specific embodiments of the present invention and are not intended to limit it. Unless otherwise indicated, all units are in grams.

EXAMPLE 1

TABLE 1

Ingredient	Control	Variant 1	Variant 2	Variant 3	Variant 4	Variant 5	Variant 6
Sodium benzoate	0.52	0.52	0.52	0.52	0.52	0.52	0.52
Sodium citrate	0.31	0.31	0.31	0.31	0.31	0.31	0.31
Rebaudio-side A	1.50	1.50	1.50	1.50	1.50	1.50	1.80
Erythritol		105		105		105	105
Phosphoric acid 80%	1.16	1.16					
Citric acid	0.21	0.21	2.46	2.46	3.96	3.96	3.96
Tartaric acid			0.15	0.15	0.49	0.49	0.49
Lactic acid 88%			0.17	0.17			
Caramel color	4.32	4.32	4.32	4.32	4.32	4.32	4.32
Cola flavor	4.33	4.33	4.33	4.33	4.33	4.33	4.33
Caffeine	0.24	0.24	0.24	0.24	0.24	0.24	0.24
EDTA	0.09	0.09	0.09	0.09	0.09	0.09	0.09
Antifoaming agent	0.56	0.56	0.56	0.56	0.56	0.56	0.56
Treated water (up to)	0.5 liter	0.5 liter	0.5 liter	0.5 liter	0.5 liter	0.5 liter	0.5 liter

[39] The control is a diet cola formulation sweetened with rebaudioside A. Each of the above variants was prepared by dissolving the above ingredients with vigorous stirring in sufficient water to obtain 0.5 liters of syrup. The syrup was then diluted

with carbonated water in a 1 plus 5 “throw”, meaning 1 part syrup was mixed with 5 parts carbonated water, to produce a finished diet cola beverage. The pH and titratable acidity (TA) of the de-gassed beverages were measured, the values for which are summarized below in Table 2.

TABLE 2

	Control	Variant 1	Variant 2	Variant 3	Variant 4	Variant 5	Variant 6
pH	3.09	3.09	3.25	3.23	2.91	2.94	2.94
TA	8.85	8.85	15.27	15.12	25.07	23.40	23.40

[40] Each of the control and variant diet cola beverages was evaluated by at least 6 cola taste experts. The taste evaluation results are summarized below in Table 3. As can be seen from Table 3, Variants 3 and 6, which include rebaudioside A and erythritol as sweeteners, and a 3-way blend of lactic, citric, and tartaric acids or a 2-way blend of citric and tartaric acids, respectively, as acidulants, were judged to have very good cola flavor and taste.

TABLE 3

	Control	Variant 1	Variant 2	Variant 3	Variant 4	Variant 5	Variant 6
Taste evaluation results	Sweet but also significant bitter aftertaste	Less bitter than control, but still quite bitter	Less bitter than control and V-1; slightly different tartness	Sweet and no bitterness; good cola flavor and taste	Much reduced bitterness but more tart than V-1	No bitterness, but tart	No bitterness; good tartness; good cola flavor and taste

EXAMPLE 2

- [41] Diet cola beverage variants as disclosed in Example 1 are prepared without sodium benzoate or EDTA. The amounts of citric, tartaric, and lactic acids are adjusted so that the pH of each of the finished beverage variants is less than about 2.9. After diluting the syrups with carbonated water, the finished beverage variants are each subjected to tunnel pasteurization at 155°F for 10 minutes. The combination of the carboxylic acids and tunnel pasteurization are believed to provide sufficient microbial stability so that no artificial preservatives are needed.
- [42] Given the benefit of the above disclosure and description of exemplary embodiments, it will be apparent to those skilled in the art that numerous alternative and different embodiments are possible in keeping with the general principles of the invention disclosed here. The scope of the claims should not be limited by the preferred embodiments set forth in the examples, but should be given the broadest interpretation consistent with the description as a whole. It should be understood that the use of a singular indefinite or definite article (e.g., “a,” “an,” “the,” etc.) in this disclosure and in the following claims follows the traditional approach in patents of meaning “at least one” unless in a particular instance it is clear from context that the term is intended in that particular instance to mean specifically one and only one. Likewise, the term “comprising” is open ended, not excluding additional items, features, components, etc.

CLAIMS:

1. A beverage product comprising:
a non-nutritive sweetener comprising rebaudioside A and at least one of tagatose, and erythritol; and
an acidulant comprising lactic, tartaric, and citric acids.
2. The beverage product of claim 1, wherein the acidulant further comprises at least one acid selected from the group consisting of malic, ascorbic, cinnamic, glutaric, fumaric, gluconic, succinic, maleic and adipic acids.
3. The beverage product of claim 1, wherein the acidulant comprises no phosphoric acid.
4. The beverage product of claim 1, wherein the acidulant comprises from about 0.01% to about 1.0% by weight of the beverage.
5. The beverage product of claim 1, having a pH of from about 2.0 to about 5.0.
6. The beverage product of claim 1, further comprising carbonated water.
7. The beverage product of claim 1, wherein the sweetener further comprises at least one sweetener selected from the group consisting of Lo Han Guo powder of mogroside V content from 2 to 99%, Lo Han Guo juice concentrate, Stevia rebaudiana extract, stevioside, other steviol glycosides, glycyrrhizin, monatin, thaumatin, monellin, and brazzein.
8. The beverage product of claim 1, further comprising a natural flavoring.

9. The beverage product of claim 8, wherein the natural flavoring comprises at least one natural flavor selected from the group consisting of natural fruit flavors, natural botanical flavors, and natural spice flavors.
10. The beverage product of claim 9, wherein the natural fruit flavor comprises at least one natural fruit flavor selected from the group consisting of citrus, berry, apple, grape, cherry, and pineapple flavors.
11. The beverage product of claim 9, wherein the natural botanical flavor comprises at least one natural botanical flavor selected from the group consisting of cola flavor, tea flavor, and coffee flavor.
12. The beverage product of claim 9, wherein the natural spice flavor comprises at least one natural spice flavor selected from the group consisting of cassia, clove, cinnamon, pepper, ginger, vanilla, cardamom, coriander, root beer, sassafras, and ginseng.
13. The beverage product of claim 9, wherein the natural fruit flavor comprises a fruit juice or fruit juice concentrate.
14. The beverage product of claim 13, wherein the fruit juice comprises from about 0.2% to about 40% by weight of the beverage.
15. The beverage product of claim 1, further comprising at least one additive selected from the group consisting of caffeine, caramel and other colorants, preservatives, antifoaming agents, gums, emulsifiers, tea solids, cloud components, minerals, antioxidants, and vitamins.

16. The beverage product of claim 1, wherein the beverage product is a natural cola beverage further comprising natural cola flavoring and a colorant comprising caramel class I and concentrated apple extract.
17. The beverage product of claim 1, wherein the beverage is clear.
18. A method of preparing a beverage product comprising including in the beverage a non-nutritive sweetener comprising rebaudioside A and at least one of tagatose and erythritol; and an acidulant comprising lactic, tartaric, and citric acids.
19. The method of claim 18, further comprising the step of subjecting the beverage product to tunnel pasteurization.
20. The beverage product of claim 4, wherein the acidulant comprises from about 0.05% to about 0.25% by weight of the beverage.
21. The beverage product of claim 10, wherein the citrus flavor comprises at least one citrus flavor selected from the group consisting of orange, lemon, lime, tangerine, mandarin orange, tangelo, pomelo, and grapefruit flavors.
22. The beverage product of claim 13 or 14, wherein the fruit juice or fruit juice concentrate is from at least one fruit juice or fruit juice concentrate selected from the group consisting of 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, pomegranate, persimmon, mango, rhubarb, papaya, litchi, lemon, orange, lime, tangerine, mandarin orange, tangelo, pomelo, and grapefruit.

23. The beverage product of claim 14, wherein the fruit juice comprises from about 1% to about 20% by weight of the beverage.
24. A beverage product comprising:
a non-nutritive sweetener comprising rebaudioside A, a sweetening amount of rebaudioside D, and at least one of tagatose, and erythritol; and
an acidulant comprising lactic, tartaric, and citric acids.
25. The beverage product of claim 24, wherein the acidulant further comprises at least one acid selected from the group consisting of malic, ascorbic, cinnamic, glutaric, fumaric, gluconic, succinic, maleic and adipic acids.
26. The beverage product of claim 24, wherein the acidulant comprises no phosphoric acid.
27. The beverage product of claim 24, wherein the acidulant comprises from about 0.01% to about 1.0% by weight of the beverage.
28. The beverage product of claim 27, wherein the acidulant comprises from about 0.05% to about 0.25% by weight of the beverage.
29. The beverage product of claim 24, having a pH of from about 2.0 to about 5.0.
30. The beverage product of claim 24, further comprising carbonated water.
31. The beverage product of claim 24, wherein the sweetener further comprises at least one sweetener selected from the group consisting of Lo Han Guo powder of mogroside V content from 2 to 99%, Lo Han Guo juice concentrate, Stevia rebaudiana extract, stevioside, other steviol glycosides, glycyrrhizin, monatin, thaumatin, monellin, and brazzein.

32. The beverage product of claim 24, further comprising a natural flavoring.
33. The beverage product of claim 32, wherein the natural flavoring comprises at least one natural flavor selected from the group consisting of natural fruit flavors, natural botanical flavors, and natural spice flavors.
34. The beverage product of claim 33, wherein the natural fruit flavor comprises at least one natural fruit flavor selected from the group consisting of citrus, berry, apple, grape, cherry, and pineapple flavors.
35. The beverage product of claim 34, wherein the citrus flavor comprises at least one citrus flavor selected from the group consisting of orange, lemon, lime, tangerine, mandarin orange, tangelo, pomelo, and grapefruit flavors.
36. The beverage product of claim 33, wherein the natural botanical flavor comprises at least one natural botanical flavor selected from the group consisting of cola flavor, tea flavor, and coffee flavor.
37. The beverage product of claim 33, wherein the natural spice flavor comprises at least one natural spice flavor selected from the group consisting of cassia, clove, cinnamon, pepper, ginger, vanilla, cardamom, coriander, root beer, sassafras, and ginseng.
38. The beverage product of claim 33, wherein the natural fruit flavor comprises a fruit juice or fruit juice concentrate.
39. The beverage product of claim 38, wherein the fruit juice or fruit juice concentrate is from at least one fruit juice or fruit juice concentrate selected from the group consisting of 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, pomegranate, persimmon, mango, rhubarb, papaya, litchi, lemon, orange, lime, tangerine, mandarin orange, tangelo, pomelo, and grapefruit.

40. The beverage product of claim 38 or 39, wherein the fruit juice comprises from about 0.2% to about 40% by weight of the beverage.
41. The beverage product of claim 38 or 39, wherein the fruit juice comprises from about 1% to about 20% by weight of the beverage.
42. The beverage product of claim 24, further comprising at least one additive selected from the group consisting of caffeine, caramel and other colorants, preservatives, antifoaming agents, gums, emulsifiers, tea solids, cloud components, minerals, antioxidants, and vitamins.
43. The beverage product of claim 24, wherein the beverage product is a natural cola beverage further comprising natural cola flavoring and a colorant comprising caramel class I and concentrated apple extract.
44. The beverage product of claim 24, wherein the beverage is clear.
45. A method of preparing a beverage product comprising including in the beverage a non-nutritive sweetener comprising rebaudioside A, a sweetening amount of rebaudioside D, and at least one of tagatose and erythritol; and an acidulant comprising lactic, tartaric, and citric acids.
46. The method of claim 45, further comprising the step of subjecting the beverage product to tunnel pasteurization.