

BEVERAGES COMPRISING REBAUDIOSIDE AM AND REBAUDIOSIDE M WITH ENHANCED FLAVOR

CROSS REFERENCE TO RELATED APPLICATION

This application claims priority to U.S. Provisional Patent Application No. 63/021,364,
5 filed May 7, 2020, the contents of which are incorporated herein.

FIELD OF THE INVENTION

The present invention relates generally to beverages comprising rebaudioside AM and rebaudioside M, wherein both are present in sweetening amounts. Use of rebaudioside AM enhances the flavor profile of the beverage when compared to a corresponding beverage that
10 does not contain rebaudioside AM. The present invention also extends to methods of improving the flavor profile of a beverage sweetened with rebaudioside M by adding rebaudioside AM in a non-sweetening amount.

BACKGROUND OF THE INVENTION

Natural caloric sugars, such as sucrose, fructose and glucose, are used to provide a
15 pleasant taste to beverages, foods, pharmaceuticals, and oral hygienic/cosmetic products. Sucrose, in particular, imparts a taste preferred by consumers. Although sucrose provides superior sweetness characteristics, it is disadvantageously caloric.

Consumers increasingly prefer non-caloric or low caloric sweeteners. However, non- and low caloric sweeteners differ from natural caloric sugars in ways that frustrate consumers. On a
20 taste basis, non-caloric or low caloric sweeteners exhibit a temporal profile, maximal response, flavor profile, mouth feel, and/or adaptation behavior that differ from sugar. Specifically, non-caloric or low caloric sweeteners exhibit delayed sweetness onset, lingering sweet aftertaste, bitter taste, metallic taste, astringent taste, cooling taste and/or licorice-like taste. On a source basis, many non-caloric or low caloric sweeteners are synthetic chemicals. Consumer desire
25 remains high for natural non-caloric or low caloric sweeteners that tastes like sucrose.

Rebaudioside M, one of many diterpene glycosides found in the leaves of *Stevia rebaudiana* varieties, has been identified as a desirable natural, non-caloric sweetener that can

achieve high maximal sweetness in beverages, e.g. the 10 Brix equivalent required for traditional carbonated soft drinks. However, rebaudioside M still suffers from undesirable flavor attributes that make rebaudioside M-sweetened beverages distinguishable from sucrose-sweetened beverages. Accordingly, there remains a need for alternative sweetener systems that provide
5 desirable flavor profiles.

SUMMARY OF THE INVENTION

In a first aspect, the present invention relates to a beverage comprising (i) a sweetening amount of rebaudioside AM (ii) a sweetening amount of rebaudioside M. The concentration of rebaudioside AM is greater than 50 ppm, such as from about 75 ppm to about 600 ppm. The
10 concentration of rebaudioside M can be from about 50 ppm to about 600 ppm, such as from about 100 ppm to about 250 ppm.

The beverage has a sucrose equivalence of at least about 5%, such as from about 5% to about 14%, from about 7% to about 14% or from about 7% to about 10%.

The beverage can be any carbonated or non-carbonated beverage. In a particular
15 embodiment, the beverage is a carbonated soft drink. In another particular embodiment, the beverage matrix of the beverage comprises citric acid or phosphoric acid.

The beverage can be selected from a zero-calorie, low-calorie, mid-calorie or full-calorie beverage. In a particular embodiment, the beverage is a zero-calorie beverage.

In certain embodiments, the beverages of the present invention have improved flavor
20 profiles compared to corresponding beverages without rebaudioside AM – assuming the same level of sweetness (sucrose equivalence). In certain embodiments, the beverages of the present invention have more rounded flavor compared to a corresponding beverage without rebaudioside AM.

In a second aspect, the present invention provides a method of preparing a beverage
25 comprising mixing a beverage syrup with a diluting quantity of water, wherein the beverage syrup comprises (i) rebaudioside AM and (ii) rebaudioside M, wherein when formulated into a beverage, the concentration of rebaudioside AM is greater than about 50 ppm and the concentration of rebaudioside M is from about 50 ppm to about 600 ppm.

In a third aspect, the present invention provides a method of preparing a beverage comprising dissolving (i) a sweetening amount of rebaudioside AM and (ii) a sweetening amount of rebaudioside M in (iii) a beverage matrix. The beverage, when formulated, contains greater than about 50 ppm rebaudioside AM and from about 50 ppm to about 600 ppm rebaudioside M.

5 In a fourth aspect, the present invention provides a method of improving the flavor profile of a beverage sweetened with rebaudioside M comprising adding rebaudioside AM in a sweetening amount to said beverage, wherein addition of rebaudioside AM improves one or more flavor attributes of the beverage compared to a corresponding beverage without rebaudioside AM, wherein the one or more flavor attributes are selected from the group
10 consisting of bitterness, astringency, licorice notes, sweetness linger, bitterness linger, bitterness aftertaste, metallic aftertaste and chemical aftertaste.

In a fifth aspect, the present invention provides a method of providing a more rounded flavor to a beverage sweetened with rebaudioside M comprising adding rebaudioside AM in a sweetening amount to said beverage.

15 Sensory comparisons between (i) rebaudioside M sweetened beverages and (ii) beverages of the present invention comprising rebaudioside M and rebaudioside AM are carried out with isosweet beverages.

DETAILED DESCRIPTION OF THE INVENTION

I. Definitions

20 The term "astringency", as used herein, refers to a perception puckering and dryness in the palate and is known to build in intensity and become increasingly difficult to clear from the mouth over repeated exposures. Astringency is a dry sensation experienced in the mouth and is commonly explained as arising from the loss of lubricity owing to the precipitation of proteins from the salivary film that coats and lubricates the oral cavity. Astringency is not confined to a
25 particular region of the mouth but is a diffuse surface phenomenon, characterized by a loss of lubrication.

The term "bitter" or "bitter taste", as used herein, refers to the perception or gustatory sensation resulting following the detection of a bitter tastant. The following attributes may contribute to bitter taste: astringent, bitter-astringent, metallic, bitter-metallic, as well as off-

tastes, aftertastes and undesirable tastes including but not limited to freezer-burn and card-board taste, and/or any combinations of these. It is noted that, in the art, the term "off-taste" is often synonymous with "bitter taste." Bitterness of substances can be compared with bitter taste threshold of quinine which is 1. (Guyton, Arthur C. (1991) Textbook of Medical Physiology. (8th ed). Philadelphia: W.B. Saunders; McLaughlin S., Margolskee R.F. (1994). "The Sense of Taste". American Scientist. 82 (6): 538–545.). Bitterness can be tested using a panel of subjects, as described herein, or in vitro, for example using a taste receptor cell line.

The term "flavor enhancer", as used herein, refers to a compound that positively impacts the perception of a non-sucrose sweetener in a consumable (e.g. a beverage) in such a way that the consumable tastes more like a sucrose-sweetened beverage. For example, certain negative taste properties of non-sucrose sweeteners can be reduced or eliminated with flavor enhancers, e.g. bitterness, sourness, astringency, saltiness and metallic notes. In another example, a flavor enhancer improves the mouthfeel of a beverage. In yet another example, a flavor enhancer improves the roundedness of a beverage.

The term "flavor profile," as generally used herein, refers to the intensity of various flavor/taste attributes of a beverage. Exemplary flavor/taste attributes are sweetness intensity, bitterness intensity, salty intensity, licorice intensity, cooling intensity, and licorice intensity. Methods of determining the flavor profile of a given sweetener or sweetened composition are known in the art.

The term "licorice," as used herein, refers to a sweet, semi-sweet, bitter, and/or aromatic taste of a sweetener or sweetened composition.

The term "mouthfeel", as used herein, refers to the sensory and tactile properties of the consumable perceived when the composition contacts the mouth cavity and surfaces. The sensory and tactile properties include the texture, thickness, consistency and body.

The term "roundedness" or "rounded flavor", as used herein, refers to a flavor profile that lacks sharp, harsh or unpleasant sensations. Beverages that have rounded flavor can also be described as "balanced."

The term “sour” or “sourness”, as used herein, refers to a taste that detects acidity. It is caused by a hydrogen atom, or ions. The more atoms present in a food, the more sour it will taste. The sourness of substances is rated relative to dilute hydrochloric acid, which has a sourness index of 1. By comparison, tartaric acid has a sourness index of 0.7, citric acid an index of 0.46, and carbonic acid an index of 0.06. A reduction in sour taste can be expressed as percentage sour taste inhibition. In one embodiment, the taste modifying compositions of the present invention reduce sour taste of a consumable (e.g., a beverage) by at least about 5%, at least about 10%, at least about 15%, at least about 20% or at least about 25% or more relative to a consumable that does not contain the taste modifying composition.

The term “sugar-like characteristic,” as used herein, refers to any characteristic similar to that of sucrose and includes, but is not limited to, maximal response, flavor profile, taste profile, temporal profile, adaptation behavior, mouthfeel, concentration/response function, tastant and flavor/sweet taste interactions, spatial pattern selectivity, and temperature effects. These characteristics are dimensions in which the taste of sucrose is different from the tastes of other compounds.

The term “sweetening amount”, as used herein, refers to the amount of compound required to provide detectable sweetness when present in a beverage. A sweetener is present in a “sweetening amount” when it is above its sweetness recognition threshold concentration.

The term “sweetness recognition threshold concentration,” as used herein, is the lowest known concentration of a compound that is perceivable by the human sense of taste as sweet. The sweetness recognition threshold concentration is specific for a particular compound, and can vary based on temperature, matrix, ingredients and/or flavor system.

II. Beverages

Rebaudioside AM has been described recently as a novel steviol glycoside. It can be isolated from Stevia (see Example 5 of WO 201875874, identified as CC-00350), prepared by recombinant enzymes (WO 2019/177634 and WO 2019/178541) or synthesized chemically (see Example 1, *infra*). WO 2019/178541 describes the sweetness recognition threshold of rebaudioside AM as 50 ppm and demonstrates that such concentrations of rebaudioside AM can

influence the flavor profile of various other beverages. The reference does not, however, teach or suggest that rebaudioside AM in concentrations above its sweetness threshold positively influence the taste profile of rebaudioside M-sweetened beverages, as described herein.

In one aspect, the present invention relates to beverages comprising (i) a sweetening
5 amount of rebaudioside AM and (ii) a sweetening amount of rebaudioside M.

The rebaudioside AM can be provided as a purified compound (i.e. >99% by weight) or as part of a mixture. Exemplary mixtures include enhanced stevia extracts and steviol glycoside mixtures. In exemplary embodiments, the steviol glycoside mixture comprises at least about 50% rebaudioside AM by weight, such as, for example, from about 50% to about 90%, from about
10 50% to about 80%, from about 50% to about 70%, from about 50% to about 60%, from about 60% to about 90%, from about 60% to about 80%, from about 60% to about 70%, from about 70% to about 90%, from about 70% to about 80% and from about 80% to about 90%. In still further embodiments, the steviol glycoside mixture contains rebaudioside AM in an amount greater than about 80%, greater than about 90%, or greater than about 95% by weight on a dry
15 basis, for example, greater than about 91%, greater than about 92%, greater than about 93%, greater than about 94%, greater than about 95%, greater than about 96%, greater than about 97% and greater than about 98%.

The amount of rebaudioside AM in the beverage can vary but is always above 50 ppm. Exemplary concentrations of rebaudioside AM include from about 75 ppm to about 600 ppm,
20 from about 100 ppm to about 600 ppm, from about 100 ppm to about 500 ppm, from about 100 ppm to about 400 ppm, from about 100 ppm to about 300 ppm, from about 100 ppm to about 200 ppm, from about 200 ppm to about 600 ppm, from about 200 ppm to about 500 ppm, from about 200 ppm to about 400 ppm, from about 200 ppm to about 300 ppm, from about 300 ppm to about 600 ppm, from about 300 ppm to about 500 ppm, from about 300 ppm to about 400 ppm, from
25 about 400 ppm to about 600 ppm, from about 400 ppm to about 500 ppm and from about 500 ppm to about 600 ppm.

In other embodiments, the concentration of rebaudioside AM in the beverage is from about 200 to about 350 ppm, from about 200 to about 300 ppm or from about 225 to about 275 ppm.

In certain other embodiments, the concentration of rebaudioside AM in the beverage is from about 250 to about 350 ppm or from about 275 ppm to about 325 ppm.

In still other embodiments, the concentration of rebaudioside AM in the beverage is from about 400 ppm to about 600 ppm, from about 450 ppm to about 550 ppm or from about 475 ppm
5 to about 525 ppm.

The rebaudioside M can be provided as a purified compound (i.e. >99% by weight) or as part of a mixture. Exemplary mixtures include enhanced stevia extracts and steviol glycoside mixtures. In exemplary embodiments, the steviol glycoside mixture comprises at least about 50% rebaudioside M by weight, such as, for example, from about 50% to about 90%, from about 50%
10 to about 80%, from about 50% to about 70%, from about 50% to about 60%, from about 60% to about 90%, from about 60% to about 80%, from about 60% to about 70%, from about 70% to about 90%, from about 70% to about 80% and from about 80% to about 90%. In still further embodiments, the steviol glycoside mixture contains rebaudioside M in an amount greater than about 80%, greater than about 90%, or greater than about 95% by weight on a dry basis, for
15 example, greater than about 91%, greater than about 92%, greater than about 93%, greater than about 94%, greater than about 95%, greater than about 96%, greater than about 97% and greater than about 98%.

The amount of rebaudioside M in the beverage can also vary but is always present in a sweetening amount. In exemplary embodiments, the concentration of rebaudioside M in the
20 beverage varies from about 50 ppm to about 600 ppm, such as, for example, from about 50 ppm to about 500 ppm, from about 50 ppm to about 400 ppm, from about 50 ppm to about 300 ppm, from about 50 ppm to about 200 ppm, from about 50 ppm to about 100 ppm, from about 100 ppm to about 600 ppm, from about 100 ppm to about 500 ppm, from about 100 ppm to about 400 ppm, from about 100 ppm to about 300 ppm, from about 100 ppm to about 200 ppm, from about
25 200 ppm to about 600 ppm, from about 200 ppm to about 500 ppm, from about 200 ppm to about 400 ppm, from about 200 ppm to about 300 ppm, from about 300 ppm to about 600 ppm, from about 300 ppm to about 500 ppm, from about 300 ppm to about 400 ppm, from about 400 ppm to about 600 ppm, from about 400 ppm to about 500 ppm and from about 500 ppm to about 600 ppm.

In other embodiments, the concentration of rebaudioside M is from about 100 ppm to about 250 ppm, from about 100 ppm to about 200 ppm or from about 125 ppm to about 175 ppm.

5 In yet other embodiments, the concentration of rebaudioside M is from about 150 ppm to about 250 ppm or from about 175 ppm to about 225 ppm.

In still other embodiments, the concentration of rebaudioside M is from about 200 ppm to about 300 ppm or from about 225 ppm to about 275 ppm.

In a particular embodiment, a beverage comprises (i) from about 75 ppm to about 600 ppm rebaudioside AM and (ii) from about 50 ppm to about 600 ppm rebaudioside M.

10 In another particular embodiment, a beverage comprises (i) from about 200 ppm to about 350 ppm rebaudioside AM and (ii) from about 100 ppm to about 250 ppm rebaudioside M.

In a more particular embodiment, a beverage comprises (i) from about 200 ppm to about 300 ppm rebaudioside AM and (ii) from about 100 ppm to about 200 ppm rebaudioside M.

15 In another more particular embodiment, a beverage comprises (i) from about 275 ppm to about 325 ppm rebaudioside AM and (ii) from about 175 ppm to about 225 ppm rebaudioside M.

In another embodiment, a beverage comprises (i) from about 400 ppm to about 600 ppm rebaudioside AM and (ii) from about 200 ppm to about 300 ppm rebaudioside M.

In a more particular embodiment, a beverage comprises (i) from about 450 ppm to about 550 ppm rebaudioside AM and (ii) from about 200 ppm to about 300 ppm rebaudioside M.

20 The sweetness of the beverage can be expressed in terms of its sucrose equivalence (SE). The sucrose equivalence of beverages of the present invention is at least about 5% sucrose equivalence, such as, for example, at least about 6% sucrose equivalence, at least about 7% sucrose equivalence, at least about 8% sucrose equivalence, at least about 9% sucrose equivalence, at least about 10% sucrose equivalence, at least about 11% sucrose equivalence, at
25 least about 12% sucrose equivalence or at least about 13% sucrose equivalence.

In other embodiments, the sucrose equivalence of the beverages of the present invention is from about 5% to about 14%, from about 5% to about 10%, from about 7% to about 14% or from about 7% to about 10%.

Beverages of the present invention include carbonated and non-carbonated beverages.

5 Carbonated beverages include, but are not limited to, frozen carbonated beverages, enhanced sparkling beverages, cola, fruit-flavored sparkling beverages (e.g. lemon-lime, orange, grape, strawberry and pineapple), ginger-ale, soft drinks and root beer.

10 Non-carbonated beverages include, but are not limited to, fruit juice, fruit-flavored juice, juice drinks, nectars, vegetable juice, vegetable-flavored juice, sports drinks, energy drinks, enhanced water drinks, enhanced water with vitamins, near water drinks (e.g., water with natural or synthetic flavorants), coconut water, tea type drinks (e.g. black tea, green tea, red tea, oolong tea), coffee, cocoa drink, beverage containing milk components (e.g. milk beverages, coffee containing milk components, café au lait, milk tea, fruit milk beverages), beverages containing cereal extracts and smoothies.

15 In a particular embodiment, the beverage of the present invention is a carbonated soft drink. In a more particular embodiment, the beverage of the present invention is a fruit-flavored carbonated soft drink. In an even more particular embodiment, the beverage of the present invention is a lemon-lime flavored carbonated soft drink. In a still more particular embodiment, the beverage of the present invention is a diet lemon-lime flavored carbonated soft drink. In other
20 still more particular embodiments, the beverage of the present invention is a diet cola.

25 Beverages comprise a matrix, i.e. the basic ingredient in which the beverage ingredients of the present invention are dissolved. In one embodiment, a beverage comprises water of beverage quality as the matrix, such as, for example deionized water, distilled water, reverse osmosis water, carbon-treated water, purified water, demineralized water and combinations thereof, can be used. Additional suitable matrices include, but are not limited to phosphoric acid, phosphate buffer, citric acid, citrate buffer and carbon-treated water.

In a particular embodiment, the beverage of the present invention comprises a beverage matrix comprising citric acid. In another particular embodiment, the beverage of the present invention comprises a beverage matrix comprising phosphoric acid.

It is contemplated that the pH of the beverage does not materially or adversely affect the taste of the sweetener. A non-limiting example of the pH range of the beverage may be from about 1.8 to about 10. A further example includes a pH range from about 2 to about 5. In a particular embodiment, the pH of beverage can be from about 2.5 to about 4.2. One of skill in the art will understand that the pH of the beverage can vary based on the type of beverage. Dairy beverages, for example, can have pHs greater than 4.2.

The titratable acidity of a beverage may, for example, range from about 0.01 to about 1.0% by weight of beverage.

In one embodiment, the sparkling beverage product has an acidity from about 0.01 to about 1.0% by weight of the beverage, such as, for example, from about 0.05% to about 0.25% by weight of beverage.

The carbonation of a sparkling beverage product has 0 to about 2% (w/w) of carbon dioxide or its equivalent, for example, from about 0.1 to about 1.0% (w/w).

The beverage can be caffeinated or non-caffeinated.

The temperature of a beverage may, for example, range from about 4°C to about 100 °C, such as, for example, from about 4°C to about 25°C.

The beverage can be a full-calorie beverage that has up to about 120 calories per 8 oz. serving.

The beverage can be a mid-calorie beverage that has up to about 60 calories per 8 oz. serving.

The beverage can be a low-calorie beverage that has up to about 40 calories per 8 oz. serving.

The beverage can be a zero-calorie that has less than about 5 calories per 8 oz. serving.

In a particular embodiment, the present invention provides a diet beverage comprising (i) a sweetening amount of rebaudioside AM and (ii) a sweetening amount of rebaudioside M, wherein the sucrose equivalence is greater than about 5%. In a more particular embodiment, the diet beverage comprises (i) greater than about 50 ppm rebaudioside AM and (ii) a sweetening amount of rebaudioside M, wherein the sucrose equivalence of the beverage is at least about 5%.

In another more particular embodiment, the diet beverage comprises (i) from about 75 ppm to about 600 ppm rebaudioside M and (ii) a sweetening amount of rebaudioside M, wherein the sucrose equivalence of the beverage is at least about 5%.

5 In other embodiments, a diet beverage comprises (i) from about 200 ppm to about 350 ppm rebaudioside AM and (ii) a sweetening amount of rebaudioside M, wherein the sucrose equivalence of the beverage is at least about 7% or from about 7% to about 8%.

In still other embodiments, a diet beverage comprises (i) from about 400 ppm to about 600 ppm rebaudioside AM and (ii) a sweetening amount of rebaudioside M, wherein the sucrose equivalence of the beverage is at least about 10%.

10 The beverages of the present invention have improved flavor profiles compared to a corresponding beverage without rebaudioside AM having the same sucrose equivalence. The flavor profile of a sweetener is a quantitative profile of the relative intensities of all of the taste attributes exhibited. Such profiles often are plotted as histograms or radar plots.

15 The beverages of the present invention have exhibit one or more improves (i.e. reduces) one or more negative flavor attributes or taste attributes compared to a corresponding beverage without rebaudioside AM. For example, beverages of the present invention have one or more of the following: reduced bitterness, reduced astringency, reduced licorice notes, reduced sweetness linger, reduced bitterness linger, reduced bitterness aftertaste, reduced metallic aftertaste or reduced chemical aftertaste.

20 The beverages of the present invention have a more rounded flavor (balanced flavor) compared to a corresponding beverage without rebaudioside AM.

25 In some embodiments, the sweeteners specified in the present beverages (i.e. rebaudioside AM and rebaudioside M) are the sole sweeteners in the beverage, i.e. the only sweeteners present in a sweetening amount. In other embodiments, the beverage comprises at least one additional sweetener, wherein the at least one additional sweetener is also present in a sweetening amount. The at least one additional sweetener can be any known sweetener, e.g. a natural sweetener (including natural high potency sweeteners), a synthetic sweetener, or a caloric sweetener.

For example, the at least one additional sweetener can be a carbohydrate sweetener. Suitable carbohydrate sweeteners are selected from, but not limited to, the group consisting of sucrose, glyceraldehyde, dihydroxyacetone, erythrose, threose, erythrulose, arabinose, lyxose, ribose, xylose, ribulose, xylulose, allose, altrose, galactose, glucose, gulose, idose, mannose, talose, fructose, psicose, sorbose, tagatose, mannoheptulose, sedoheltulose, octulose, fucose, rhamnose, arabinose, turanose, sialose and combinations thereof.

The at least one additional sweetener can also be selected from a rare sugar, e.g. sorbose, lyxose, ribulose, xylose, xylulose, D-allose, L-ribose, D-tagatose, L-glucose, L-fucose, L-arabinose, turanose and combinations thereof.

The at least one additional sweetener may be other steviol glycosides or mogrosides, or compositions containing steviol glycosides or mogrosides.

Exemplary steviol glycoside sweeteners include, but are not limited to, rebaudioside M, rebaudioside D, rebaudioside A, rebaudioside N, rebaudioside O, rebaudioside E, steviolmonoside, steviolbioside, rubusoside, dulcoside B, dulcoside A, rebaudioside B, rebaudioside G, stevioside, rebaudioside C, rebaudioside F, rebaudioside I, rebaudioside H, rebaudioside L, rebaudioside K, rebaudioside J, rebaudioside M2, rebaudioside D2, rebaudioside S, rebaudioside T, rebaudioside U, rebaudioside V, rebaudioside W, rebaudioside Z1, rebaudioside Z2, rebaudioside IX, enzymatically glucosylated steviol glycosides, stevia extracts and combinations thereof.

Exemplary mogroside sweeteners include, but are not limited to, grosmogroside I, mogroside IA, mogroside IE, 11-oxomogroside IA, mogroside II, mogroside II A, mogroside II B, mogroside II E, 7-oxomogroside II E, mogroside III, Mogroside IIIe, 11-oxomogroside IIIe, 11-deoxymogroside III, mogroside IV, Mogroside IVA 11-oxomogroside IV, 11-oxomogroside IVA, mogroside V, isomogroside V, 11-deoxymogroside V, 7-oxomogroside V, 11-oxomogroside V, isomogroside V, mogroside VI, mogrol, 11-oxomogrol, siamenoside I, an isomer of siamenoside I (e.g. those disclosed in 20170119032; incorporated by reference in its entirety), in particular the 1,6- α isomer of siamenoside I, luohan guo, mogroside mixtures and combinations thereof.

Other sweeteners include monatin and its salts (monatin SS, RR, RS, SR), curculin, glycyrrhizic acid and its salts, thaumatin, monellin, mabinlin, brazzein, hernandulcin, phyllodulcin, glycyphyllin, phloridzin, trilobatin, baiyunoside, osladin, polypodoside A, pterocaryoside A, pterocaryoside B, mukurozioside, phlomisioside I, periandrin I, abrusoside A, steviolbioside and cyclocarioside I, sugar alcohols such as erythritol, sucralose, potassium acesulfame, acesulfame acid and salts thereof, aspartame, alitame, saccharin and salts thereof, neohesperidin dihydrochalcone, cyclamate, cyclamic acid and salts thereof, neotame, advantame, glucosylated steviol glycosides (GSGs) and combinations thereof.

The beverage of the present invention can contain additives including, but not limited to, carbohydrates, polyols, amino acids and their corresponding salts, poly-amino acids and their corresponding salts, sugar acids and their corresponding salts, nucleotides, organic acids, inorganic acids, organic salts including organic acid salts and organic base salts, inorganic salts, bitter compounds, caffeine, flavorants and flavoring ingredients, astringent compounds, proteins or protein hydrolysates, surfactants, emulsifiers, weighing agents, juice, dairy, cereal and other plant extracts, flavonoids, alcohols, polymers and combinations thereof. Any suitable additive described herein can be used.

In one embodiment, the beverage further comprises one or more polyols. The term "polyol", as used herein, refers to a molecule that contains more than one hydroxyl group. A polyol may be a diol, triol, or a tetraol which contains 2, 3, and 4 hydroxyl groups respectively. A polyol also may contain more than 4 hydroxyl groups, such as a pentaol, hexaol, heptaol, or the like, which contain 5, 6, or 7 hydroxyl groups, respectively. Additionally, a polyol also may be a sugar alcohol, polyhydric alcohol, or polyalcohol which is a reduced form of carbohydrate, wherein the carbonyl group (aldehyde or ketone, reducing sugar) has been reduced to a primary or secondary hydroxyl group.

Non-limiting examples of polyols in some embodiments include maltitol, mannitol, sorbitol, lactitol, xylitol, isomalt, propylene glycol, glycerol (glycerin), threitol, galactitol, palatinose, reduced isomalto-oligosaccharides, reduced xylo-oligosaccharides, reduced gentio-oligosaccharides, reduced maltose syrup, reduced glucose syrup, and sugar alcohols or any other carbohydrates capable of being reduced which do not adversely affect taste.

Suitable amino acid additives include, but are not limited to, aspartic acid, arginine, glycine, glutamic acid, proline, threonine, theanine, cysteine, cystine, alanine, valine, tyrosine, leucine, arabinose, trans-4-hydroxyproline, isoleucine, asparagine, serine, lysine, histidine, ornithine, methionine, carnitine, aminobutyric acid (α -, β -, and/or δ -isomers), glutamine, 5 hydroxyproline, taurine, norvaline, sarcosine, and their salt forms such as sodium or potassium salts or acid salts. The amino acid additives also may be in the D- or L-configuration and in the mono-, di-, or tri-form of the same or different amino acids. Additionally, the amino acids may be α -, β -, γ - and/or δ -isomers if appropriate. Combinations of the foregoing amino acids and their corresponding salts (*e.g.*, sodium, potassium, calcium, magnesium salts or other alkali or 10 alkaline earth metal salts thereof, or acid salts) also are suitable additives in some embodiments. The amino acids may be natural or synthetic. The amino acids also may be modified. Modified amino acids refers to any amino acid wherein at least one atom has been added, removed, substituted, or combinations thereof (*e.g.*, N-alkyl amino acid, N-acyl amino acid, or N-methyl amino acid). Non-limiting examples of modified amino acids include amino acid derivatives 15 such as trimethyl glycine, N-methyl-glycine, and N-methyl-alanine. As used herein, modified amino acids encompass both modified and unmodified amino acids. As used herein, amino acids also encompass both peptides and polypeptides (*e.g.*, dipeptides, tripeptides, tetrapeptides, and pentapeptides) such as glutathione and L-alanyl-L-glutamine. Suitable polyamino acid additives include poly-L-aspartic acid, poly-L-lysine (*e.g.*, poly-L- α -lysine or poly-L- ϵ -lysine), poly-L- 20 ornithine (*e.g.*, poly-L- α -ornithine or poly-L- ϵ -ornithine), poly-L-arginine, other polymeric forms of amino acids, and salt forms thereof (*e.g.*, calcium, potassium, sodium, or magnesium salts such as L-glutamic acid mono sodium salt). The poly-amino acid additives also may be in the D- or L-configuration. Additionally, the poly-amino acids may be α -, β -, γ -, δ -, and ϵ - isomers if appropriate. Combinations of the foregoing poly-amino acids and their corresponding 25 salts (*e.g.*, sodium, potassium, calcium, magnesium salts or other alkali or alkaline earth metal salts thereof or acid salts) also are suitable additives in some embodiments. The poly-amino acids described herein also may comprise co-polymers of different amino acids. The poly-amino acids may be natural or synthetic. The poly-amino acids also may be modified, such that at least one atom has been added, removed, substituted, or combinations thereof (*e.g.*, N-alkyl poly- 30 amino acid or N-acyl poly-amino acid). As used herein, poly-amino acids encompass both modified and unmodified poly-amino acids. For example, modified poly-amino acids include,

but are not limited to, poly-amino acids of various molecular weights (MW), such as poly-L- α -lysine with a MW of 1,500, MW of 6,000, MW of 25,200, MW of 63,000, MW of 83,000, or MW of 300,000.

In particular embodiments, the amino acid is present in the consumable in an amount
5 from about 10 ppm to about 50,000 ppm. In another embodiment, the amino acid is present in the consumable in an amount from about 1,000 ppm to about 10,000 ppm, such as, for example, from about 2,500 ppm to about 5,000 ppm or from about 250 ppm to about 7,500 ppm.

Suitable sugar acid additives include, but are not limited to, aldonic, uronic, aldaric, alginic, gluconic, glucuronic, glucaric, galactaric, galacturonic, and salts thereof (e.g., sodium,
10 potassium, calcium, magnesium salts or other physiologically acceptable salts), and combinations thereof.

Suitable nucleotide additives include, but are not limited to, inosine monophosphate ("IMP"), guanosine monophosphate ("GMP"), adenosine monophosphate ("AMP"), cytosine monophosphate (CMP), uracil monophosphate (UMP), inosine diphosphate, guanosine
15 diphosphate, adenosine diphosphate, cytosine diphosphate, uracil diphosphate, inosine triphosphate, guanosine triphosphate, adenosine triphosphate, cytosine triphosphate, uracil triphosphate, alkali or alkaline earth metal salts thereof, and combinations thereof. The nucleotides described herein also may comprise nucleotide-related additives, such as nucleosides or nucleic acid bases (e.g., guanine, cytosine, adenine, thymine, uracil).

Suitable organic acid additives include any compound which comprises a -COOH
20 moiety, such as, for example, C2-C30 carboxylic acids, substituted hydroxyl C2-C30 carboxylic acids, butyric acid (ethyl esters), substituted butyric acid (ethyl esters), benzoic acid, substituted benzoic acids (e.g., 2,4-dihydroxybenzoic acid), substituted cinnamic acids, hydroxyacids, substituted hydroxybenzoic acids, anisic acid substituted cyclohexyl carboxylic acids, tannic
25 acid, aconitic acid, lactic acid, tartaric acid, citric acid, isocitric acid, gluconic acid, glucoheptonic acids, adipic acid, hydroxycitric acid, malic acid, fruitaric acid (a blend of malic, fumaric, and tartaric acids), fumaric acid, maleic acid, succinic acid, chlorogenic acid, salicylic acid, creatine, caffeic acid, bile acids, acetic acid, ascorbic acid, alginic acid, erythorbic acid, polyglutamic acid, glucono delta lactone, and their alkali or alkaline earth metal salt derivatives
30 thereof. In addition, the organic acid additives also may be in either the D- or L-configuration.

Suitable organic acid additive salts include, but are not limited to, sodium, calcium, potassium, and magnesium salts of all organic acids, such as salts of citric acid, malic acid, tartaric acid, fumaric acid, lactic acid (*e.g.*, sodium lactate), alginic acid (*e.g.*, sodium alginate), ascorbic acid (*e.g.*, sodium ascorbate), benzoic acid (*e.g.*, sodium benzoate or potassium benzoate), sorbic acid and adipic acid. The examples of the organic acid additives described optionally may be substituted with at least one group chosen from hydrogen, alkyl, alkenyl, alkynyl, halo, haloalkyl, carboxyl, acyl, acyloxy, amino, amido, carboxyl derivatives, alkylamino, dialkylamino, arylamino, alkoxy, aryloxy, nitro, cyano, sulfo, thiol, imine, sulfonyl, sulfenyl, sulfinyl, sulfamyl, carboxalkoxy, carboxamido, phosphonyl, phosphinyl, phosphoryl, phosphino, thioester, thioether, anhydride, oximino, hydrazino, carbamyl, phosphor or phosphonato. In particular embodiments, the organic acid additive is present in the sweetener composition in an amount effective to provide a concentration from about 10 ppm to about 5,000 ppm when present in a consumable, such as, for example, a beverage.

Suitable inorganic acid additives include, but are not limited to, phosphoric acid, phosphorous acid, polyphosphoric acid, hydrochloric acid, sulfuric acid, carbonic acid, sodium dihydrogen phosphate, and alkali or alkaline earth metal salts thereof (*e.g.*, inositol hexaphosphate Mg/Ca).

The inorganic acid additive is present in the consumable in a concentration from about 25 ppm to about 25,000 ppm.

Suitable bitter compound additives include, but are not limited to, caffeine, quinine, urea, bitter orange oil, naringin, quassia, and salts thereof.

The bitter compound is present in the consumable in a concentration from about 25 ppm to about 25,000 ppm.

Suitable flavorants and flavoring ingredient additives include, but are not limited to, vanillin, vanilla extract, mango extract, cinnamon, citrus, coconut, ginger, viridiflorol, almond, menthol (including menthol without mint), grape skin extract, and grape seed extract. "Flavorant" and "flavoring ingredient" are synonymous and can include natural or synthetic substances or combinations thereof. Flavorants also include any other substance which imparts flavor and may include natural or non-natural (synthetic) substances which are safe for human or animals when used in a generally accepted range. Non-limiting examples of proprietary

flavorants include Döhler™ Natural Flavoring Sweetness Enhancer K14323 (Döhler™, Darmstadt, Germany), Symrise™ Natural Flavor Mask for Sweeteners 161453 and 164126 (Symrise™, Holzminden, Germany), Natural Advantage™ Bitterness Blockers 1, 2, 9 and 10 (Natural Advantage™, Freehold, New Jersey, U.S.A.), and Sucramask™ (Creative Research
5 Management, Stockton, California, U.S.A.).

The flavorant is present in the consumable in a concentration from about 0.1 ppm to about 4,000 ppm.

Suitable polymer additives include, but are not limited to, chitosan, pectin, pectic, pectinic, polyuronic, polygalacturonic acid, starch, food hydrocolloid or crude extracts thereof
10 (e.g., gum acacia senegal (Fibergum™), gum acacia seyal, carageenan), poly-L-lysine (e.g., poly-L- α -lysine or poly-L- ϵ -lysine), poly-L-ornithine (e.g., poly-L- α -ornithine or poly-L- ϵ -ornithine), polypropylene glycol, polyethylene glycol, poly(ethylene glycol methyl ether), polyarginine, polyaspartic acid, polyglutamic acid, polyethylene imine, alginic acid, sodium alginate, propylene glycol alginate, and sodium polyethyleneglycolalginate, sodium
15 hexametaphosphate and its salts, and other cationic polymers and anionic polymers.

The polymer is present in the consumable a concentration from about 30 ppm to about 2,000 ppm.

Suitable protein or protein hydrolysate additives include, but are not limited to, bovine serum albumin (BSA), whey protein (including fractions or concentrates thereof such as 90%
20 instant whey protein isolate, 34% whey protein, 50% hydrolyzed whey protein, and 80% whey protein concentrate), soluble rice protein, soy protein, protein isolates, protein hydrolysates, reaction products of protein hydrolysates, glycoproteins, and/or proteoglycans containing amino acids (e.g., glycine, alanine, serine, threonine, asparagine, glutamine, arginine, valine, isoleucine, leucine, norvaline, methionine, proline, tyrosine, hydroxyproline, and the like), collagen (e.g.,
25 gelatin), partially hydrolyzed collagen (e.g., hydrolyzed fish collagen), and collagen hydrolysates (e.g., porcine collagen hydrolysate).

The protein hydrolysate is present in the consumable in a concentration from about 200 ppm to about 50,000 ppm.

Suitable surfactant additives include, but are not limited to, polysorbates (e.g., polyoxyethylene sorbitan monooleate (polysorbate 80), polysorbate 20, polysorbate 60), sodium dodecylbenzenesulfonate, dioctyl sulfosuccinate or dioctyl sulfosuccinate sodium, sodium dodecyl sulfate, cetylpyridinium chloride (hexadecylpyridinium chloride),
5 hexadecyltrimethylammonium bromide, sodium cholate, carbamoyl, choline chloride, sodium glycocholate, sodium taurodeoxycholate, lauric arginate, sodium stearyl lactylate, sodium taurocholate, lecithins, sucrose oleate esters, sucrose stearate esters, sucrose palmitate esters, sucrose laurate esters, and other emulsifiers, and the like.

The surfactant additive is present in the consumable in a concentration from about 30
10 ppm to about 2,000 ppm.

Suitable flavonoid additives are classified as flavonols, flavones, flavanones, flavan-3-ols, isoflavones, or anthocyanidins. Non-limiting examples of flavonoid additives include, but are not limited to, catechins (e.g., green tea extracts such as Polyphenon™ 60, Polyphenon™ 30, and Polyphenon™ 25 (Mitsui Norin Co., Ltd., Japan), polyphenols, rutins (e.g., enzyme
15 modified rutin Sanmelin™ AO (San-fi Gen F.F.I., Inc., Osaka, Japan)), neohesperidin, naringin, neohesperidin dihydrochalcone, and the like.

The flavonoid additive is present in the consumable in a concentration from about 0.1 ppm to about 1,000 ppm.

Suitable alcohol additives include, but are not limited to, ethanol. In particular
20 embodiments, the alcohol additive is present in the consumable in a concentration from about 625 ppm to about 10,000 ppm.

Suitable astringent compound additives include, but are not limited to, tannic acid, europium chloride (EuCl_3), gadolinium chloride (GdCl_3), terbium chloride (TbCl_3), alum, tannic acid, and polyphenols (e.g., tea polyphenols). The astringent additive is present in the
25 consumable in a concentration from about 10 ppm to about 5,000 ppm.

The beverages of the present invention can also contain one or more functional ingredients, which provide a real or perceived health benefit to the composition. Functional ingredients include, but are not limited to, saponins, antioxidants, dietary fiber sources, fatty acids, vitamins, glucosamine, minerals, preservatives, hydration agents, probiotics, prebiotics,

weight management agents, osteoporosis management agents, phytoestrogens, long chain primary aliphatic saturated alcohols, phytosterols and combinations thereof.

Examples of suitable antioxidants for embodiments of this invention include, but are not limited to, vitamins, vitamin cofactors, minerals, hormones, carotenoids, carotenoid terpenoids, non-carotenoid terpenoids, flavonoids, flavonoid polyphenolics (e.g., bioflavonoids), flavonols, flavones, phenols, polyphenols, esters of phenols, esters of polyphenols, nonflavonoid phenolics, isothiocyanates, and combinations thereof. In some embodiments, the antioxidant is vitamin A, vitamin C, vitamin E, ubiquinone, mineral selenium, manganese, melatonin, α -carotene, β -carotene, lycopene, lutein, zeaxanthin, cryptoxanthin, resveratrol, eugenol, quercetin, catechin, gossypol, hesperetin, curcumin, ferulic acid, thymol, hydroxytyrosol, tumeric, thyme, olive oil, lipoic acid, glutathione, glutamine, oxalic acid, tocopherol-derived compounds, butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), ethylenediaminetetraacetic acid (EDTA), tert-butylhydroquinone, acetic acid, pectin, tocotrienol, tocopherol, coenzyme Q10, zeaxanthin, astaxanthin, canthaxanthin, saponins, limonoids, kaempferol, myricetin, isorhamnetin, proanthocyanidins, quercetin, rutin, luteolin, apigenin, tangeretin, hesperetin, naringenin, erodictyol, flavan-3-ols (e.g., anthocyanidins), gallo catechins, epicatechin and its gallate forms, epigallocatechin and its gallate forms (ECGC) theaflavin and its gallate forms, thearubigins, isoflavone, phytoestrogens, genistein, daidzein, glycitein, anthocyanins, cyaniding, delphinidin, malvidin, pelargonidin, peonidin, petunidin, ellagic acid, gallic acid, salicylic acid, rosmarinic acid, cinnamic acid and its derivatives (e.g., ferulic acid), chlorogenic acid, chicoric acid, gallotannins, ellagitannins, anthoxanthins, betacyanins and other plant pigments, silymarin, citric acid, lignan, antinutrients, bilirubin, uric acid, R- α -lipoic acid, N-acetylcysteine, emblicanin, apple extract, apple skin extract (applephenon), rooibos extract, green, hawthorn berry extract, red raspberry extract, green coffee antioxidant (GCA), aronia extract 20%, grape seed extract (VinOseed), cocoa extract, hops extract, mangosteen extract, mangosteen hull extract, cranberry extract, pomegranate extract, pomegranate hull extract, pomegranate seed extract, hawthorn berry extract, pomella pomegranate extract, cinnamon bark extract, grape skin extract, bilberry extract, pine bark extract, pycnogenol, elderberry extract, mulberry root extract, wolfberry (gogi) extract, blackberry extract, blueberry extract, blueberry leaf extract, raspberry extract, turmeric extract, citrus bioflavonoids, black currant, ginger, acai powder, green coffee bean extract, green tea

extract, and phytic acid, or combinations thereof. In alternate embodiments, the antioxidant is a synthetic antioxidant such as butylated hydroxytoluene or butylated hydroxyanisole, for example. Other sources of suitable antioxidants for embodiments of this invention include, but are not limited to, fruits, vegetables, tea, cocoa, chocolate, spices, herbs, rice, organ meats from
5 livestock, yeast, whole grains, or cereal grains.

Particular antioxidants belong to the class of phytonutrients called polyphenols (also known as “polyphenolics”), which are a group of chemical substances found in plants, characterized by the presence of more than one phenol group per molecule. Suitable polyphenols for embodiments of this invention include catechins, proanthocyanidins, procyanidins,
10 anthocyanins, quercetin, rutin, resveratrol, isoflavones, curcumin, punicalagin, ellagitannin, hesperidin, naringin, citrus flavonoids, chlorogenic acid, other similar materials, and combinations thereof.

In particular embodiments, the antioxidant is a catechin such as, for example, epigallocatechin gallate (EGCG). Suitable sources of catechins for embodiments of this
15 invention include, but are not limited to, green tea, white tea, black tea, oolong tea, chocolate, cocoa, red wine, grape seed, red grape skin, purple grape skin, red grape juice, purple grape juice, berries, pycnogenol, and red apple peel.

In some embodiments, the antioxidant is chosen from proanthocyanidins, procyanidins or combinations thereof. Suitable sources of proanthocyanidins and procyanidins for embodiments
20 of this invention include, but are not limited to, red grapes, purple grapes, cocoa, chocolate, grape seeds, red wine, cacao beans, cranberry, apple peel, plum, blueberry, black currants, chokeberry, green tea, sorghum, cinnamon, barley, red kidney bean, pinto bean, hops, almonds, hazelnuts, pecans, pistachio, pycnogenol, and colorful berries.

In particular embodiments, the antioxidant is an anthocyanin. Suitable sources of
25 anthocyanins for embodiments of this invention include, but are not limited to, red berries, blueberries, bilberry, cranberry, raspberry, cherry, pomegranate, strawberry, elderberry, chokeberry, red grape skin, purple grape skin, grape seed, red wine, black currant, red currant, cocoa, plum, apple peel, peach, red pear, red cabbage, red onion, red orange, and blackberries.

In some embodiments, the antioxidant is chosen from quercetin, rutin or combinations
30 thereof. Suitable sources of quercetin and rutin for embodiments of this invention include, but

are not limited to, red apples, onions, kale, bog whortleberry, lingonberries, chokeberry, cranberry, blackberry, blueberry, strawberry, raspberry, black currant, green tea, black tea, plum, apricot, parsley, leek, broccoli, chili pepper, berry wine, and ginkgo.

5 In some embodiments, the antioxidant is resveratrol. Suitable sources of resveratrol for embodiments of this invention include, but are not limited to, red grapes, peanuts, cranberry, blueberry, bilberry, mulberry, Japanese Itadori tea, and red wine.

In particular embodiments, the antioxidant is an isoflavone. Suitable sources of isoflavones for embodiments of this invention include, but are not limited to, soy beans, soy products, legumes, alfalfa sprouts, chickpeas, peanuts, and red clover.

10 In some embodiments, the antioxidant is curcumin. Suitable sources of curcumin for embodiments of this invention include, but are not limited to, turmeric and mustard.

In particular embodiments, the antioxidant is chosen from punicalagin, ellagitannin or combinations thereof. Suitable sources of punicalagin and ellagitannin for embodiments of this invention include, but are not limited to, pomegranate, raspberry, strawberry, walnut, and oak-
15 aged red wine.

In some embodiments, the antioxidant is a citrus flavonoid, such as hesperidin or naringin. Suitable sources of citrus flavonoids, such as hesperidin or naringin, for embodiments of this invention include, but are not limited to, oranges, grapefruits, and citrus juices.

In particular embodiments, the antioxidant is chlorogenic acid. Suitable sources of
20 chlorogenic acid for embodiments of this invention include, but are not limited to, green coffee, yerba mate, red wine, grape seed, red grape skin, purple grape skin, red grape juice, purple grape juice, apple juice, cranberry, pomegranate, blueberry, strawberry, sunflower, Echinacea, pycnogenol, and apple peel.

Suitable dietary fibers include, but are not limited to, non-starch polysaccharides, lignin,
25 cellulose, methylcellulose, the hemicelluloses, β -glucans, pectins, gums, mucilage, waxes, inulins, oligosaccharides, fructooligosaccharides, cyclodextrins, chitins, and combinations thereof.

Food sources of dietary fiber include, but are not limited to, grains, legumes, fruits, and vegetables. Grains providing dietary fiber include, but are not limited to, oats, rye, barley,

wheat. Legumes providing fiber include, but are not limited to, peas and beans such as soybeans. Fruits and vegetables providing a source of fiber include, but are not limited to, apples, oranges, pears, bananas, berries, tomatoes, green beans, broccoli, cauliflower, carrots, potatoes, celery. Plant foods such as bran, nuts, and seeds (such as flax seeds) are also sources of dietary fiber.

5 Parts of plants providing dietary fiber include, but are not limited to, the stems, roots, leaves, seeds, pulp, and skin.

Fatty acids any straight chain monocarboxylic acid and includes saturated fatty acids, unsaturated fatty acids, long chain fatty acids, medium chain fatty acids, short chain fatty acids, fatty acid precursors (including omega-9 fatty acid precursors), and esterified fatty acids. As

10 used herein, "long chain polyunsaturated fatty acid" refers to any polyunsaturated carboxylic acid or organic acid with a long aliphatic tail. Suitable omega-3 fatty acids include, but are not limited to, linolenic acid, alpha-linolenic acid, eicosapentaenoic acid, docosahexaenoic acid, stearidonic acid, eicosatetraenoic acid and combinations thereof. Suitable omega-6 fatty acids

15 include, but are not limited to, linoleic acid, gamma-linolenic acid, dihomo-gamma-linolenic acid, arachidonic acid, eicosadienoic acid, docosadienoic acid, adrenic acid, docosapentaenoic acid and combinations thereof. Suitable esterified fatty acids for embodiments of the present invention include, but are not limited to, monoacylglycerols containing omega-3 and/or omega-6 fatty acids, diacylglycerols containing omega-3 and/or omega-6 fatty acids, or triacylglycerols containing omega-3 and/or omega-6 fatty acids and combinations thereof.

20 Suitable vitamins include, vitamin A, vitamin D, vitamin E, vitamin K, vitamin B1, vitamin B2, vitamin B3, vitamin B5, vitamin B6, vitamin B7, vitamin B9, vitamin B12, and vitamin C. Various other compounds have been classified as vitamins by some authorities. These compounds may be termed pseudo-vitamins and include, but are not limited to, compounds such as ubiquinone (coenzyme Q10), pangamic acid, dimethylglycine, taestrile,

25 amygdaline, flavanoids, para-aminobenzoic acid, adenine, adenylic acid, and s-methylmethionine. As used herein, the term vitamin includes pseudo-vitamins.

Minerals are selected from bulk minerals, trace minerals or combinations thereof. Non-limiting examples of bulk minerals include calcium, chlorine, magnesium, phosphorous, potassium, sodium, and sulfur. Non-limiting examples of trace minerals include chromium,

30 cobalt, copper, fluorine, iron, manganese, molybdenum, selenium, zinc, and iodine. Although

iodine generally is classified as a trace mineral, it is required in larger quantities than other trace minerals and often is categorized as a bulk mineral.

In other particular embodiments of this invention, the mineral is a trace mineral, believed to be necessary for human nutrition, non-limiting examples of which include bismuth, boron,
5 lithium, nickel, rubidium, silicon, strontium, tellurium, tin, titanium, tungsten, and vanadium.

Preservatives are selected from antimicrobials, antioxidants, antienzymatics or combinations thereof. Non-limiting examples of antimicrobials include sulfites, propionates, benzoates, sorbates, nitrates, nitrites, bacteriocins, salts, sugars, acetic acid, dimethyl dicarbonate (DMDC), ethanol, and ozone. Sulfites include, but are not limited to, sulfur dioxide, sodium
10 bisulfite, and potassium hydrogen sulfite. Propionates include, but are not limited to, propionic acid, calcium propionate, and sodium propionate. Benzoates include, but are not limited to, sodium benzoate and benzoic acid. Sorbates include, but are not limited to, potassium sorbate, sodium sorbate, calcium sorbate, and sorbic acid. Nitrates and nitrites include, but are not limited to, sodium nitrate and sodium nitrite. In yet another particular embodiment, the at least one
15 preservative is a bacteriocin, such as, for example, nisin. In another particular embodiment, the preservative is ethanol. In still another particular embodiment, the preservative is ozone. Antienzymatics suitable for use as preservatives in particular embodiments of the invention include ascorbic acid, citric acid, and metal chelating agents such as ethylenediaminetetraacetic acid (EDTA).

20 Hydration products can be electrolytes, non-limiting examples of which include sodium, potassium, calcium, magnesium, chloride, phosphate, bicarbonate, and combinations thereof. Suitable electrolytes for use in particular embodiments of this invention are also described in U.S. Patent No. 5,681,569, the disclosure of which is expressly incorporated herein by reference. Non-limiting examples of salts for use in particular embodiments include chlorides, carbonates,
25 sulfates, acetates, bicarbonates, citrates, phosphates, hydrogen phosphates, tartrates, sorbates, citrates, benzoates, or combinations thereof. In particular embodiments of this invention, the hydration product is a carbohydrate to supplement energy stores burned by muscles. Suitable carbohydrates for use in particular embodiments of this invention are described in U.S. Patent Numbers 4,312,856, 4,853,237, 5,681,569, and 6,989,171, the disclosures of which are expressly
30 incorporated herein by reference. Non-limiting examples of suitable carbohydrates include

monosaccharides, disaccharides, oligosaccharides, complex polysaccharides or combinations thereof. Non-limiting examples of suitable types of monosaccharides for use in particular embodiments include trioses, tetroses, pentoses, hexoses, heptoses, octoses, and nonoses. Non-limiting examples of specific types of suitable monosaccharides include glyceraldehyde, dihydroxyacetone, erythrose, threose, erythrulose, arabinose, lyxose, ribose, xylose, ribulose, xylulose, allose, altrose, galactose, glucose, gulose, idose, mannose, talose, fructose, psicose, sorbose, tagatose, mannoheptulose, sedoheptulose, octulose, and sialose. Non-limiting examples of suitable disaccharides include sucrose, lactose, and maltose. Non-limiting examples of suitable oligosaccharides include saccharose, maltotriose, and maltodextrin. In other particular embodiments, the carbohydrates are provided by a corn syrup, a beet sugar, a cane sugar, a juice, or a tea. In another particular embodiment, the hydration is a flavanol that provides cellular rehydration. Non-limiting examples of suitable flavanols for use in particular embodiments of this invention include catechin, epicatechin, galocatechin, epigallocatechin, epicatechin gallate, epigallocatechin 3-gallate, theaflavin, theaflavin 3-gallate, theaflavin 3'-gallate, theaflavin 3,3'-gallate, thearubigin or combinations thereof. In a particular embodiment, the hydration product is a glycerol solution to enhance exercise endurance.

Probiotics comprise microorganisms that benefit health when consumed in an effective amount. Probiotics may include, without limitation, bacteria, yeasts, and fungi. Examples of probiotics include, but are not limited to, bacteria of the genus *Lactobacilli*, *Bifidobacteria*, *Streptococci*, or combinations thereof. In particular embodiments of the invention, the at least one probiotic is chosen from the genus *Lactobacilli*. *Lactobacilli* (i.e., bacteria of the genus *Lactobacillus*, hereinafter "*L.*"). Non-limiting examples of species of *Lactobacilli* found in the human intestinal tract include *L. acidophilus*, *L. casei*, *L. fermentum*, *L. salivarius*, *L. brevis*, *L. leichmannii*, *L. plantarum*, *L. cellobiosus*, *L. reuteri*, *L. rhamnosus*, *L. GG*, *L. bulgaricus*, and *L. thermophilus*. According to other particular embodiments of this invention, the probiotic is chosen from the genus *Bifidobacteria*. Non-limiting species of *Bifidobacteria* found in the human gastrointestinal tract include *B. angulatum*, *B. animalis*, *B. asteroides*, *B. bifidum*, *B. boum*, *B. breve*, *B. catenulatum*, *B. choerinum*, *B. coryneforme*, *B. cuniculi*, *B. dentium*, *B. gallicum*, *B. gallinarum*, *B. indicum*, *B. longum*, *B. magnum*, *B. merycicum*, *B. minimum*, *B. pseudocatenulatum*, *B. pseudolongum*, *B. psychraerophilum*, *B. pullorum*, *B. ruminantium*, *B. saeculare*, *B. scardovii*, *B. simiae*, *B. subtile*, *B. thermacidophilum*, *B. thermophilum*, *B. urinalis*,

and *B. sp.* According to other particular embodiments of this invention, the probiotic is chosen from the genus *Streptococcus*. *Streptococcus thermophilus* is a gram-positive facultative anaerobe. Other non-limiting probiotic species of this bacteria include *Streptococcus salivarius* and *Streptococcus cremoris*.

5 Prebiotics are compositions that promote the growth of beneficial bacteria in the intestines. Prebiotics include, without limitation, mucopolysaccharides, oligosaccharides, polysaccharides, amino acids, vitamins, nutrient precursors, proteins and combinations thereof. According to a particular embodiment of this invention, the prebiotic is chosen from dietary fibers, including, without limitation, polysaccharides and oligosaccharides. Non-limiting
10 examples of oligosaccharides that are categorized as prebiotics in accordance with particular embodiments of this invention include fructooligosaccharides, inulins, isomalto-oligosaccharides, lactitol, lactosucrose, lactulose, pyrodextrins, soy oligosaccharides, transgalacto-oligosaccharides, and xylo-oligosaccharides. According to other particular embodiments of the invention, the prebiotic is an amino acid.

15 As used herein, “a weight management agent” includes an appetite suppressant and/or a thermogenesis agent. As used herein, the phrases “appetite suppressant”, “appetite satiation compositions”, “satiety agents”, and “satiety ingredients” are synonymous. The phrase “appetite suppressant” describes macronutrients, herbal extracts, exogenous hormones, anorectics, anorexigenics, pharmaceutical drugs, and combinations thereof, that when delivered in an
20 effective amount, suppress, inhibit, reduce, or otherwise curtail a person’s appetite. The phrase “thermogenesis agent” describes macronutrients, herbal extracts, exogenous hormones, anorectics, anorexigenics, pharmaceutical drugs, and combinations thereof, that when delivered in an effective amount, activate or otherwise enhance a person’s thermogenesis or metabolism.

 Suitable weight management agents include macronutrients selected from the group
25 consisting of proteins, carbohydrates, dietary fats, and combinations thereof. Carbohydrates generally comprise sugars, starches, cellulose and gums that the body converts into glucose for energy. Non-limiting examples of carbohydrates include polydextrose; inulin; monosaccharide-derived polyols such as erythritol, mannitol, xylitol, and sorbitol; disaccharide-derived alcohols such as isomalt, lactitol, and maltitol; and hydrogenated starch hydrolysates. Carbohydrates are
30 described in more detail herein below. Dietary fats are lipids comprising combinations of

saturated and unsaturated fatty acids. Polyunsaturated fatty acids have been shown to have a greater satiating power than mono-unsaturated fatty acids. Accordingly, the dietary fats embodied herein desirably comprise poly-unsaturated fatty acids, non-limiting examples of which include triacylglycerols.

- 5 In a particular embodiment, the weight management agents is an herbal extract. Non-limiting examples of plants whose extracts have appetite suppressant properties include plants of the genus *Hoodia*, *Trichocaulon*, *Caralluma*, *Stapelia*, *Orbea*, *Asclepias*, and *Camelia*. Other embodiments include extracts derived from *Gymnema Sylvestre*, Kola Nut, Citrus Aurantium, Yerba Mate, *Griffonia Simplicifolia*, Guarana, myrrh, guggul Lipid, and black current seed oil.
- 10 In a particular embodiment, the herbal extract is derived from a plant of the genus *Hoodia*, species of which include *H. alstonii*, *H. currorii*, *H. dregei*, *H. flava*, *H. gordonii*, *H. jutatae*, *H. mossamedensis*, *H. officinalis*, *H. parviflorai*, *H. pedicellata*, *H. pilifera*, *H. ruschii*, and *H. triebneri*. *Hoodia* plants are stem succulents native to southern Africa. In another particular embodiment, the herbal extract is derived from a plant of the genus *Caralluma*, species of which
- 15 include *C. indica*, *C. fimbriata*, *C. attenuata*, *C. tuberculata*, *C. edulis*, *C. adscendens*, *C. stalagmifera*, *C. umbellata*, *C. penicillata*, *C. russeliana*, *C. retrospiciens*, *C. Arabica*, and *C. lasiantha*. *Caralluma* plants belong to the same Subfamily as *Hoodia*, Asclepiadaceae. In another particular embodiment, the at least one herbal extract is derived from a plant of the genus *Trichocaulon*. *Trichocaulon* plants are succulents that generally are native to southern Africa,
- 20 similar to *Hoodia*, and include the species *T. piliferum* and *T. officinale*. In another particular embodiment, the herbal extract is derived from a plant of the genus *Stapelia* or *Orbea*, species of which include *S. gigantean* and *O. variegata*, respectively. Both *Stapelia* and *Orbea* plants belong to the same Subfamily as *Hoodia*, Asclepiadaceae. In another particular embodiment, the herbal extract is derived from a plant of the genus *Asclepias*. *Asclepias* plants also belong to
- 25 the Asclepiadaceae family of plants. Non-limiting examples of *Asclepias* plants include *A. incarnate*, *A. curassavica*, *A. syriaca*, and *A. tuberosa*. Not wishing to be bound by any theory, it is believed that the extracts comprise steroidal compounds, such as pregnane glycosides and pregnane aglycone, having appetite suppressant effects. In a particular embodiment, the weight management agent is an exogenous hormone having a weight management effect. Non-limiting
- 30 examples of such hormones include CCK, peptide YY, ghrelin, bombesin and gastrin-releasing peptide (GRP), enterostatin, apolipoprotein A-IV, GLP-1, amylin, somastatin, and leptin.

In certain embodiments, the osteoporosis management agent is at least one calcium source, i.e. any compound containing calcium, including salt complexes, solubilized species, and other forms of calcium. Non-limiting examples of calcium sources include amino acid chelated calcium, calcium carbonate, calcium oxide, calcium hydroxide, calcium sulfate, calcium chloride, calcium phosphate, calcium hydrogen phosphate, calcium dihydrogen phosphate, calcium citrate, calcium malate, calcium citrate malate, calcium gluconate, calcium tartrate, calcium lactate, solubilized species thereof, and combinations thereof. According to a particular embodiment, the osteoporosis management agent is a magnesium source, i.e. any compound containing magnesium, including salt complexes, solubilized species, and other forms of magnesium. Non-limiting examples of magnesium sources include magnesium chloride, magnesium citrate, magnesium gluceptate, magnesium gluconate, magnesium lactate, magnesium hydroxide, magnesium picolate, magnesium sulfate, solubilized species thereof, and mixtures thereof. In another particular embodiment, the magnesium source comprises an amino acid chelated or creatine chelated magnesium. In other embodiments, the osteoporosis agent is chosen from vitamins D, C, K, their precursors and/or beta-carotene and combinations thereof. Numerous plants and plant extracts also have been identified as being effective in the prevention and treatment of osteoporosis. Not wishing to be bound by any theory, it is believed that the plants and plant extracts stimulates bone morphogenic proteins and/or inhibits bone resorption, thereby stimulating bone regeneration and strength. Non-limiting examples of suitable plants and plant extracts as osteoporosis management agents include species of the genus *Taraxacum* and *Amelanchier*, as disclosed in U.S. Patent Publication No. 2005/0106215, and species of the genus *Lindera*, *Artemisia*, *Acorus*, *Carthamus*, *Carum*, *Cnidium*, *Curcuma*, *Cyperus*, *Juniperus*, *Prunus*, *Iris*, *Cichorium*, *Dodonaea*, *Epimedium*, *Erigonoum*, *Soya*, *Mentha*, *Ocimum*, *thymus*, *Tanacetum*, *Plantago*, *Spearmint*, *Bixa*, *Vitis*, *Rosemarinus*, *Rhus*, and *Anethum*, as disclosed in U.S. Patent Publication No. 2005/0079232.

Examples of suitable phytoestrogens for embodiments of this invention include, but are not limited to, isoflavones, stilbenes, lignans, resorcylic acid lactones, coumestans, coumestrol, equol, and combinations thereof. Isoflavones belong to the group of phytonutrients called polyphenols. In general, polyphenols (also known as "polyphenolics"), are a group of chemical substances found in plants, characterized by the presence of more than one phenol group per molecule. Suitable phytoestrogen isoflavones in accordance with embodiments of this invention

include genistein, daidzein, glycitein, biochanin A, formononetin, their respective naturally occurring glycosides and glycoside conjugates, matairesinol, secoisolariciresinol, enterolactone, enterodiol, textured vegetable protein, and combinations thereof.

Long-chain primary aliphatic saturated alcohols are a diverse group of organic compounds. The term long-chain refers to the fact that the number of carbon atoms in these compounds is at least 8 carbons. Non-limiting examples of particular long-chain primary aliphatic saturated alcohols for use in particular embodiments of the invention include the 8 carbon atom 1-octanol, the 9 carbon 1-nonanol, the 10 carbon atom 1-decanol, the 12 carbon atom 1-dodecanol, the 14 carbon atom 1-tetradecanol, the 16 carbon atom 1-hexadecanol, the 18 carbon atom 1-octadecanol, the 20 carbon atom 1-eicosanol, the 22 carbon 1-docosanol, the 24 carbon 1-tetracosanol, the 26 carbon 1-hexacosanol, the 27 carbon 1-heptacosanol, the 28 carbon 1-octacosol, the 29 carbon 1-nonacosanol, the 30 carbon 1-triacontanol, the 32 carbon 1-dotriacontanol, and the 34 carbon 1-tetracontanol. In a particularly desirable embodiment of the invention, the long-chain primary aliphatic saturated alcohols are policosanol. Policosanol is the term for a mixture of long-chain primary aliphatic saturated alcohols composed primarily of 28 carbon 1-octacosol and 30 carbon 1-triacontanol, as well as other alcohols in lower concentrations such as 22 carbon 1-docosanol, 24 carbon 1-tetracosanol, 26 carbon 1-hexacosanol, 27 carbon 1-heptacosanol, 29 carbon 1-nonacosanol, 32 carbon 1-dotriacontanol, and 34 carbon 1-tetracontanol.

At least 44 naturally-occurring phytosterols have been discovered, and generally are derived from plants, such as corn, soy, wheat, and wood oils; however, they also may be produced synthetically to form compositions identical to those in nature or having properties similar to those of naturally-occurring phytosterols. According to particular embodiments of this invention, non-limiting examples of phytosterols well known to those of ordinary skill in the art include 4-desmethylsterols (e.g., β -sitosterol, campesterol, stigmasterol, brassicasterol, 22-dehydrobrassicasterol, and Δ^5 -avenasterol), 4-monomethyl sterols, and 4,4-dimethyl sterols (triterpene alcohols) (e.g., cycloartenol, 24-methylenecycloartanol, and cyclobranol).

According to particular embodiments of this invention, non-limiting examples of phytosterols include β -sitosterol, campesterol, cycloartenol, and saturated forms of other triterpene alcohols.

Both phytosterols and phytostanols, as used herein, include the various isomers such as the α and β isomers (e.g., α -sitosterol and β -sitostanol, which comprise one of the most effective phytosterols and phytostanols, respectively, for lowering serum cholesterol in mammals). The phytosterols and phytostanols of the present invention also may be in their ester form. Non-limiting examples of suitable phytosterol and phytostanol esters include sitosterol acetate, sitosterol oleate, stigmasterol oleate, and their corresponding phytostanol esters. The phytosterols and phytostanols of the present invention also may include their derivatives.

Generally, the amount of functional ingredient in the composition varies widely depending on the particular composition and the desired functional ingredient. Those of ordinary skill in the art will readily ascertain the appropriate amount of functional ingredient for each composition.

III. Methods

In one aspect, the present invention provides methods of preparing a beverage of the present invention.

In one embodiment, a method of preparing a beverage comprises mixing a beverage syrup with an appropriate quantity of diluting water. A beverage syrup contains all of the ingredients of the beverage other than the diluting water, e.g. the rebaudioside M, rebaudioside AM, and, optionally, other sweeteners, additives or functional ingredients.

In a particular embodiment, the beverage is a carbonated soft drink. In such embodiments, the diluting water is carbonated water. Typically, the volumetric ratio of syrup to diluting carbonated water is between 1:3 to 1:8, such as, for example, between 1:3 and 1:8, between 1:3 and 1:7, between 1:3 and 1:6, between 1:3 and 1:5, between 1:3 and 1:4, between 1:4 and 1:8, between 1:4 and 1:7, between 1:4 and 1:6, between 1:4 and 1:5, between 1:5 and 1:8, between 1:5 and 1:7, between 1:5 and 1:6, between 1:6 and 1:8, between 1:6 and 1:7 and between 1:7 and 1:8. In a particular embodiment, the volumetric ration of syrup to water is about 1:5.5.

In another embodiment, a method of preparing a beverage comprises dissolving one or more beverage ingredients described herein in a beverage matrix. Beverage ingredients of the

present invention include the rebaudioside AM, rebaudioside M, and optionally, additional sweeteners, additives or functional ingredients.

In a particular embodiment, the beverage matrix comprises citric acid or phosphoric acid.

In another particular embodiment, a method of preparing a beverage comprises dissolving
5 (i) rebaudioside AM and (ii) rebaudioside M in (iii) a beverage matrix wherein, when formulated, the beverage contains greater than about 50 ppm rebaudioside AM and from about 50 ppm to about 600 ppm rebaudioside M. The method can further include addition/dissolution of additional sweeteners, additives and/or functional ingredients as described herein.

In another aspect, the present invention provides methods of improving the flavor profile
10 of a beverage.

In one embodiment, a method for improving the flavor profile of a rebaudioside M-sweetened beverage comprises adding rebaudioside AM in a sweetening amount to said beverage. Improvement in the flavor profile means improving (i.e. reducing) one or more negative flavor attributes of the final beverage (comprising rebaudioside AM) compared to the
15 initial beverage (comprising no rebaudioside AM). For example, addition of rebaudioside AM provides one or more of the following: reduced bitterness, reduced astringency, reduced licorice notes, reduced sweetness linger, reduced bitterness linger, reduced bitterness aftertaste, reduced metallic aftertaste or reduced chemical aftertaste.

20

EXAMPLES

EXAMPLE 1: PREPARATION OF Rebaudioside AM

All reactions were performed under a dry atmosphere of nitrogen unless otherwise specified. Indicated reaction temperatures refer to the reaction bath, while room temperature (rt) is noted as 25 °C. Commercial grade reagents and anhydrous solvents were used as received from vendors
25 and no attempts were made to purify or dry these components further. Removal of solvents under reduced pressure was accomplished with a Buchi rotary evaporator at approximately 28 mm Hg pressure using a Teflon-linked KNf vacuum pump. Flash column chromatography was carried out using a Teledyne Isco CombiFlash Companion unit with RediSep Rf silica gel columns.

Proton NMR spectra were obtained on a 300 MHz and 400 MHz Bruker Nuclear Magnetic Resonance Spectrometer. Chemical shifts (δ) are reported in parts per million (ppm) and coupling constants (J) values are given in Hz, with the following spectral pattern designations: s, singlet; d, doublet; t, triplet; q, quartet; dd, doublet of doublet; m, multiplet; brs, broad singlet.

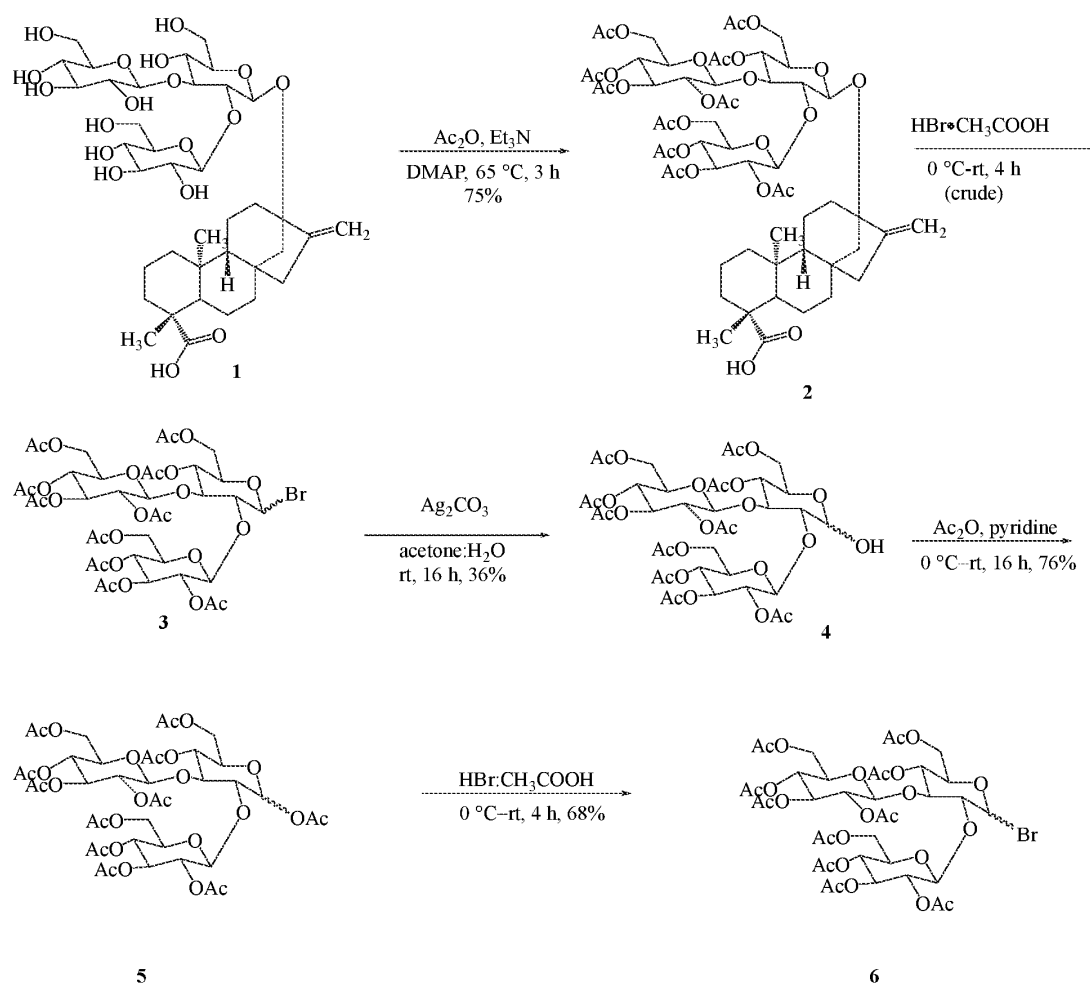
5 Tetramethylsilane was used as an internal reference. Mass spectroscopic analysis were performed using positive and negative mode electron spray ionization (ESI) on an Agilent 1200 system. High pressure liquid chromatography (HPLC) purity analysis was performed using a Varian Pro Star HPLC system with a binary solvent system A and B using a gradient elution [A, H₂O with 0.0284% NH₄OAc and 0.0116% Acetic acid; B, CH₃CN] and flow rate = 1 mL/min, 10 with PDA Scan for UV detection. The following Varian Pro Star HPLC method was used to establish compound purity:

A) Phenomenex Hydro RP (250 × 4.6 mm, 5 μ m); mobile phase, A= H₂O with 0.0284% NH₄OAc and 0.0116% Acetic acid and B= CH₃CN; gradient: 15-70% B (0.0-58 min); UV detection at 210 nm.

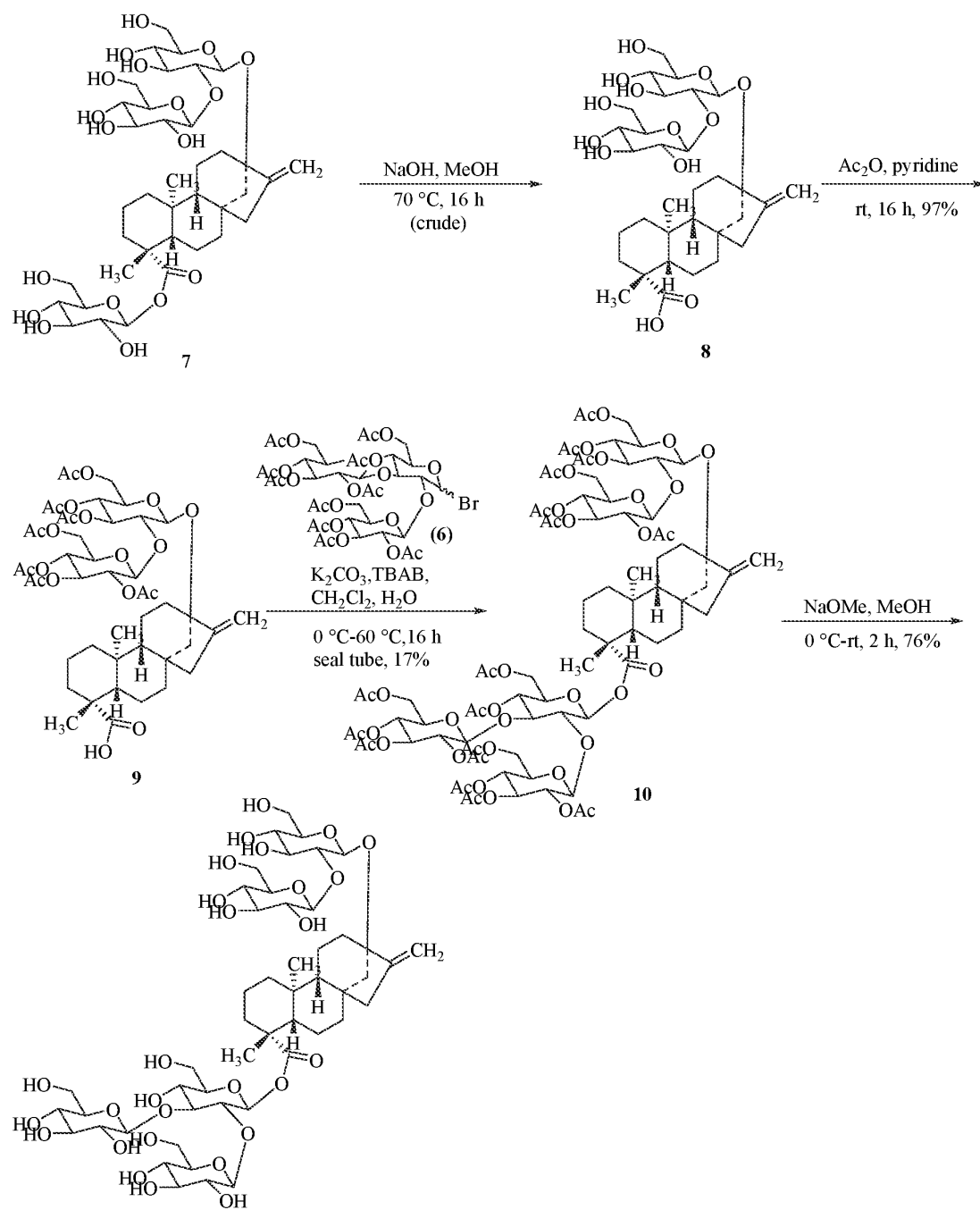
15 B) HPLC Method: Phenomenex Hydro RP (250 × 4.6 mm, 5 μ m); mobile phase, A= H₂O with 0.0284% NH₄OAc and 0.0116% Acetic acid and B= CH₃CN; gradient: 15-70% B (0.0-58 min); UV detection at 210 nm.

20 **Preparation of CC-00350 (Rebaudioside AM)**

Scheme 1:



Scheme 2:



CC-00350

Preparation of 2 (IN-AYR-A-16-1):

To a stirred solution of **1** (3.50 g, 4.35 mmol) in Ac₂O (6.20 mL, 65.3 mmol) was added DMAP (cat) and Et₃N (1.8 mL, 13.05 mmol) at room temperature. The reaction mixture was stirred at 60 °C for 3 h. After completion of the reaction (TLC), the reaction mixture was cooled to room temperature, quenched with water and extracted with CH₂Cl₂ (3 × 50 mL). The combined organic layer was separated, dried over Na₂SO₄ and concentrated under reduced pressure. The residue was dissolved in MeOH (10 mL) and acidified with 1% aq HCl (3 mL), the reaction mixture was stirred for 4 h and basified with 2 M KOH to get the pH 4-5. The solvent was evaporated under reduced pressure to afford the compound **2** (4.00 g, 75%, AMRI lot # IN-AYR-A-16-1) as a white solid. ¹H NMR (400 MHz, CDCl₃): δ 5.25-4.80 (m, 10H), 4.51 (d, *J* = 7.6 Hz, 1H), 4.43 (dd, *J* = 12.4, 4.4 Hz, 1H), 4.18 (dd, *J* = 12.4, 6.0 Hz, 1H), 4.12-3.98 (m, 4H), 3.94-3.81 (m, 2H), 3.73-3.63 (m, 2H), 3.55-3.48 (m, 2H), 2.23-1.98 (m, 32H), 1.98-1.72 (m, 6H), 1.68-1.50 (m, 3H), 1.50-1.43 (m, 3H), 1.34-1.25 (m, 2H), 1.23 (s, 3H), 1.16-1.09 (m, 1H), 1.02 (s, 3H), 0.99-0.95 (m, 1H), 0.91-0.82 (m, 2H).

Preparation of 3 (IN-AYR-A-47-1):

To a stirred solution of **2** (11.0 g, 8.98 mmol) in CH₂Cl₂ (10 mL) HBr in acetic acid (25 mL) was added at 0 °C for 30 min. The reaction mixture was stirred at room temperature for 4 h. The reaction mixture quenched with ice cooled water and extracted with CH₂Cl₂ (3 × 100 mL). The combined organic layer was washed with saturated NaHCO₃ solution (2 × 100 mL), dried over Na₂SO₄ and concentrated under reduced pressure to afford the compound **3** as a light yellow solid. (Note: crude product was directly used in the next step). ESI MS: *m/z* = 987 [M+H]⁺.

Preparation of 4 (IN-VSK-C-50-1):

To a stirred solution of **3** (4.45 g, 4.45 mmol) in acetone (40 mL) and water (10 mL) Ag₂CO₃ (615 mg, 2.22 mmol) was added at room temperature in one lot. The reaction mixture was stirred at room temperature for 16 h. After completion of the reaction (TLC), the reaction mixture was filtered through celite pad and filtrate was concentrated under reduced pressure. The residue was purified by silica gel chromatography (eluted with 70 – 80 % EtOAc in hexanes) to afford the compound **4** (1.50 g, 36%, AMRI lot # IN-VSK-C-50-1) as a white solid. ¹H NMR (400 MHz, CDCl₃): δ 5.48-5.42 (m, 1H), 5.30 (s, 1H), 5.01-5.20 (m, 1H), 4.98-4.85 (m, 2H), 4.64 (dd, *J* =

9.0, 5.4 Hz, 2H), 4.44-4.01 (m, 9H), 3.76-3.47 (m, 5H), 2.20-1.97 (m, 30H). ESI MS: m/z = 947 $[M+Na]^+$.

Preparation of 5 (IN-VSK-C-51-1):

To a stirred solution of **4** (1.50 g, 1.62 mmol) in pyridine (10 mL) was added Ac₂O (1.65 g, 16.23 mmol) at room temperature under nitrogen atmosphere for overnight. After completion of the reaction (TLC), the reaction mixture was azeotroped with toluene (3 × 30 mL) and CH₂Cl₂ (30 mL). The crude compound was purified by silica gel chromatography (eluted with 40 – 50 % EtOAc in hexanes) to afford the compound **5** (1.20 g, 76%, AMRI lot # IN-VSK-C-51-1) as a solid. ¹H NMR (300 MHz, CDCl₃): δ 6.37 (d, J = 7.6 Hz, 1H), 5.24-4.91 (m, 7H), 4.64-4.47 (m, 3H), 4.22-3.96 (m, 7H), 3.81-3.48 (m, 3H), 2.22-1.98 (m, 33H). MS: m/z = 989 $[M+Na]^+$.

Preparation of 6 (IN-VSK-C-55-1):

To a stirred solution of **5** (1.00 g, 1.03 mmol) in CH₂Cl₂ (10 mL) HBr in acetic acid (4 mL) was added at 0 °C for 30 min. The reaction mixture was stirred at room temperature for 16 h. After completion of the reaction (TLC), the reaction mixture was quenched with ice cooled water and extracted with CH₂Cl₂ (3 × 20 mL). The combined organic layer was washed with saturated bicarbonate solution (2 × 30 mL), dried over Na₂SO₄ and concentrate under reduced pressure to afford the compound **6** (700 mg, 68%, AMRI lot # IN-VSK-C-55-1) as a pale yellow solid. (Note: crude product was directly used in the next step). ¹H NMR (300 MHz, CDCl₃): δ 6.00 (dd, J = 11.4, 3.9 Hz, 1H), 5.30-4.78 (m, 8H), 4.72-4.43 (m, 2H), 4.37-4.01 (m, 8H), 3.72-3.61 (m, 2H), 2.22-1.98 (m, 30H). ESI MS: m/z = 1006 $[M+NH_4]^+$;

Preparation of 8: (IN-VSK-C-57-2):

To a stirred solution of **7** (5.0 g, crude) in MeOH (150 mL) was added NaOH (9.44 g, 236.06 mmol) at room temperature and stirred at 70 °C for 16 h. After completion of the reaction (TLC monitored), reaction mixture was cooled to room temperature and acidified with 1 N HCl (pH 4.0-5.0) at 10 °C, the solvent was evaporated under reduced pressure and compound was extracted with n-butanol (3 × 50 mL). The combined organic layer was washed with water and concentrated under reduced pressure. The crude compound was azeotroped with 1:1 of methanol/ acetonitrile (3 × 30 mL) to afford **8** (5.0 g, crude) as a white solid. (Note: crude product was

directly used in the next step). ¹H NMR (400 MHz, DMSO-d₆): δ 5.68 (s, 1H), 5.41 (d, *J* = 3.2 Hz, 1H), 5.12-4.88 (m, 5H), 4.74 (s, 1H), 4.48 (d, *J* = 7.6 Hz, 1H), 4.43-4.38 (m, 1H), 4.36 (d, *J* = 7.6 Hz, 1H), 4.25-4.17 (m, 1H), 3.63-3.53 (m, 2H), 3.51-3.37 (m, 3H), 3.27-2.96 (m, 6H), 2.13-1.65 (m, 9H), 1.54-1.28 (m, 7H), 1.10 (s, 3H), 1.03-0.90 (m, 3H), 0.87 (s, 3H), 0.83-0.72 (m, 1H). ESI MS: *m/z* = 665 [M+Na]⁺;

Preparation of 9 (IN-VSK-C-58-1):

To a stirred solution of compound **8** (5.00 g, 7.77 mmol) in pyridine (50 mL) Ac₂O (7.94 g, 77.79 mmol) was added at room temperature under nitrogen atmosphere for 16 h. After completion of the reaction (TLC monitored), the reaction mixture was azeotroped with toluene (3 × 50 mL), CH₂Cl₂ (100 mL) the solvent was evaporated under reduced pressure. The crude compound was purified by silica gel chromatography (eluted with 60 – 70 % EtOAc in hexanes) to afford the compound **9** (7.00 g, 97%, AMRI lot # IN-VSK-C-58-1) as a white solid. ¹H NMR (400 MHz, CDCl₃): δ 5.20-5.09 (m, 3H), 5.00-4.82 (m, 4H), 4.65 (d, *J* = 8.0 Hz, 1H), 4.58 (d, *J* = 8.0 Hz, 1H), 4.22-4.05 (m, 4H), 3.81-3.60 (m, 3H), 2.26-2.12 (m, 3H), 2.08 (s, 3H), 2.05 (s, 9H), 2.04 (s, 3H), 2.00 (s, 3H), 1.98 (s, 3H), 1.97-1.38 (m, 13H), 1.23 (s, 3H), 1.17-1.09 (m, 1H), 1.03 (s, 3H), 1.02-0.95 (m, 2H), 0.90-0.80 (m, 1H). ESI MS: *m/z* = 959 [M+NH₄]⁺;

Preparation of 10 (IN-VSK-C-66-1):

To a stirred solution of **9** (900 mg, 0.96 mmol) and **6** (948 mg, 0.96 mmol) in CH₂Cl₂ (25 mL), H₂O (5 mL), were added K₂CO₃ (530 mg, 3.84 mmol), TBAB (29 mg, 0.096 mmol) at room temperature and stirred in sealed tube at 60 °C for 16 h. After completion of the reaction (TLC), the reaction mixture was quenched with water and extracted the compound CH₂Cl₂ (3 × 30 mL). The organic layer was dried over Na₂SO₄ and concentrate under reduced pressure. The crude compound was purified by silica gel chromatography (70 – 80 % EtOAc in hexanes) to afford the compound **10** (300 mg, 17%, AMRI lot # IN-VSK-C-66-1) as a white solid. ¹H NMR (400 MHz, CD₃OD): δ 5.65 (d, *J* = 7.6 Hz, 1H), 5.20-5.08 (m, 5H), 5.05-4.80 (m, 11H), 4.76-4.67 (m, 5H), 4.37 (dd, *J* = 12.4, 8.4 Hz, 1H), 4.28 (dd, *J* = 12.4, 8.0 Hz, 1H), 4.17-3.89 (m, 8H), 3.84-3.71 (m, 4H), 3.58 (dd, *J* = 9.2, 7.6 Hz, 1H), 2.12-1.85 (m, 53H), 1.84-1.70 (m, 6H), 1.62-1.30 (m, 8H), 1.20 (s, 3H), 1.06-0.86 (m, 3H), 0.82 (s, 3H), 0.81-0.74 (m, 1H).

Preparation of CC-00350 (IN-VSK-C-67-2):

To a stirred solution of **10** (300 mg, 0.19 mmol) in MeOH (3 mL) NaOMe (1.02 mg, 0.019 mmol) was added at 0 °C and stirred for 5 min. The reaction mixture was stirred at room temperature for 1 h. After completion of the reaction (TLC), the reaction mixture was concentrated under reduced pressure. The residue was triturated in n-pentane (2 × 5 mL). The solvent was decanted and dried under reduced pressure. The residue compound was purified by prep.HPLC (Method A) to afford the title compound **CC-0350** (140 mg, 76%, AMRI lot # IN-VSK-C-67-2) as a white fluffy solid. ¹H NMR (400 MHz, CDCl₃): δ 5.46 (d, *J* = 7.6 Hz, 1H), 5.15 (s, 1H), 4.93 (d, *J* = 8.0 Hz, 1H), 4.83 (s, 1H), 4.73 (s, 1H), 4.65 (d, *J* = 8.0 Hz, 1H), 4.57 (d, *J* = 7.6 Hz, 1H), 4.51 (s, 1H), 4.48 (d, *J* = 7.2 Hz, 1H), 3.98-3.83 (m, 2H), 3.82-3.73 (m, 2H), 3.71-3.68 (m, 3H), 3.62-3.48 (m, 6H), 3.43-3.24 (m, 9H), 3.18-3.03 (m, 6H), 2.22-2.14 (m, 2H), 2.05-1.91 (m, 5H), 1.85-1.67 (m, 4H), 1.55-1.30 (m, 5H), 1.15 (s, 3H), 1.02-0.89 (m, 3H), 0.85 (s, 3H), 0.83-0.72 (m, 1H); UPLC MS: *m/z* = 1146 [M+NH₄]⁺; HPLC 99.6% (AUC), (Method B), *t_R* = 28.96 min.

15

Following the same synthetic route, additional batches, Lot AMR101011-87-2 (3.05 g) and IN-RSV-M-47-2 (1.1 g), were prepared

EXAMPLE 2: CARBONATED BEVERAGES WITH 7-8% SUCROSE EQUIVALENCE (SE) SWEETNESS

20 Rebaudioside AM was synthesized as set forth in Example 1. Commercial rebaudioside M was supplied by Pure Circle (purity SG>95%, Reb-M 82.35%, Reb-D 9.4%).

Diet Carbonated Cola

The following ingredients were used to make 1 liter of beverage:

Ingredients	Control 7% SE	Test 7% SE	Control 8% SE	Test 8% SE
	Reb M 240 ppm	250 ppm Reb AM + 150 ppm Reb M	Reb M 320 ppm	300 ppm Reb AM + 210 ppm Reb-M

Water	997.062	996.902	996.982	996.792
Phosphoric acid (75%)	0.304	0.304	0.304	0.304
Citric acid	0.095	0.095	0.095	0.095
Caffeine	0.076	0.076	0.076	0.076
Caramel	0.113	0.113	0.113	0.113
Sodium benzoate	0.087	0.087	0.087	0.087
Potassium sorbate	0.105	0.105	0.105	0.105
Cola flavor	1.918	1.918	1.918	1.918
Reb-M	0.24	0.15	0.32	0.21
Reb-AM	-	0.25	-	0.3
Total	1000 g	1000 g	1000 g	1000 g

Diet Carbonated Lemon Lime

The following ingredients were used to make 1 liter of beverage:

Ingredients	Control 7% SE Reb M 240 ppm	Test 7% SE 250 ppm Reb AM + 150 ppm Reb M	Control 8% SE Reb M 320 ppm	Test 8% SE 300 ppm Reb AM + 210 ppm Reb M
Water	997.264	997.104	997.184	996.994
Citric acid	1.171	1.171	1.171	1.171

Sodium Citrate	0.275	0.275	0.275	0.275
Sodium benzoate	0.185	0.185	0.185	0.185
Lemon lime flavor	0.865	0.865	0.865	0.865
Reb-M	0.24	0.15	0.32	0.21
Reb-AM	-	0.25	-	0.3
Total	1000 g	1000 g	1000 g	1000 g

The diet cola and lemon lime beverages were carbonated with beverage grade carbon dioxide to a carbonation level of 3.8 volume, then filled in 300 ml glass bottles and aged over night at 35°C. The following day the beverages were cooled to 4°C and bench tasted.

5 Bench Tasting and Results

Four experienced panelists bench tasted the beverages blindly. Each panelist was given warm bottled water and unsalted crackers to eat and rinse the palate between samples. A maximum of 3 samples was tasted at each session to avoid fatigue.

Sensory Taste Comments – Diet Cola Beverages

Diet Cola Beverages	Taste Comments
Diet Cola Control 7% SE Sweetness	Some bitterness and lingering aftertaste
Diet Cola Test 7% Sweetness	More balanced, less bitter, less astringent, bolder flavor, much preferred over control
Diet Cola Control 8% SE Sweetness	Some bitterness and lingering aftertaste

Diet Cola Test 8% SE Sweetness	Less linger, less bitter, more balanced flavor, preferred over control
--------------------------------	--

Sensory Taste Comments – Diet Lemon Lime Beverages

Diet Lemon Lime Beverages	Taste Comments
Diet Lemon Lime Control 7% SE Sweetness	Some bitterness and lingering aftertaste
Diet Lemon Lime Test 7% SE Sweetness	More balanced, less bitter, less astringent, more bold and better flavor, much preferred over control
Diet Lemon Lime Control 8% SE Sweetness	Some bitterness and lingering aftertaste
Diet Lemon Lime Test 8% SE Sweetness	Less linger, less bitter, more balanced flavor, better mouthfeel, preferred over control

5 All panelists agreed that the cola and lemon lime beverages with blends of reb AM and reb M showed overall taste improvement compared to the controls with reb M only. The blend significantly reduced the sweetness lingering and bitterness aftertaste while balancing the flavor with more rounded and pleasant notes, including more mouthfeel sensations

EXAMPLE 3: CARBONATED BEVERAGES WITH 10% SUCROSE EQUIVALENCE (SE)

Rebaudioside AM was synthesized as set forth in Example 1. Commercial rebaudioside M was supplied by Pure Circle (purity SG>95%, Reb-M 82.35%, Reb-D 9.4%).

5

Diet Carbonated Cola

The following ingredients were used to make 1 liter of beverage:

Ingredients	Control 10% SE	Test 10% SE
	Reb M 472 ppm	500 ppm Reb AM + 220 ppm Reb M
Water	996.83	996.58
Phosphoric acid (75%)	0.304	0.304
Citric acid	0.095	0.095
Caffeine	0.076	0.076
Caramel	0.113	0.113
Sodium benzoate	0.087	0.087
Potassium sorbate	0.105	0.105
Cola flavor	1.918	1.918
Reb-M	0.472	0.22
Reb-AM	-	0.5
Total	1000 g	1000 g

Diet Carbonated Lemon Lime

The following ingredients were used to make 1 liter of beverage:

Ingredients	Control 10% SE	Test 10% SE
	Reb M 472 ppm	500 ppm Reb AM + 240 ppm Reb M
Water	997.03	996.76
Citric acid	1.171	1.171
Sodium Citrate	0.275	0.275
Sodium benzoate	0.185	0.185
Lemon lime flavor	0.865	0.865
Reb-M	0.472	0.24
Reb-AM	-	0.5
Total	1000 g	1000 g

- 5 The diet cola and lemon lime beverages were carbonated with beverage grade carbon dioxide to a carbonation level of 3.8 volume, then filled in 300 ml glass bottles and aged over night at 35°C. Next day the beverages were cooled at 4°C then bench tasted.

Bench Tasting and Results

- 10 Four experienced panelists bench tasted the beverages blindly. Each panelist was given warm bottled water and unsalted crackers to eat and rinse the palate between samples.

Sensory Taste Comments – Diet Cola Beverages

Diet Cola Beverages	Taste Comments
Diet Cola Control 10% SE Sweetness	Some bitterness and lingering aftertaste
Diet Cola Test 10% SE Sweetness	Less sweetness lingering, less bitterness aftertaste, flavor is more balanced, preferred over control

Sensory Taste Comments – Diet Lemon Lime Beverages

Diet Lemon Lime Beverages	Taste Comments
Diet Lemon Lime Control 10% SE Sweetness	Some bitterness and lingering aftertaste
Diet Lemon Lime Test 10% SE Sweetness	Faster sweetness onset, sugar-like sweetness, lemon lime flavor is richer and more balanced, preferred over control

5 All panelists agreed that the cola and lemon lime beverages with blends of reb AM and reb M showed overall taste improvement compared to the controls with reb M only. The blend significantly reduced the sweetness lingering and bitterness aftertaste while balancing the flavor with more rounded and pleasant notes, including more mouthfeel sensations.