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(54) Title: SENSORY MODIFIERS FOR SUGAR ALCOHOL AND/OR RARE SUGAR COMPOSITIONS

(57) Abstract: A composition including i) a rare sugar and/or a sugar alcohol, and ii) a sensory modifier and with reduced bitterness, reduced metallic flavor, and/or improved temporal sweetness aspects relative to an equivalent composition without the sensory modifier is described herein. The sensory modifier may include a dicaffeoylquinic acid or salt thereof; and one or more compounds selected from the group consisting of monocaffeoylquinic acids, monoferuloylquinic acids, diferuloylquinic acids, monocoumaroylquinic acids, dicoumaroylquinic acids, and salts thereof.

SENSORY MODIFIERS FOR SUGAR ALCOHOL AND/OR RARE SUGAR COMPOSITIONS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 63/387,125, filed December 13, 2022, which is incorporated by reference herein in its entirety.

BACKGROUND

[0002] Within the food and beverage industry, there continues to be efforts to reduce the amount of caloric sugars, such as sucrose, fructose, and/or glucose, in products. While sugar substitutes can provide a sweetened taste to products, there can be limitations to preparing products with sugar substitutes. For example, consumers may find that the sensory and temporal characteristics of sugar substitutes differ from those found in caloric sweeteners such as glucose, sucrose, and/or fructose. These sensory characteristics can limit the use of sugar substitutes in products and become increasingly limiting as the concentration of sugar substitute increases.

SUMMARY

[0003] The present disclosure provides compositions comprising a sugar alcohol and/or a rare sugar and a sensory modifier comprising a dicaffeoylquinic acid or salt thereof and at least one compound selected from the group consisting of monocaffeoylquinic acids, monoferuloylquinic acids, diferuloylquinic acids, monocoumaroylquinic acids, dicoumaroylquinic acids, and salts thereof. The composition may comprise the sugar alcohol and the sensory modifier. The composition may comprise the rare sugar and the sensory modifier. The sugar alcohol and/or rare sugar may be present in the composition in a sweetening amount. The sugar alcohol and/or rare sugar may be present in the composition in an amount such that, when in water to form a solution, sweetness of the solution is at least 1.5 Brix. The composition may comprise a sugar alcohol selected from the group consisting of glycerol, erythritol, sorbitol, xylitol, mannitol, lactitol, maltitol, isomalt, and combinations thereof. The composition may comprise a rare sugar selected from the group consisting of allulose, tagatose, and combinations thereof. The composition may comprise erythritol, allulose, sorbitol, or combinations thereof. In the composition the ratio of total concentration of sugar alcohol and/or rare sugar to sensory modifier may be between 100:1 and 10,000:1, between 2500:1 and 7000:1, between 5000:1 and 10,000:1, between 100:1 and 750:1, between 150:1 and 600:1, or between 250:1 and 550:1.

[0004] The present disclosure also provides a food or beverage product comprising the rare sugar and/or sugar alcohol compositions described herein. The food or beverage product may comprise 0.001 (wt)% to 1.0 (wt)%, 0.005 (wt)% to 0.5 (wt)%, or 0.075 (wt)% to 0.2 (wt)% of the sensory modifier. The food or beverage product may comprise at least 1.0 (wt)%, at least 5 (wt)%, at least 10 (wt)%, at least 15 (wt)%, at least 20 (wt)%, at least 30 (wt)%, at least 40 (wt)%, at least 50 (wt)%, at least 60 (wt)%, at least 70 (wt)%, at least 80 (wt)%, at least 90 (wt)%, or at least 95 (wt)% of the sugar alcohol and/or rare sugar. The food or beverage product may comprise at least 1.0 (wt)%, at least 5 (wt)%, at least 10 (wt)%, at least 15 (wt)%, at least 20 (wt)%, at least 30 (wt)%, at least 40 (wt)%, at least 50 (wt)%, at least 60 (wt)%, at least 70 (wt)%, at least 80 (wt)%, at least 90 (wt)%, or at least 95 (wt)% of allulose, erythritol, sorbitol, or a combination thereof.

[0005] The disclosure also provides a method for reducing bitterness in a sugar alcohol and/or rare sugar composition, the method comprising, adding to a composition comprising a sugar alcohol and/or a rare sugar a sensory modifier comprising a dicaffeoylquinic acid or salt thereof and at least one compound selected from the group consisting of monocaffeoylquinic acids, monoferuloylquinic acids, diferuloylquinic acids, monocoumaroylquinic acids, dicoumaroylquinic acids, and salts thereof, wherein, when added in water to form a solution, bitterness of the solution is reduced relative to bitterness of an aqueous solution prepared from an equivalent sugar alcohol composition lacking the sensory modifier. The sensory modifier may be added to the sugar alcohol and/or rare sugar composition in an amount effective to reduce bitterness such that a bitterness score of the composition is reduced by at least 1 unit, at least 2 units, or at least 3 units relative to a comparable composition without the sensory modifier, wherein bitterness score is determined by at least four panelists experienced in sensory testing using a roundtable methodology using a scale of 0 to 9 with a score of 0 indicating no bitterness and a score of 9 indicating extreme bitterness. The composition may be a food or beverage product.

[0006] The disclosure also provides a use of a sensory modifier comprising a dicaffeoylquinic acid or salt thereof and at least one compound selected from the group consisting of monocaffeoylquinic acids, monoferuloylquinic acids, diferuloylquinic acids, monocoumaroylquinic acids, dicoumaroylquinic acids, and salts thereof to reduce bitterness, reduce metallic flavor, or combinations thereof, in a sugar alcohol and/or rare sugar composition.

[0007] The sensory modifier may comprise less than 0.3% (wt) of malonate, malonic acid, oxalate, oxalic acid, lactate, lactic acid, succinate, succinic acid, malate, or malic acid; or less than 0.05% (wt) of pyruvate, pyruvic acid, fumarate, fumaric acid, tartrate, tartaric acid, sorbate, sorbic

acid, acetate, or acetic acid; or less than 0.05% (wt) of chlorophyll; or less than 0.1% (wt) of furans, furan-containing chemicals, theobromine, theophylline, or trigonelline as a weight percentage on a dry weight basis of the sensory modifier. The sensory modifier may comprise 0% (wt) of malonate, malonic acid, oxalate, oxalic acid, lactate, lactic acid, succinate, succinic acid, malate, or malic acid; or 0% (wt) of chlorophyll. The dicaffeoylquinic acid or dicaffeoylquinic salt may comprise at least one compound selected from the group consisting of 1,3-dicaffeoylquinic acid, 1,4-dicaffeoylquinic acid, 1,5-dicaffeoylquinic acid, 3,4-dicaffeoylquinic acid, 3,5-dicaffeoylquinic acid, 4,5-dicaffeoylquinic acid, and salts thereof. The total of all dicaffeoylquinic acids and dicaffeoylquinic salts present in the sensory modifier may comprise 10% (wt) or more, 15 wt % or more, 20% (wt) or more, 25% (wt) or more, 30% (wt) or more, 35% (wt) or more, 40% (wt) or more, 45% (wt) or more, 50% (wt) or more, 60% (wt) or more, 70% (wt) or more, 25-75% (wt), or 40-60% (wt) of a total weight of the sensory modifier. The sensory modifier may comprise a monocaffeoylquinic component selected from the group consisting of chlorogenic acid, neochlorogenic acid, cryptochlorogenic acid, and salts thereof. The sensory modifier may comprise a monocaffeoylquinic component and a dicaffeoylquinic component that together comprise more than 50% (wt), preferably more than 60% (wt), more than 70% (wt), more than 80% (wt), more than 90% (wt), or more than 95% (wt) of the sensory modifier.

DETAILED DESCRIPTION

[0008] Reference will now be made in detail to certain aspects of the disclosed subject matter, examples of which are illustrated in part in the accompanying drawings. While the disclosed subject matter will be described in conjunction with the enumerated claims, it will be understood that the exemplified subject matter is not intended to limit the claims to the disclosed subject matter.

[0009] In this document, the terms “a,” “an,” or “the” are used to include one or more than one unless the context clearly dictates otherwise. The term “or” is used to refer to a nonexclusive “or” unless otherwise indicated. All publications, patents, and patent documents referred to in this document are incorporated by reference herein in their entirety, as though individually incorporated by reference. In the event of inconsistent usages between this document and those documents so incorporated by reference, the usage in the incorporated reference should be considered supplementary to that of this document; for irreconcilable inconsistencies, the usage in this document controls.

[0010] Values expressed in a range format should be interpreted in a flexible manner to include not only the numerical values explicitly recited as the limits of the range, but also to include all the individual numerical values or sub-ranges encompassed within that range as if each numerical value and sub-range were explicitly recited. For example, a range of “about 0.1% to about 5%” or “about 0.1% to 5%” should be interpreted to include not just about 0.1% to about 5%, but also the individual values (e.g., 1%, 2%, 3%, and 4%) and the sub-ranges (e.g., 0.1% to 0.5%, 1.1% to 2.2%, 3.3% to 4.4%) within the indicated range. The statement “about X to Y” has the same meaning as “about X to about Y,” unless indicated otherwise. Likewise, the statement “about X, Y, or about Z” has the same meaning as “about X, about Y, or about Z,” unless indicated otherwise.

[0011] Unless expressly stated, ppm (parts per million), percentage, and ratios are on a by weight basis. Percentage on a by weight basis is also referred to as wt% or % (wt) below.

[0012] This disclosure relates to various compositions include a sugar alcohol, a rare sugar, or combinations thereof, which have improved sensory attributes, such as reduced bitterness, improved sweetness temporal profile, reduced metallic flavor, and the like. The disclosure also relates to compositions, such as food and beverage compositions, made with the sugar alcohol and/or rare sugar compositions, the food and beverage compositions having improved sensory attributes such as reduced bitterness, improved sweetness temporal profile, reduced metallic flavor, and the like. The disclosure also relates, generally, to a sensory modifier and uses thereof. In various aspects, the sensory modifier contains one or more caffeoyl-substituted quinic acids, and salts thereof.

Compositions

[0013] The present disclosure provides rare sugar and/or sugar alcohol compositions containing a rare sugar, a sugar alcohol, or combinations thereof, with various improvements which serve to modify the sensory perception thereof in use. In general, the rare sugar and/or sugar alcohol compositions will include a rare sugar, a sugar alcohol, or combinations thereof and a sensory modifier that improves one or more sensory attributes of the rare sugar and/or sugar alcohol composition relative to an equivalent composition lacking the sensory modifier.

[0014] As used herein, “sugar alcohol” refers to organic compounds generally having the formula $\text{HOCH}_2(\text{CHOH})_n\text{CH}_2\text{OH}$ that may be naturally occurring or produced by hydrogenation of sugars. In the art, sugar alcohols may also be referred to as polyhydric alcohols, polyalcohols, alditols, and/or glycitols and are generally classified as polyols. Sugar alcohols for use in the compositions described herein may include, but are not limited to, erythritol, sorbitol, mannitol,

arabitol, xylitol, isomalt, lactitol, maltitol, and the like. Sugar alcohols may have a relative sweetness of 30-100% of the sweetness of sucrose and may be used in compositions as a sugar substitute. Sugar alcohols may also be used as bulking agents.

[0015] As used herein, “rare sugar” refers to a sugar that occurs in low or limited quantities in nature and may include, but are not limited to, allulose, allose, sorbose, and tagatose. Rare sugars may have a relative sweetness of 60-95% of the sweetness of sucrose and may be used in compositions as a sugar substitute. Rare sugars may also be used as bulking agents.

[0016] As used herein, “sugar substitute” refers to a low-calorie sweetener or a no-calorie sweetener.

[0017] As used herein, “low-calorie sweetener” refers to sweeteners that have the same or lower intensity of sweetness per gram than sucrose but fewer calories. For example, suitable low-calorie sweeteners may include, but are not limited to, erythritol, arabitol, isomalt, tagatose, erythritol, maltitol, lactitol, sorbitol, mannitol, allulose, allose, sorbose, xylitol, hydrogenated starch hydrolysates, combinations thereof, and the like. Preferably, the low-calorie sweetener is a sugar alcohol or rare sugar.

[0018] As used herein, “no-calorie sweetener” refers to sweeteners that have no calories, or do not add calories to the compositions to which they are added due to their low usage levels, but have higher intensity of sweetness per gram than sucrose. No-calorie sweeteners may also be known in the art as high intensity sweeteners or high potency sweeteners. No-calorie sweeteners may include, but are not limited to, steviol glycosides, mogrosides, sucralose, acesulfame potassium (acesulfame K), aspartame, saccharin, brazzein, combinations thereof, and the like.

[0019] The compositions described herein may include a sweetener in addition to the rare sugar and/or sugar alcohol. Suitable sweeteners are known and described in the art. The composition may include a caloric sweetener, a non-nutritive sweetener, or combinations thereof. The sweetener can be any type of sweetener, for example, a sweetener obtained from a plant or plant product, or a physically or chemically modified sweetener obtained from a plant, or a synthetic sweetener. Suitable sweeteners and aspects thereof are also described in PCT International Publication Nos. WO 2019/071220 and WO 2019/071182 and in US Patent Application Publication Nos. 2019/0223481 and 2019/0223483, each of which is incorporated by reference herein in its entirety.

[0020] As used herein, “caloric sweeteners” refer to ingredients that add both sweetness and calories to the compositions to which they are added. Caloric sweeteners include, but are not limited to, trehalose, glucose, dextrose, fructose, galactose, sucrose, lactose, maltose, palatinose,

isomaltulose, cane sugar, beet sugar, rice syrup, invert sugar, honey, agave syrup, maple syrup, high fructose corn syrup, combinations thereof, and the like. The term “sucrose” as used herein includes sucrose in various forms including but not limited to standard (e.g. granulated or crystalline) table sugar, powdered sugar, caster sugar, icing sugar, sugar syrup, silk sugar, unrefined sugar, raw sugar cane, and molasses. Preferably, the caloric sweetener is sucrose.

[0021] The compositions described herein may additionally include one or more bulking agents (in addition to the sugar alcohol and/or rare sugar), plasticizing ingredients, emulsifiers, flavorings, or combinations thereof.

[0022] Suitable bulking agents include, but are not limited to, oligosaccharides (such as fructo-oligosaccharides (kestose, nystose, and the like), nigero-oligosaccharides, xylo-oligosaccharides (xylotriose, xylobiose and the like), gentio-oligosaccharides (gentiobiose, gentiotriose, gentiotetraose and the like), galacto-oligosaccharides, tetrasaccharides, mannan-oligosaccharides, malto-oligosaccharides (maltotriose, maltotetraose, maltopentaose, maltohexaose, maltoheptaose and the like), soybean oligosaccharides, and the like), polysaccharides (such as starch and starch-derivatives including maltodextrin, dextrans, and glucose syrup; fructan; inulin; polydextrose; pectin and the like), insoluble fibers (such as resistant starches, cereal fibers, grain fibers, fruit fibers, and legume fibers), sugar alcohols (such as erythritol, maltitol, lactitol, sorbitol, mannitol, xylitol), rare sugar (such as allulose, tagatose, and the like) and combinations thereof. In some aspects, the bulking agent may be selected from the group consisting of vegetable fibers, dextrin, maltodextrin, polydextrose, inulin, dehydrated grain syrups (such as dried rice syrup), pectin, sugar alcohols, and combinations thereof. Preferably, the bulking agent is a sugar alcohol. Bulking agents may be added to the composition in an amount of up to 75%, up to 70%, up to 65%, up to 60%, up to 55%, up to 50%, up to 45%, up to 40%, up to 35%, up to 30%, up to 25%, up to 20%, up to 15%, or up to 10% by weight of the composition. The compositions described herein may include a bulking agent in an amount of 0.5% to 75%, 1% to 60%, 2% to 55%, or 3% to 50% by weight. In some aspects, an ingredient may function as both a sweetener and a bulking agent in a composition, such as erythritol, maltitol, lactitol, sorbitol, mannitol, xylitol, allulose, and tagatose.

[0023] The compositions described herein can be incorporated in or used to prepare any known edible material or other composition intended to be ingested and/or contacted with the mouth of a human or animal, such as, for example, pharmaceutical compositions, supplement compositions (e.g., gummy, tablet, etc.), edible gel mixes and compositions, dental and oral hygiene compositions, foodstuffs (e.g., confections, condiments, chewing gum, cereal compositions, baked goods, baking goods, cooking adjuvants, dairy products, and tabletop sweetener

compositions), and beverage products (e.g., beverages, beverage mixes, beverage concentrates, etc.). Examples of such compositions and aspects thereof are set forth in PCT International Publication Nos. WO 2019/071220 and WO 2019/071182 and in US Patent Application Publication Nos. 2019/0223481 and 2019/0223483, each of which is incorporated by reference herein in its entirety.

[0024] The compositions described herein can be a beverage product or can be used to prepare a beverage product. As used herein a "beverage product" includes, but is not limited to, a ready-to-drink beverage, a beverage concentrate, a beverage syrup, frozen beverage, or a powdered beverage. Suitable ready-to-drink beverages include carbonated and non-carbonated beverages. Carbonated beverages include, but are not limited to, enhanced sparkling beverages, cola, lemon-lime flavored sparkling beverage, orange flavored sparkling beverage, grape flavored sparkling beverage, strawberry flavored sparkling beverage, pineapple flavored sparkling beverage, ginger-ale, soft drinks and root beer. 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, cafe au lait, milk tea, fruit milk beverages), beverages containing cereal extracts, smoothies and combinations thereof. Examples of frozen beverages include, but are not limited to, icees, frozen cocktails, daiquiris, pina coladas, margaritas, milk shakes, frozen coffees, frozen lemonades, granitas, and slushees. Beverages may be alcoholic (e.g., a liqueur or cream liqueur) or non-alcoholic beverages. The beverage may be a brewed for fermented beverage, for example, beer or kombucha. Beverage concentrates and beverage syrups can be prepared with an initial volume of liquid matrix (e.g., water) and the desired beverage ingredients. Full strength beverages are then prepared by adding further volumes of water. Powdered beverages are prepared by dry-mixing all of the beverage ingredients in the absence of a liquid matrix. Full strength beverages are then prepared by adding the full volume of water, liquid matrix, or aqueous solution.

[0025] In some aspects, a method of preparing a beverage provided herein includes adding a composition as described herein to a liquid matrix (e.g., water or an aqueous solution). The method can further comprise adding one or more sweeteners, additives and/or functional ingredients to the beverage or to the composition before adding it to the liquid matrix.

[0026] The compositions described herein can be a food product or can be used to prepare a food product. The food product may be any caloric or non-caloric food product suitable for human consumption. Suitable food products include, but are not limited to, confectionary products (e.g., candies, candied nuts, candy bars, caramels, chocolates, chocolate bars, chocolate drops, chocolate in the form of hollow figures or any desired shape, filled chocolate bars, pralines, truffles, cereal bars, chewing gum, and pastillage), condiments, chewing gum, cereal compositions, baked goods, bakery products (e.g., breads such as bagels, buns, rolls, biscuits and loaf breads; cookies; brownies; muffins; desserts such as cakes, cheesecakes and pies; snack cakes; sweet goods such as doughnuts, Danish, sweet rolls, cinnamon rolls and coffee cake), cooking adjuvants, dairy products (e.g., ice cream, yogurt, chilled desserts, pudding, mousse, custard, milk shakes, malts, cream cheeses, cheeses, fudge), dairy-alternatives, frozen desserts (e.g., ice cream, sorbet, frozen yoghurt, and the like), tabletop sweetener compositions, seasoning, sauces, gravies, soups, dressings, snack products (e.g., granola bars, nutrition bars, and the like), and the like. The compositions described herein may be used in food products in any form, such as melted or mixed into the recipe of the end product, in the form of a filling, inclusions, toppings, or coatings, molded around other discrete ingredients such as nuts, fruit, dried fruit, biscuits, candy pieces or shapes, combinations thereof, and the like. In frozen dessert compositions, the composition may be used as a coating, inclusion (chunks, flakes, or ripples), topping, or core (soft or solid).

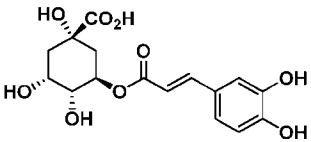
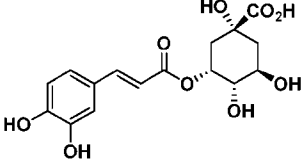
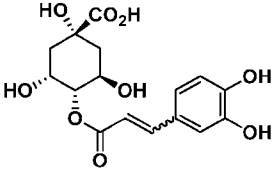
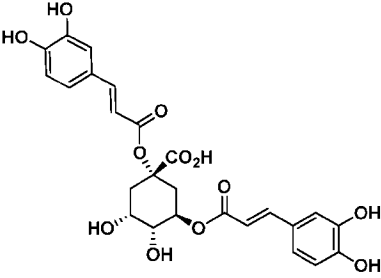
Sensory Modifier

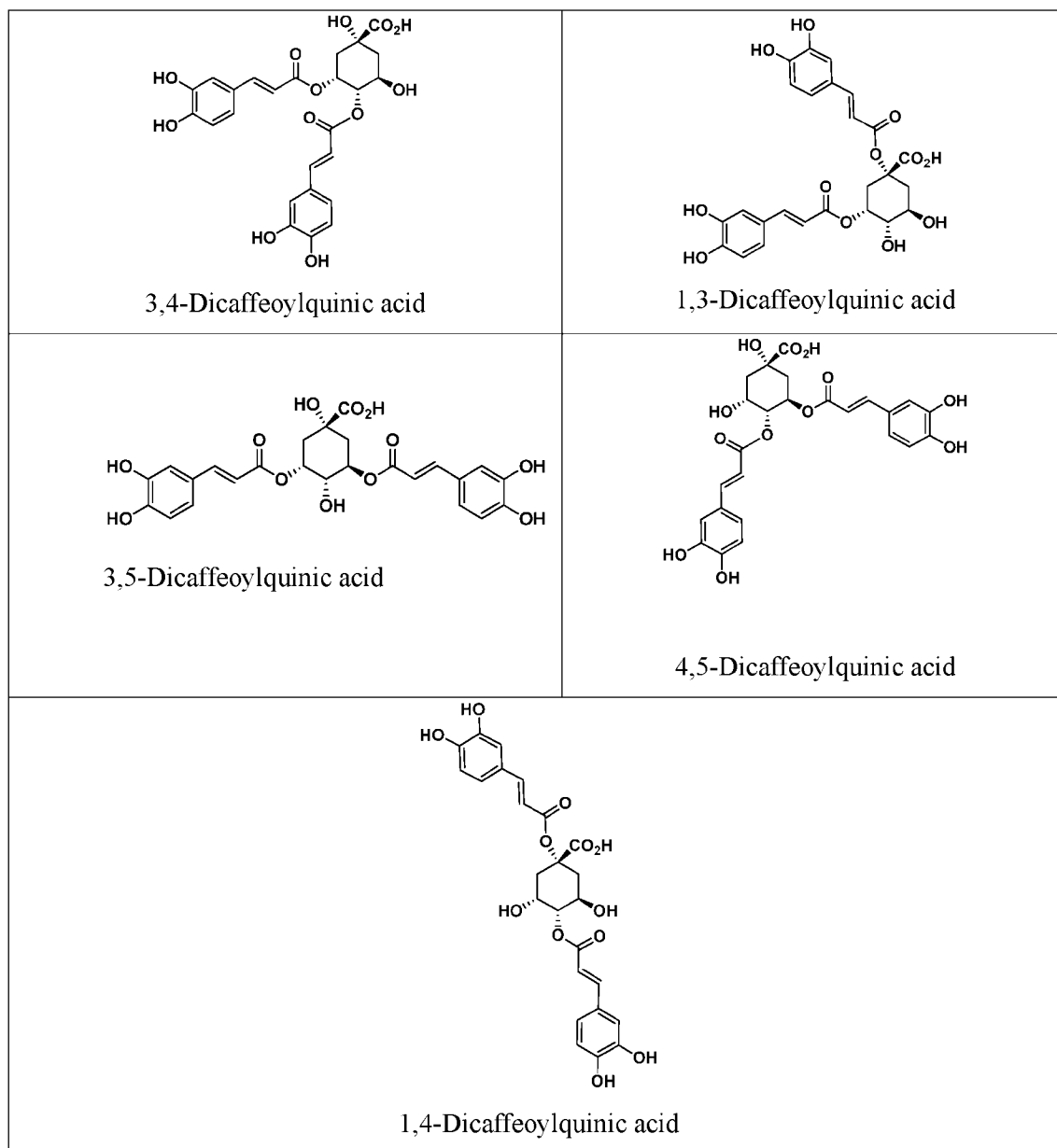
[0027] A sensory modifier is a compound or composition that in certain amounts changes the sensory characteristics or sensory attributes of a consumable, e.g., a beverage, a food product, etc. Non-limiting examples of sensory characteristics that a sensory modifier can change include bitterness, sourness, numbness, astringency, metallic notes, cloyingness, dryness, sweetness, starchiness, mouthfeel, temporal aspects of sweetness, temporal aspects of saltiness, temporal aspects of bitterness, or temporal aspects of any sensory characteristic described herein, as well as flavor notes, such as licorice, vanilla, prune, cotton candy, lactic, umami, pulse, and molasses flavor notes. The sensory modifier may enhance a sensory characteristic, such as enhancing flavor profile; may suppress a sensory characteristic, such as reducing bitterness and reducing cooked milk flavor; or may change the temporal aspects of a sensory characteristic. In some aspects, the amount of sensory modifier employed in a rare sugar and/or sugar alcohol composition alters at least one sensory characteristic, e.g., the combination may have reduced bitterness, reduced

metallic flavor, and/or improved sweetness temporal character compared to the equivalent compositions without the sensory modifier.

[0028] The present disclosure provides a sensory modifier comprising one or more caffeoyl-substituted quinic acids, and salts thereof. In various aspects, the caffeoyl-substituted quinic acids comprise an ester derived from the carboxylic acid of caffeic acid and an alcohol of quinic acid. A “caffeoyl-substituted quinic acid” or “caffeoylquinic acid” as the terms are used herein, include moncaffeoylquinic acids and dicaffeoylquinic acids and salts thereof. Moncaffeoylquinic acids comprise an ester derived from a single caffeic acid and a quinic acid (e.g., chlorogenic acid (5-O-caffeoylquinic acid), neochlorogenic acid (3-O-caffeoylquinic acid), and cryptochlorogenic acid (4-O-caffeoylquinic acid)). Dicaffeoylquinic acids comprise an ester derived from two caffeic acids and a quinic acid (e.g., 1,3-dicaffeoylquinic acid, 1,4-dicaffeoylquinic acid, 1,5-dicaffeoylquinic acid, 3,4-dicaffeoylquinic acid, 3,5-dicaffeoylquinic acid, and 4,5-dicaffeoylquinic acid)). Thus, the sensory modifier includes both acid forms and salt forms of caffeoyl-substituted quinic acids. Free acid forms of various caffeoyl-substituted quinic acids are shown in Table 1.

Table 1. Structures of various caffeoyl-substituted quinic acids.

 Chlorogenic acid (5-O-caffeoylquinic acid)	 Neochlorogenic acid (3-O-caffeoylquinic acid)
 Cryptochlorogenic acid (4-O-caffeoylquinic acid)	 1,5-Dicaffeoylquinic acid



[0029] In various aspects, the sensory modifier further comprises one or more of quinic acid, caffeic acid, ferulic acid, sinapic acid, p-coumaric acid, an ester of quinic acid, an ester of caffeic acid, an ester of ferulic acid, an ester of sinapic acid, an ester of p-coumaric acid, an ester of caffeic acid and quinic acid, an ester of caffeic acid and quinic acid comprising a single caffeic acid moiety, an ester of caffeic acid and quinic acid comprising more than one caffeic acid moiety, an ester of ferulic acid and quinic acid, an ester of ferulic acid and quinic acid comprising a single ferulic acid moiety, an ester of ferulic acid and quinic acid comprising more than one ferulic acid moiety, an ester of sinapic acid and quinic acid, an ester of sinapic acid and quinic acid comprising

a single sinapic acid moiety, an ester of sinapic acid and quinic acid comprising more than one sinapic acid moiety, an ester of p-coumaric acid and quinic acid, an ester of p-coumaric acid and quinic acid comprising a single p-coumaric acid moiety, an ester of p-coumaric acid and quinic acid comprising more than one p-coumaric acid moiety, a di-ester of quinic acid containing one caffeic acid moiety and one ferulic acid moiety, a caffeic ester of 3-(3,4-dihydroxyphenyl)lactic acid, a caffeic acid ester of tartaric acid, a caffeic acid ester of tartaric acid containing more than one caffeic acid moieties, and/or isomers thereof, and the corresponding salts.

[0030] In some aspects, the sensory modifier comprises one or more of chlorogenic acid (5-O-caffeoylquinic acid), neochlorogenic acid (3-O-caffeoylquinic acid), cryptochlorogenic acid (4-O-caffeoylquinic acid), 1,3-dicaffeoylquinic acid, 1,4-dicaffeoylquinic acid, 1,5-dicaffeoylquinic acid, 3,4-dicaffeoylquinic acid, 3,5-dicaffeoylquinic acid, 4,5-dicaffeoylquinic acid, 3-O-feruloylquinic acid, 4-O-feruloylquinic acid, 5-O-feruloylquinic acid, 1,3-diferuloylquinic acid, 1,4-diferuloylquinic acid, 1,5-diferuloylquinic acid, 3,4-diferuloylquinic acid, 3,5-diferuloylquinic acid, 4,5-diferuloylquinic acid, rosmarinic acid, caftaric acid (monocaffeoyltartaric acid), cichoric acid (dicaffeoyltartaric acid) and salts, and/or isomers thereof, and the corresponding salts.

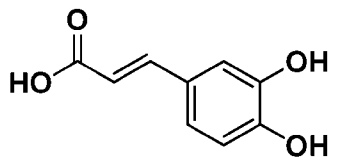
[0031] In some aspects, the sensory modifier consists essentially of one or more compounds selected from the list consisting of chlorogenic acid (5-O-caffeoylquinic acid), neochlorogenic acid (3-O-caffeoylquinic acid), cryptochlorogenic acid (4-O-caffeoylquinic acid), 1,3-dicaffeoylquinic acid, 1,4-dicaffeoylquinic acid, 1,5-dicaffeoylquinic acid, 3,4-dicaffeoylquinic acid, 3,5-dicaffeoylquinic acid, and 4,5-dicaffeoylquinic acid, and any combination thereof, isomers thereof, and the corresponding salts. In various aspects, one or more alcohol of the caffeoyl moiety is replaced with a hydrogen or substituted with an C1-C10 alkyl (e.g., methyl, ethyl, propyl, etc), C1-C10 alkenyl, C6-C10 aryl, C2-C10 acyl, acrylate, caffeoyl, o-coumaroyl, p-coumaroyl, m-coumaroyl, cinnamoyl, 4-hydroxycinnamoyl, feruloyl, iso-feruloyl, sinapoyl, galloyl, sulfate, phosphate, or phosphonate. Thus, modified and substituted caffeic acid moieties result in a cinnamic acid, o-coumaroyl, p-coumaric acid, m-coumaric acid, ferulic acid, and the acyl and ester forms thereof. In various aspects, one or more alcohol of the quinic acid moiety is substituted with an C1-C10 alkyl (e.g., methyl, ethyl, propyl, etc), C1-C10 alkenyl, C6-C10 aryl, C2-C10 acyl, acrylate, caffeoyl, o-coumaroyl, p-coumaroyl, m-coumaroyl, cinnamoyl, 4-hydroxycinnamoyl, feruloyl, iso-feruloyl, sinapoyl, galloyl, sulfate, phosphate, or phosphonate.

[0032] The sensory modifier can include one or more of a caffeic ester of 3-(3,4-dihydroxyphenyl)lactic acid, a caffeic acid ester of tartaric acid, a ferulic ester of quinic acid or

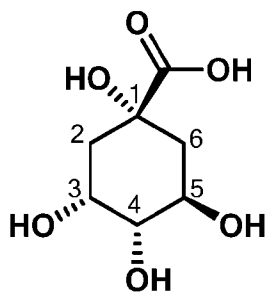
any other optionally-substituted cinnamoyl ester of quinic acid other than a caffeoylquinic acid. Examples of a ferulic ester of quinic acid includes 3-O-feruloylquinic acid, 4-O-feruloylquinic acid, 5-O-feruloylquinic acid, 1,3-diferuloylquinic acid, 1,4-diferuloylquinic acid, 1,5-diferuloylquinic acid, 3,4-diferuloylquinic acid, 3,5-diferuloylquinic acid, 4,5-diferuloylquinic acid, and combinations thereof. An example of a caffeic ester of 3-(3,4-dihydroxyphenyl)lactic acid is rosmarinic acid. Examples of a caffeic acid ester of tartaric acid includes cichoric acid (dicafeoyltartaric acid) and caftaric acid (monocafeoyltartaric acid) and combinations thereof.

[0033] In an alternative aspect, the sensory modifier is a mixture consisting of one or more of a caffeic ester of 3-(3,4-dihydroxyphenyl)lactic acid, a caffeic acid ester of tartaric acid, a ferulic ester of quinic acid or any other optionally-substituted cinnamoyl ester of quinic acid other than a caffeoylquinic acid. Such sensory modifier also includes salts thereof so as to have a salt fraction and an acid fraction. It is thus further envisaged that each of the various aspects described herein related to caffeoylquinic acid and other sensory modifiers can be equally applicable to this alternative.

[0034] Caffeic acid has the structure:



[0035] Quinic acid has the structure:



[0036] The structure provided above is D-(-)-quinic acid and the numbers shown correspond to current IUPAC numbering.

[0037] In various aspects, the sensory modifier can be enriched for one or more of caffeic acid, monocafeoylquinic acids, and dicafeoylquinic acids. The term “enriched” refers to an increase in an amount of one of caffeic acid, monocafeoylquinic acids, and dicafeoylquinic acids relative to one or more other compounds that are present in the sensory modifier. A sensory modifier that

is enriched for one or more of caffeic acid, moncaffeoylquinic acids, and dicaffeoylquinic acids can modify the sensory attributes of the salt composition.

[0038] The sensory modifier enriched for one or more dicaffeoylquinic acids can modify the sensory attributes of a salt composition. A sensory modifier that is enriched for dicaffeoylquinic acids can comprise 10% or more, 15% or more, 20% or more, 25% or more, 30% or more, 35% or more, 40% or more, 45% or more, or 50% or more, 60% or more, 70% or more, or 80% or more, or 90% or more dicaffeoylquinic acids as a percentage of the total weight of the sensory modifier.

[0039] In various aspects, at least or about 10 wt%, 15 wt%, 20 wt%, 25 wt%, 30 wt%, 35 wt%, 40 wt%, 45 wt%, or at least or about 50 wt% of the total sensory modifier can be moncaffeoylquinic acids and salts thereof. In various aspects, at least or about 10 wt%, 15 wt%, 20 wt%, 25 wt%, 30 wt%, 35 wt%, 40 wt%, 45 wt%, or at least or about 50 wt% of the total sensory modifier can be chlorogenic acid (5-O-caffeoylquinic acid) and salts thereof. In various aspects, at least or about 10 wt%, 15 wt%, 20 wt%, 25 wt%, 30 wt%, 35 wt%, 40 wt%, 45 wt%, or at least or about 50 wt% of the total sensory modifier can be neochlorogenic acid (3-O-caffeoylquinic acid) and salts thereof. In various aspects, at least or about 10 wt%, 15 wt%, 20 wt%, 25 wt%, 30 wt%, 35 wt%, 40 wt%, 45 wt%, or at least or about 50 wt% of the total sensory modifier can be cryptochlorogenic acid (4-O-caffeoylquinic acid) and salts thereof.

[0040] In various further aspects, at least or about 10 wt%, 15 wt%, 20 wt%, 25 wt%, 30 wt%, 35 wt%, 40 wt%, 45 wt%, or at least or about 50 wt% of the total sensory modifier can be 1,3-dicaffeoylquinic acid and salts thereof. In various aspects, at least or about 10 wt%, 15 wt%, 20 wt%, 25 wt%, 30 wt%, 35 wt%, 40 wt%, 45 wt%, or at least or about 50 wt% of the total sensory modifier can be 1,4-dicaffeoylquinic acid and salts thereof. In various aspects, at least or about 10 wt%, 15 wt%, 20 wt%, 25 wt%, 30 wt%, 35 wt%, 40 wt%, 45 wt%, or at least or about 50 wt% of the total sensory modifier can be 1,5-dicaffeoylquinic acid and salts thereof. In various aspects, at least or about 10 wt%, 15 wt%, 20 wt%, 25 wt%, 30 wt%, 35 wt%, 40 wt%, 45 wt%, or at least or about 50 wt% of the total sensory modifier can be 3,4-dicaffeoylquinic acid and salts thereof. In various aspects, at least or about 10 wt%, 15 wt%, 20 wt%, 25 wt%, 30 wt%, 35 wt%, 40 wt%, 45 wt%, or at least or about 50 wt% of the total sensory modifier can be 3,5-dicaffeoylquinic acid and salts thereof. In various aspects, at least or about 10 wt%, 15 wt%, 20 wt%, 25 wt%, 30 wt%, 35 wt%, 40 wt%, 45 wt%, or at least or about 50 wt% of the total sensory modifier can be 4,5-dicaffeoylquinic acid and salts thereof.

[0041] The sensory modifier can, for example, have a weight ratio of total monocaffeoylquinic acids and salts to total dicaffeoylquinic acids and salts of 20:1 to 1:20, e.g., from 3:1 to 1:20. In various aspects, the sensory modifier has a weight ratio from 15:1 to 1:15, from 10:1 to 1:10, from 5:1 to 1:5, from 3:1 to 1:3, from 2:1 to 1:2, from 1.5:1 to 1:1.5, from 5:1 to 1:1, from 3:1 to 1:1, from 2:1 to 1:1, from 1.5:1 to 1:1.1, from 1:1 to 1:20, from 1:1 to 1:15, from 1:1 to 1:10, from 1:5 to 1:20, from 1:5 to 1:15, from 1:5 to 1:10, from 1:2 to 1:20, from 1:2 to 1:15, from 1:2 to 1:10, from 1:2 to 1:5, from 1:1 to 1:3, from 1:1 to 1:2, or from 1:1 to 1:1.5 monocaffeoylquinic acid and salts thereof:dicaffeoylquinic acids and salts thereof. In some aspects, the sensory modifier has a greater amount, by weight, of dicaffeoylquinic acids and salts of dicaffeoylquinic acids compared to the amount of monocaffeoylquinic acids and salts of monocaffeoylquinic acids. In various aspects, the sensory modifier has a ratio of about 1:1 of monocaffeoylquinic acid:dicaffeoylquinic acids, including salts thereof.

[0042] The sensory modifier provided herein may contain a portion that is in salt form (corresponding to a “salt fraction”) and a portion that is in acid form (corresponding to an “acid fraction”). In various aspects, the salt fraction accounts for at least 50 wt% of the total sensory modifier. In various aspects, the sensory modifier comprises a salt fraction and an acid fraction, wherein the salt fraction comprises one or more of a salt of a monocaffeoylquinic acid and a salt of a dicaffeoylquinic acid, wherein the acid fraction comprises one or more of a monocaffeoylquinic acid and a dicaffeoylquinic acid, and wherein the salt fraction comprises at least 50 wt% of the total sensory modifier.

[0043] For example, the salt fraction comprises at least or about 50 wt%, 55 wt%, 60 wt%, 65 wt%, 70 wt%, 75 wt%, 80 wt%, 85 wt%, or at least or about 90 wt% of the total sensory modifier. In further aspects, the salt fraction comprises less than or about 60 wt%, 65 wt%, 70 wt%, 75 wt%, 80 wt%, 85 wt%, or less than or about 90 wt% of the total sensory modifier. In yet further aspects, the salt fraction comprises 50 wt% to 90 wt%, 50 wt% to 80 wt%, 50 wt% to 75 wt%, 60 wt% to 90 wt%, 60 wt% to 80 wt%, 65 wt% to 80 wt%, or 65 wt% to 75 wt% of the total sensory modifier. Unless otherwise specified the wt% of the salt fraction should be calculated inclusive of the balancing cation species.

[0044] In further examples, the acid fraction comprises at least or about 5 wt%, 10 wt%, 15 wt%, 20 wt%, 25 wt%, 30 wt%, 35 wt%, 40 wt%, or at least or about 45 wt% of the total sensory modifier. In further aspects, the acid fraction comprises less than or about 10 wt%, 15 wt%, 20 wt%, 25 wt%, 30 wt%, 35 wt%, 40 wt%, or less than about 50 wt% of the total sensory modifier. In yet further aspects, the acid fraction comprises 5 wt% to 50 wt%, 10 wt% to 50 wt%, 15 wt%

to 50 wt%, 20 wt% to 50 wt%, 5 wt% to 40 wt%, 10 wt% to 40 wt%, 15 wt% to 40 wt%, 20 wt% to 40 wt%, 5 wt% to 35 wt%, 10 wt% to 35 wt%, 15 wt% to 35 wt%, 20 wt% to 35 wt%, 5 wt% to 30 wt%, 10 wt% to 30 wt%, 15 wt% to 30 wt%, 20 wt% to 30 wt%, 5 wt% to 20 wt%, 10 wt% to 20 wt%, 15 wt% to 20 wt%, 5 wt% to 15 wt%, 10 wt% to 15 wt%, or 5 wt% to 10 wt% of the total sensory modifier.

[0045] In various aspects, e.g., in an aqueous solution, the salt form of the total sensory modifier exists in equilibrium with the acid form. For example, a particular salt form molecule can become protonated and thus convert into the acid form and an acid form molecule can become deprotonated to result in a salt form. After approaching or achieving equilibrium, such interplay will not substantially alter the overall wt% of a given form or fraction of the total sensory modifier. For example, a composition having a salt fraction of 50 wt% or more of the total sensory modifier can maintain the same proportions of salt and acid fractions even though the various compounds might exchange from one fraction to another.

[0046] There are also cases where the equilibrium between salt and acids forms can shift in response to the addition of components to the composition. For example, addition of buffer solution, salts, acid, or base can shift the equilibrium to favor the salt or acid fraction, and thus alter the wt% of the composition.

[0047] In various other aspects, e.g., in a solid composition, the salt form and acid forms can be in a solid state, in which the proportion between salt and acid forms is frozen. It should be understood that, in various aspects, the ratio of the salt fraction to acid fraction in a solid composition, such as a granulated salt composition, can differ from that of a resulting solution to which the solid composition is added. For example, in some aspects, a solid state salt composition will, upon dissolving or disintegrating, result in a solution having a sensory modifier of which at least 50 wt% is in salt form.

Effective Amount of Sensory Modifier

[0048] The compositions of the present disclosure comprise a sensory modifier in an amount effective to reduced bitterness, improve sweetness temporal attributes, reduce bitterness, and/or reduce metallic notes of the rare sugar and/or sugar alcohol compositions.

[0049] As used herein, “taste” refers to sensory perception on the tongue. For example, the 5 basic tastes are sweet, sour, salty, bitter, and umami.

[0050] As used herein, “aroma” refers to the orthonasal perception in the nasal cavity.

[0051] As used herein, “flavor” refers to the taste and retronasal perception in the nasal cavity.

[0052] As used herein, “off-taste(s)” refer to a taste or flavor attribute profile that is not characteristic or usually associated with a substance or composition as described herein and/or a characteristic taste or flavor associated with a substance or composition that is undesirable. For example, the off-taste may be an undesirable taste such as bitterness, undesirable mouthfeel such as astringency, mouth drying, undesirable flavor such as rancid, cardboard, aftertaste, inconsistent flavor (e.g., a flavor with an uneven onset or intensity, a flavor that may be perceived too early or too late), and the like.

[0053] A sensory panel can be used to determine the magnitude of, for example, reduction in bitterness or shifts in its temporal profile, thereby quantifying the amount of sensory modifier effective to reduce said bitterness. Sensory panels are a scientific and reproducible method that is essential to the food and beverage industry. A sensory panel involves a group of two or more individual panelists. Panelists are instructed according to industry-recognized practices to avoid the influence of personal subjectivity and strengthen reproducibility. For example, panelists may objectively evaluate sensory attributes of a tested product but may not provide subjective attributes such as personal preference. In various aspects, the sensory panel can be conducted with two, three, four, five, six, or more panelists, in which the panelists identify and agree on a lexicon of sensory attributes for a given set of samples. After evaluating a specific sample, the panelists can assign a numerical intensity score for each attribute using an intensity scale. For example, intensity scales can range from 0 to 6 (i.e., 0=not detected, 1=trace, 2=slight, 3=moderate, 4=definite, 5=strong, 6=extreme), 0 to 9 (i.e., 0=not detected, 1=trace, 2=faint, 3=slight, 4=mild, 5=moderate, 6=definite, 7=strong, 8=very strong, 9=extreme), or 0 to 15, where 0 corresponds to the absence of the attribute, while 6, 9, or 15, respectively, corresponds to the upper bound extreme occurrence of the attribute. The panel may use a roundtable consensus approach, or the panelists may score and evaluate the sensory attribute(s) individually. Either format can further involve a panel leader who directs the discussion regarding terminology and directs the panel to evaluate particular products and attributes. In other aspects, a trained sensory panel can be utilized to assess specific attributes using descriptive analysis or time intensity methodologies.

[0054] As used herein, “panelist” refers to a highly trained expert taster, such as those commonly used for sensory methodologies such as descriptive analysis, and/or an experienced taster familiar with the sensory attribute(s) being tested. In some aspects, the panelist may be a trained panelist. A trained panelist has undergone training to understand the terms and sensory phenomenon associated with those sensory attributes relevant to the tested product and are aligned on the use of common descriptors for those sensory attributes of interest (i.e., a sensory lexicon).

For example, a trained panelist testing a given composition will understand the terms and sensory attributes associated with said composition, e.g., saltiness, sourness, bitterness, astringency, mouthfeel, acidity, and the like. The trained panelist will have been trained against reference samples corresponding to the sensory attributes being tested and thus have calibrated to recognize and quantitatively assess such criteria. In some aspects, the panelist may be an experienced taster.

[0055] As used herein, “roundtable consensus approach” refers to the sensory panel assay methodology wherein panelists discuss sensory attributes and intensities before mutually agreeing on an intensity score and attribute characterization for the particular sensory attribute(s) being assayed. A sensory panel using a roundtable consensus approach may include 2, 3, 4, 5, 6, or more panelists. Consensus intensity scales can range from 0 to 6 (i.e., 0=not detected, 1=trace, 2=slight, 3=moderate, 4=definite, 5=strong, 6=extreme) or 0 to 9 (i.e., 0=not detected, 1=trace, 2=faint, 3=slight, 4=mild, 5=moderate, 6=definite, 7=strong, 8=very strong, 9=extreme). For a given set of samples, the panelists will identify and agree on a lexicon of sensory attribute, including, if applicable, reference or standardized samples (also referred to as sensory anchors) for a particular sensory attribute. The reference sample(s) used for a given sensory attribute(s) will depend on the samples being assayed and the lexicon of sensory attributes determined by the panel. One of skill in the art will recognize the appropriate lexicon and reference or standard samples necessary for sensory assessment of a given sample(s).

[0056] In some aspects, the samples are scored and evaluated by panelists independently after panelists have agreed upon or been instructed in a lexicon of sensory attributes and intensity scores including, if applicable, assay specific calibration on reference samples (also referred to as sensory anchors) for a particular sensory attribute. Examples of common reference samples are described below. Panelists may evaluate samples in replicate and may be blinded to the samples they are testing. Samples being tested may be provided to the panelists randomly or in a sequential order. In some aspects, samples may be tested by panelists using a randomized balanced sequential order. Scores from individual panelists are then assessed using standard statistical analysis methods to determine an average sensory intensity score. One of skill in the art will recognize the appropriate lexicon and reference or standard samples necessary for sensory assessment of a given sample(s) as well as the appropriate statistical analysis methods.

[0057] As used herein, “randomized balanced sequential order” refers to the order in which samples are presented in which the order is randomized but across all panelists all possible orders of the samples will be presented to remove bias for the samples being tested in a particular order. For example, for a randomized balanced sequential order of two samples, there would be an equal

likelihood that a given panelist receives sample 1 before sample 2 and sample 2 before sample 1. In an example with three samples (i.e., samples 1, 2, and 3), a randomized balanced sequential order would include an equal likelihood that panelists receiving samples in the following orders: (i) 1, 2, 3; (ii) 1, 3, 2; (iii) 2, 1, 3; (iv) 2, 3, 1; (v) 3, 2, 1; (vi) 3, 1, 2.

[0058] A sensory attribute(s) of a given composition may be evaluated in comparison to one or more reference or anchor samples. For example, sodium chloride solutions can be used by experienced panelists as saltiness anchors to assess the relative intensity of saltiness for a given composition; sucrose solutions can be used by experienced panelists as sweetness anchors to assess the relative intensity of sweetness for a given composition; citric acid solutions can be used by experienced panelists as sourness anchors to assess the relative intensity of sourness for a given composition; caffeine solutions can be used by experienced panelists as bitterness anchors to assess the relative intensity of bitterness for a given composition; and monosodium glutamate (MSG) solutions can be used by experienced panelists as umami anchors to assess the relative intensity of umami for a given composition. Experienced panelists can be presented with a solution to assess sensory attributes, e.g., 10-20 mL of a sample. Panelists will dispense approximately 3-4 mL of each solution into their own mouths, disperse the solution by moving their tongues, and record a value for the particular sensory attribute being tested. If multiple solutions are to be tested in a session, the panelists may cleanse their palates with water between samples. For example, a roundtable assessment of saltiness, sweetness, sourness, umami, and the like can assign a scale of 0 to 9 with, e.g., a score of 0 indicating no saltiness and a score of 9 indicating extreme saltiness (0=not detected, 1=trace, 2=faint, 3=slight, 4=mild, 5=moderate, 6=definite, 7=strong, 8=very strong, 9=extreme). Equivalent scales and methodologies can be used for sweet, bitter, sour, and umami sensory attributes.

[0059] As a further example, saltiness of a composition can be tested by a panel of at least two panelists. The panelists can use a standard range of 0.18% (wt), 0.2% (wt), 0.35% (wt), 0.5% (wt), 0.567% (wt), 0.6% (wt), 0.65% (wt), and 0.7% (wt) sodium chloride solutions in water corresponding to a saltiness intensity value of 2, 2.5, 5, 8.5, 10, 11, 13, and 15, respectively. A skilled artisan will recognize that depending on the sample/composition being tested, the number and range of standard solutions may be changed (e.g., using only the solutions corresponding to the 2, 2.5, and 5 saltiness intensity values). For each test composition, the panelists dispense approximately 2-5 mL, for liquid compositions or solutions prepared with water, or 5-10 g, for solid compositions, of each composition into their own mouths, disperses the composition by moving their tongues/chewing, and records a saltiness intensity value between 0 and 15 for each

composition based on comparison to the aforementioned standard sodium chloride solutions. Between tasting compositions, the panelists are able to cleanse their palates with water. The panelists also can taste the standard 0.18%, 0.2%, 0.35%, 0.5%, 0.567%, 0.6%, 0.65%, and 0.7% sodium chloride solutions ad libitum between tasting test solutions to ensure recorded saltiness intensity values are accurate against the scale of the standard sodium chloride solutions. The temperature at which the test is conducted may be specific to the sample beginning tested, e.g., samples may be tested at 22 °C (e.g., room temperature), at 0 °C (e.g., for frozen samples), or between 60-80°C (e.g., a cooked sample served warm). One skilled in the art will recognize the appropriate temperature for testing a given sample. This test is referred to herein as the “Standardized Saltiness Intensity Test.”

[0060] Sourness of a composition can be tested by a panel of at least two panelists. The panelists can use a standard range of 0.035% (wt), 0.05% (wt), 0.07% (wt), 0.15% (wt), and 0.2% (wt) citric acid solutions in water corresponding to a sourness intensity value of 2, 3, 5, 10, and 15, respectively. A skilled artisan will recognize that depending on the sample/composition being tested, the number and range of standard solutions may be changed (e.g., using only the solutions corresponding to the 2 and 7 sourness intensity values). For each test composition, the panelists dispense approximately 2-5 mL, for liquid compositions or solutions prepared with water, or 5-10 g, for solid compositions, of each composition into their own mouths, disperses the composition by moving their tongues/chewing, and records a sourness intensity value between 0 and 15 for each composition based on comparison to the aforementioned standard citric acid solutions. Between tasting compositions, the panelists are able to cleanse their palates with water. The panelists also can taste the standard 0.035%, 0.05%, 0.07%, 0.15%, and 0.2% citric acid solutions ad libitum between tasting test solutions to ensure recorded sourness intensity values are accurate against the scale of the standard citric acid solutions. The temperature at which the test is conducted may be specific to the sample beginning tested, e.g., samples may be tested at 22 °C (e.g., room temperature), at 0 °C (e.g., for frozen samples), or between 60-80°C (e.g., a cooked sample served warm). One skilled in the art will recognize the appropriate temperature for testing a given sample. This test is referred to herein as the “Standardized Sourness Intensity Test.”

[0061] Bitterness of a composition can be tested by a panel of at least two panelists. The panelists can use a standard range of 0.0125% (wt), 0.01875% (wt), 0.025% (wt), 0.031% (wt), 0.07% (wt), and 0.12% (wt) caffeine solutions in water corresponding to a bitterness intensity value of 2, 3, 4, 5, 10, and 15, respectively. A skilled artisan will recognize that depending on the sample/composition being tested, the number and range of standard solutions may be changed

(e.g., using only the solutions corresponding to the 2, 3, and 5 bitterness intensity values). For each test composition, the panelists dispense approximately 2-5 mL, for liquid compositions or solutions prepared with water, or 5-10 g, for solid compositions, of each composition into their own mouths, disperses the composition by moving their tongues/chewing, and records a bitterness intensity value between 0 and 15 for each composition based on comparison to the aforementioned standard caffeine solutions. Between tasting compositions, the panelists are able to cleanse their palates with water. The panelists also can taste the standard 0.0125%, 0.01875%, 0.025%, 0.031%, 0.07%, and 0.12% caffeine solutions ad libitum between tasting test solutions to ensure recorded bitterness intensity values are accurate against the scale of the standard caffeine solutions. The temperature at which the test is conducted may be specific to the sample beginning tested, e.g., samples may be tested at 22 °C (e.g., room temperature), at 0 °C (e.g., for frozen samples), or between 60-80°C (e.g., a cooked sample served warm). One skilled in the art will recognize the appropriate temperature for testing a given sample. This test is referred to herein as the “Standardized Bitterness Intensity Test.”

[0062] Sweetness of a composition can be tested by a panel of at least two panelists. The panelists can use a standard range of 2% (wt), 5% (wt), 8% (wt), 10% (wt), and 15% (wt) sucrose solutions corresponding to a sweetness intensity value of 2, 5, 8, 10, and 15, respectively. A skilled artisan will recognize that depending on the sample/composition being tested, the number and range of standard solutions may be changed (e.g., using only the solutions corresponding to the 2, 5, and 8 sweetness intensity values). For each test composition, the panelists dispense approximately 2-5 mL, for liquid compositions or solutions prepared with water, or 5-10 g, for solid compositions, of each composition into their own mouths, disperses the composition by moving their tongues/chewing, and records a sweetness intensity value between 0 and 15 for each composition based on comparison to the aforementioned standard sucrose solutions. Between tasting compositions, the panelists are able to cleanse their palates with water. The panelists also can taste the standard 2%, 5%, 8%, 10%, and 15% sucrose solutions ad libitum between tasting test solutions to ensure recorded sweetness intensity values are accurate against the scale of the standard sucrose solutions. The temperature at which the test is conducted may be specific to the sample beginning tested, e.g., samples may be tested at 22 °C (e.g., room temperature), at 0 °C (e.g., for frozen samples), or between 60-80°C (e.g., a cooked sample served warm). One skilled in the art will recognize the appropriate temperature for testing a given sample. This test is referred to herein as the “Standardized Sweetness Intensity Test.”

[0063] Umami of a composition can be tested by a panel of at least two panelists. The panelists can use a standard range of 0.75% (wt) and 0.125% (wt) monosodium glutamate (MSG) solutions corresponding to an umami intensity value of 4 and 6.5, respectively. A skilled artisan will recognize that depending on the sample/composition being tested, the number and range of standard solutions may be changed (e.g., adding additional umami solutions if the umami intensity is expected to be appreciably outside of the umami intensity value of 4-6.5). For each test composition, the panelists dispense approximately 2-5 mL, for liquid compositions or solutions prepared with water, or 5-10 g, for solid compositions, of each composition into their own mouths, disperses the composition by moving their tongues/chewing, and records an umami intensity value between 0 and 15 for each composition based on comparison to the aforementioned standard MSG solutions. Between tasting compositions, the panelists are able to cleanse their palates with water. The panelists also can taste the standard 0.075% and 0.125% MSG solutions ad libitum between tasting test solutions to ensure recorded umami intensity values are accurate against the scale of the standard MSG solutions. The temperature at which the test is conducted may be specific to the sample beginning tested, e.g., samples may be tested at 22 °C (e.g., room temperature), at 0 °C (e.g., for frozen samples), or between 60-80°C (e.g., a cooked sample served warm). One skilled in the art will recognize the appropriate temperature for testing a given sample. This test is referred to herein as the “Standardized Umami Intensity Test.”

[0064] Temporal aspects of taste, flavor, and/or aromatic properties of compositions described herein may be evaluated by any suitable means known in the art. Temporal aspects, also referred to as time attributes, may include, but are not limited to, time to taste/flavor/aroma onset, time at max taste/flavor/aroma, and taste/flavor/aroma linger. Time to taste/flavor/aroma onset refers to the time (in seconds) it takes from the time you put the sample in your mouth until you perceive the given taste/flavor/aroma. Time to taste/flavor/aroma inset may be measured by putting a sample in your mouth and swallowing (not holding in the mouth or spitting), starting a timer when the sample is put in the mouth, and noting the time when the given taste/flavor/aroma is perceived. Time at max flavor/taste/aroma is defined as the time (in seconds) the sample remains at the highest intensity of the given taste/flavor/aroma. Time at max taste/flavor/aroma may be measured by putting a sample in your mouth and swallowing (not holding in the mouth or spitting), starting a timer when peak intensity of the taste/flavor/aroma begins and noting the time when the taste/flavor/aroma intensity begins to decline. Taste/flavor/aroma linger is defined as the time (in seconds) from when the taste/flavor/aroma starts to drop from peak intensity until you no longer discern the given taste/flavor/aroma. Taste/flavor/aroma linger may be measured by putting a

sample in your mouth and swallowing (not holding in the mouth or spitting), starting a timer when the peak intensity of the taste/ flavor/ aroma begins to decline, and noting the time when the taste/ flavor/ aroma is no longer perceived.

[0065] A control sample is typically used as a reference point or for comparison purposes. For example, a control sample can be used to qualify the effectiveness of a sensory modifier. The control sample can be a composition such as a composition as described herein, but without the presence of the sensory modifier. Other than the sensory modifier, the control sample is otherwise the same, and it should contain the same component(s) and other ingredients at the same relative concentrations. Other standard samples are commonly used in sensory panels, for example standard samples used to evaluate intensity of sensory attributes as outlined above. In other aspects, the control sample may be a modified control sample which contains a different sensory modifier such as a competitor sensory modifier.

[0066] This disclosure is not limited to sensory testing by experienced or trained panelists. For example, it is possible to utilize untrained and inexperienced panelists. However, in the case of untrained and inexperienced panelists, a greater number of these panelists is usually necessary to provide reproducible results, which will typically focus on subjective attributes such as preference or overall liking. Similarly, untrained, and inexperienced panelists may be asked to evaluate relative changes in a given sensory attribute between two samples. For example, if a particular sample is more or less salty, more or less sweet, more or less bitter, etc., than a reference sample.

[0067] An exemplified sensory assay and test criteria for further sensory attributes are described in the Examples provided in this disclosure.

[0068] In some aspects, the amount of sensory modifier effective to decrease bitterness can be the amount effective to reduce bitterness intensity by at least 0.5, 1, 1.5, 2, or at least 2.5 units relative to bitterness intensity in an equivalent composition lacking the sensory modifier. The bitterness intensity score is determined by at least three panelists trained in tasting bitter compositions using a roundtable methodology using a scale of 0 to 9, where a score of 0 indicates no bitterness and 9 indicates extreme bitterness intensity (i.e., 0=not detected, 1=trace, 2=faint, 3=slight, 4=mild, 5=moderate, 6=definite, 7=strong, 8=very strong, 9=extreme). In some aspects, the bitterness may be reduced by at least 2, at least 3, or at least 4 units. Similar evaluation processes may be used to score other sensory attributes of the composition described herein.

[0069] In some aspects, the amount of sensory modifier effective to decrease bitterness can be the amount effective to reduce bitterness intensity score by at least 0.5, 1, 1.5, 2, or at least 2.5 units relative to bitterness intensity in an equivalent composition lacking the sensory modifier.

The bitterness intensity score may be determined as the average bitterness intensity score from at least seven panelists, trained in sensory evaluation, upon randomized balanced sequential order evaluation of samples using a scale of 0 to 15, where a score of 0 indicates no bitterness and 15 indicates extreme bitterness intensity. In some aspects, the bitterness may be reduced by at least 2, at least 3, at least 4 units, at least 5, at least 6, at least 7, or more units.

[0070] The compositions described herein can have various amounts of sensory modifier. For example, the compositions described herein may include rare sugars and/or sugar alcohols and the sensory modifier in a ratio between 50:1 to 750:1, between 100:1 and 600:1, or between 150:1 and 500:1. For example, the rare sugar and the sensory modifier may be present in the composition at a ratio of about 50:1, about 100:1, about 150:1, about 200:1, about 250:1, about 300:1, about 400:1, about 500:1, about 600:1 or about 750:1. For example, the sugar alcohol and the sensory modifier may be present in the composition at a ratio of about 50:1, about 100:1, about 150:1, about 200:1, about 250:1, about 300:1, about 400:1, about 500:1, about 600:1 or about 750:1. In another example, the combined sugar alcohol and rare sugar and the sensory modifier may be present in the composition at a ratio of about 50:1, about 100:1, about 150:1, about 200:1, about 250:1, about 300:1, about 400:1, about 500:1, about 600:1 or about 750:1. In some aspects, the ratio of sugar alcohol and/or rare sugar and the sensory modifier may be between 100:1 and 10,000:1, between 2500:1 and 7000:1, between 5000:1 and 10,000:1, between 100:1 and 750:1, between 150:1 and 600:1, or between 250:1 and 550:1.

[0071] The sensory modifier can be present in the composition in any amount desired for the particular use. For example, the sensory modifier can be present in a composition at a total concentration from 0.001% (wt) to 5.0% (wt), from 0.001% (wt) to 1.0% (wt), 0.001% (wt) to 0.5% (wt), 0.005% (wt) to 0.1% (wt), 0.005% (wt) to 0.075% (wt), or 0.005% (wt) to 0.05% (wt). The composition may include at least 0.001%, 0.002%, 0.005%, 0.01%, 0.02%, or 0.05% by weight of the sensory modifier. The composition may include the sensory modifier at a concentration up to 1.0% (wt), 0.5% (wt), 0.25% (wt), 0.2% (wt), 0.1% (wt), or 0.05% (wt).

[0072] The sensory modifier can be present in the composition at a total concentration such that when used in the preparation of a food or beverage product, the resulting food or beverage product includes from 0.001% (wt) to 1.0% (wt), 0.001% (wt) to 0.5% (wt), 0.005% (wt) to 0.1% (wt), 0.005% (wt) to 0.050% (wt), or 0.005% (wt) to 0.02% (wt) of the sensory modifier. The composition may include the sensory modifier at a concentration such that a food or beverage product made therefrom contains of at least 0.001%, 0.002%, 0.005%, 0.01%, 0.02%, or 0.05% by weight of the sensory modifier. The composition may include the sensory modifier at a

concentration such that a food or beverage product prepared therefrom contains up to 1.0% (wt), 0.5% (wt), 0.25% (wt), 0.2% (wt), 0.1% (wt), or 0.05% (wt) of the sensory modifier. For example, the sensory modifier can be present in a composition at a total concentration from about 0.1% (wt) to about 75.0% (wt), from about 0.5% (wt) to about 50.0% (wt), or from about 1.0% (wt) to about 25.0% (wt). In some aspects, the sensory modifier can be present in a dry composition at a total concentration of at least 0.5%, 1.0%, 1.5%, 2.0%, 3.0%, 4.0%, 5.0%, 6.0%, 7.0%, 8.0%, 9.0%, or at least 10% by weight of the composition.

[0073] The composition can comprise an amount of sensory modifier such that, when the composition is used in the preparation of a food or beverage product, the sensory modifier is present in the food or beverage product in an amount desired for a particular use. For example, sensory modifier can be present in the food or beverage product at a total concentration from about 1 ppm to about 1000 ppm, or from about 1 ppm to about 2000 ppm. In some aspects, sensory modifier can be present in the food or beverage product at a total concentration from about 100 ppm to about 2000 ppm, about 200 ppm to about 2000 ppm, 300 ppm to about 2000 ppm, 400 ppm to about 2000 ppm, 500 ppm to about 2000 ppm, 600 ppm to about 2000 ppm, 700 ppm to about 2000 ppm, 800 ppm to about 2000 ppm, 900 ppm to about 2000 ppm, or 1000 ppm to about 2000 ppm. In some aspects, sensory modifier can be present in the food or beverage product at a total concentration of or greater than about 10, 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 110, 1200, 1300, 1400, 1500, 1600, 1700, 1800, 1900, or 2000 ppm. In various aspects, the sensory modifier can be present in the food or beverage product at a total concentration from about 100 ppm to about 1000 ppm, about 200 ppm to about 1000 ppm, 300 ppm to about 1000 ppm, 400 ppm to about 1000 ppm, 500 ppm to about 1000 ppm, 600 ppm to about 1000 ppm, 700 ppm to about 1000 ppm, 800 ppm to about 1000 ppm, or 900 ppm to about 1000 ppm. In some aspects, sensory modifier can be present in the food or beverage product at a total concentration from about 100 ppm to about 800 ppm, about 200 ppm to about 800 ppm, 300 ppm to about 800 ppm, 400 ppm to about 800 ppm, 500 ppm to about 800 ppm, 600 ppm to about 800 ppm, or 700 ppm to about 800 ppm. In some aspects, sensory modifier can be present in the food or beverage product at a total concentration from about 400 ppm to about 800 ppm.

[0074] The amount of an individual sensory modifier species in the various compositions described herewith can each independently vary. For example, moncaffeoylquinic acid, dicaffeoylquinic acid, or both, can each individually be present in the composition at a concentration from about 1 ppm to about 1000 ppm. In some aspects, moncaffeoylquinic acid, dicaffeoylquinic acid, or both, can each individually be present in the composition at a

concentration from about 100 ppm to about 1000 ppm, about 200 ppm to about 1000 ppm, 300 ppm to about 1000 ppm, 400 ppm to about 1000 ppm, 500 ppm to about 1000 ppm, 600 ppm to about 1000 ppm, 700 ppm to about 1000 ppm, 800 ppm to about 1000 ppm, 900 ppm to about 1000 ppm. In some aspects, monocaffeoylquinic acid, dicaffeoylquinic acid, or both, can each individually be present at a concentration of or greater than about 10, 50, 100, 200, 300, 400, 500, 600, 700, 800, 900, or 1000 ppm in the composition. In some aspects, monocaffeoylquinic acid, dicaffeoylquinic acid, or both, can each individually be present in the composition at a concentration from about 100 ppm to about 800 ppm, about 200 ppm to about 800 ppm, 300 ppm to about 800 ppm, 400 ppm to about 800 ppm, 500 ppm to about 800 ppm, 600 ppm to about 800 ppm, or 700 ppm to about 800 ppm. In some aspects, monocaffeoylquinic acid, dicaffeoylquinic acid, or both, can each individually be present in the composition at a concentration from about 400 ppm to about 800 ppm.

Botanical Source of Sensory Modifier

[0075] In various aspects, the sensory modifier can be isolated from botanical sources. Various botanical sources comprise sensory modifiers and sensory modifiers can be isolated from these botanical sources. Some examples of botanical sources from which sensory modifiers can be isolated include *Eucommia ulmoides*, honeysuckle, *Nicotiana benthamiana*, artichoke, globe artichoke, cardoon, *Stevia rebaudiana*, monkfruit, coffee, coffee beans, green coffee beans, tea, white tea, yellow tea, green tea, oolong tea, black tea, red tea, post-fermented tea, bamboo, heather, sunflower, blueberries, cranberries, bilberries, grouseberries, whortleberry, lingonberry, cowberry, huckleberry, grapes, chicory, eastern purple coneflower, echinacea, Eastern pellitory-of-the-wall, Upright pellitory, Lichwort, Greater celandine, Tetterwort, Nipplewort, Swallowwort, Bloodroot, Common nettle, Stinging nettle, Potato, Potato leaves, Eggplant, Aubergine, Tomato, Cherry tomato, Bitter apple, Thorn apple, Sweet potato, apple, Peach, Nectarine, Cherry, Sour cherry, Wild cherry, Apricot, Almond, Plum, Prune, Holly, Yerba mate, Mate, Guayusa, Yaupon Holly, Kuding, Guarana, Cocoa, Cocoa bean, Cacao, Cacao bean, Kola nut, Kola tree, Cola nut, Cola tree, Ostrich fern, Oriental ostrich fern, Fiddlehead fern, Shuttlecock fern, Oriental ostrich fern, Asian royal fern, Royal fern, Bracken, Brake, Common bracken, Eagle fern, Eastern brackenfern, Clove, Cinnamon, Indian bay leaf, Nutmeg, Bay laurel, Bay leaf, Basil, Great basil, Saint-Joseph's-wort, Thyme, Sage, Garden sage, Common sage, Culinary sage, Rosemary, Oregano, Wild marjoram, Marjoram, Sweet marjoram, Knotted marjoram, Pot marjoram, Dill, Anise, Star anise, Fennel, Florence fennel, Tarragon, Estragon, Mugwort, Licorice, Liquorice, Soy, Soybean,

Soyabean, Soya vean, Wheat, Common wheat, Rice, Canola, Broccoli, Cauliflower, Cabbage, Bok choy, Kale, Collard greens, Brussels sprouts, Kohlrabi, Winter's bark, Elderflower, Assa-Peixe, Greater burdock, Valerian, and Chamomile.

[0076] Some botanical sources may produce sensory modifiers that are enriched for one or more of caffeic acid, moncaffeoylquinic acids, and dicaffeoylquinic acids. For example, sensory modifiers isolated from yerba mate plant (*Ilex paraguariensis*) are enriched for moncaffeoylquinic and dicaffeoylquinic acids. In other aspects, sensory modifiers isolated from yerba mate plant that are enriched for dicaffeoylquinic acids can comprise 10% or more, 15% or more, 20% or more, 25% or more, 30% or more, 35% or more, 40% or more, 45% or more, or 50% or more, 60% or more, 70% or more, or 80% or more, or 90% or more of a combination of one or more of 1,3-dicaffeoylquinic acid, 1,4-dicaffeoylquinic acid, 1,5-dicaffeoylquinic acid, 3,4-dicaffeoylquinic, 3,5-dicaffeoylquinic acid, and 4,5-dicaffeoylquinic acid, and salts thereof. For example, sensory modifiers isolated from other botanical sources can be enriched for dicaffeoylquinic acids. In other aspects, sensory modifiers isolated from other botanical sources that are enriched for dicaffeoylquinic acids can comprise 10% or more, 15% or more, 20% or more, 25% or more, 30% or more, 35% or more, 40% or more, 45% or more, or 50% or more, 60% or more, 70% or more, or 80% or more, or 90% or more of a combination of one or more of 1,3-dicaffeoylquinic acid, 1,4-dicaffeoylquinic acid, 1,5-dicaffeoylquinic acid, 3,4-dicaffeoylquinic acid, 3,5-dicaffeoylquinic acid, and 4,5-dicaffeoylquinic acid, and salts thereof.

[0077] Sensory modifier may be isolated in a variety of ways. Some suitable processes are disclosed in more detail in U.S. Application No. 16/373,206, filed April 4, 2019 and entitled "Steviol Glycoside Solubility Enhancers," which was published on July 25, 2019 as US Patent Application Publication No. 2019/0223481; International Application No. PCT/US2018/054691, filed October 5, 2018 and entitled "Steviol Glycoside Solubility Enhancers;" U.S. Provisional Application No. 62/569,279, filed October 6, 2017, and entitled "Steviol Glycoside Solubility Enhancers;" U.S. Application No. 16/374,894, filed April 4, 2019 and entitled "Methods for Making Yerba Mate Composition," which was published on August 1, 2019 as US Patent Application Publication No. 2019/0231834; International Application No. PCT/US2018/054688, filed October 5, 2018 and entitled "Methods for Making Yerba Mate Composition;" U.S. Provisional Application Serial No. 62/676,722, filed May 25, 2018, and entitled "Methods for Making Yerba Mate Extract Composition;" and International Application No. PCT/US2020/026885 filed April 6, 2020, entitled "Stevia Processing," and published as WO 2020/210161 on October 15, 2020, each of which is incorporated herein by reference. For

example, sensory modifier may be isolated from a botanical source that comprises one or more of monocaffeoylquinic acid, dicaffeoylquinic acid, and salts thereof. For example, yerba mate biomass and stevia biomass can be used to prepare sensory modifier. In one exemplary process, sensory modifier is prepared from commercially obtained comminuted yerba mate biomass. Briefly, yerba mate biomass is suspended in 50% (v/v) ethanol/water, shaken for at least 1 hour, and the resulting mixture filtered to obtain an initial extract. The initial extract is diluted to 35% (v/v) ethanol with water and refiltered. Refiltered permeate is then applied to a column of AMBERLITE® FPA 53 resin that has been equilibrated in 35% (v/v) ethanol/water and the column permeate is discarded. The column is washed with 35% (v/v) ethanol/water and the column permeate is discarded. The column is then eluted with 10% (w/v) FCC grade sodium chloride in 50 % (v/v) ethanol/water and the eluent retained. Nitrogen gas is blown at room temperature over a surface of the eluent to remove ethanol and reduce the eluent to 1/3 of its original volume. The reduced volume eluent is then filtered through a 0.2 µm polyethersulfone filter and then decolorized by passing through a 3 kDa molecular weight cutoff membrane. The decolorized permeate is retained and desalted by passing through a nanofiltration membrane. The desalted permeate is then freeze-dried to obtain the sensory modifier. This process is also suitable to obtain sensory modifier from stevia biomass and can be adapted to obtain sensory modifier from other botanical sources for example those described above. Another exemplary process may be the process outlined in Example 3 of PCT Application No. WO2020/210161, published October 15, 2020, which is incorporated by reference herein.

[0078] In some aspects, the sensory modifier can be a blend of sensory modifier isolated from more than one botanical source.

[0079] Some compounds can adversely impact flavor or aroma of a rare sugar and/or sugar alcohol composition or an aqueous solution or food product prepared therefrom. Certain sensory modifiers, such as those prepared from plant extract do not include one or more of the compounds shown in Table 2, or any combination thereof, above the disclosed preferred content levels. All preferred content levels are stated as weight percent on a dry weight basis. Certain commercially desirable solid (dry) sensory modifiers do not include more than the preferred level of any of the compounds listed in Table 2. For those compounds listed that are acids, the compound may be present in acid form and/or in salt form.

Table 2.

<u>Class of compounds</u>	<u>Preferred Content Level (%wt)</u>	<u>%wt of compounds in steviol glycoside solubility enhancer solid (dry) compositions</u>
Organic acids	<3%, preferably <2%, <1%, or 0%	malonate, malonic acid, oxalate, oxalic acid, lactate, lactic acid, succinate, succinic acid, malate, malic acid, citrate, citric acid
	<0.5%, preferably <0.25% or 0%	tartrate, tartaric acid, pyruvate, pyruvic acid, fumarate, fumaric acid, ascorbic acid, sorbate, sorbic acid, acetate, acetic acid
Inorganic acids	<1%, preferably <0.5% or 0%	sulfate, sulfuric acid, phosphate, phosphoric acid, nitrate, nitric acid, nitrite, nitrous acid, chloride, hydrochloric acid, ammonia, ammonium
Flavanoids, isoflavanoids, and neoflavanoids	<5%, preferably <4%, <3%, or <2%, more preferably <1%, <0.5%, or 0%	quercetin, kaempferol, myricetin, fisetin, galangin, isorhamnetin, pachypodol, rhamnazin, pyranoflavonols, furanoflavonols, luteolin, apigenin, tangeritin, taxifolin (or dihydroquercetin), dihydrokaempferol, hesperetin, naringenin, eriodictyol, homoeriodictyol, genistein, daidzein, glycitein
Flavanoid glycosides	<5%, preferably <4%, <3%, or <2%, more preferably <1%, <0.5%, or 0%	hesperidin, naringin, rutin, quercitrin, luteolin-glucoside, quercetin-xyloside
Anthocyanidins	<5%, preferably <4%, <3%, or <2%, more preferably <1%, <0.5%, or 0%	cyanidin, delphinidin, malvidin, pelargonidin, peonidin, petunidin
Tannins	<1%, preferably <0.5%, <0.25%, or 0%	tannic acid

Amino acids + total protein	<0.1%, preferably <0.05%, or 0%	alanine, arginine, asparagine, aspartic acid, cysteine, glutamine, glutamic acid, glycine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, proline, serine, threonine, tryptophan, tyrosine, and valine
Total Fat	<1%, preferably <0.5%, <0.25%, or 0%	monoglycerides, diglycerides, triglycerides
Monosaccharides, disaccharides, and polysaccharides	<1%	glucose, fructose, sucrose, galactose, ribose, trehalose, trehalulose, lactose, maltose, isomaltose, isomaltulose, mannose, tagatose, arabinose, rhamnose, xylose, dextrose, erythrose, threose, maltotriose, panose
Sugar alcohols	<1%	glycerol, sorbitol, mannitol, xylitol, maltitol, lactitol, erythritol, isomalt, inositol
Dietary fiber	<0.1%, preferably <0.05% or 0%	acacia (arabic) gum, agar-agar, algin-alginate, arabinoxylan, beta-glucan, beta mannan, carageenan gum, carob or locust bean gum, fenugreek gum, galactomannans, gellan gum, glucomannan or konjac gum, guar gum, hemicellulose, inulin, karaya gum, pectin, polydextrose, psyllium husk mucilage, resistant starches, tara gum, tragacanth gum, xanthan gum, cellulose, chitin, and chitosan
Saponins	< 2%, preferably <1%, <0.5%, <0.25%, or 0%	glycosylated ursolic acid and glycosylated oleanolic acid
Terpenes other than saponins and steviol glycoside compounds	< 2%, preferably <1%, <0.5%, <0.25%, or 0%	eugenol, geraniol, geranial, alpha-ionone, beta-ionone, epoxy-ionone, limonene, linalool, linalool oxide, nerol, damascenone

Lipid oxidation products	< 2%, preferably <1%, <0.5%, <0.25%, or 0%	Decanone, decenal, nonenal, octenal, heptenal, hexenal, pentenal, pentenol, pentenone, hexenone, hydroxynonenal, malondialdehyde
Polycyclic Aromatic Hydrocarbons	<0.1%, preferably <0.05% or 0%	Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(ghi)perylene, Benzo(k)fluoranthene, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Fluorene, Indeno(1,2,3-cd)pyrene, Naphthalene, Phenanthrene, Pyrene
Other compounds	<0.1%, preferably <0.05% or 0%	chlorophyll, furans, furan-containing chemicals, theobromine, theophylline, and trigonelline
	<1%, preferably <0.5%, <0.25%, or 0%	saponins

[0080] In some aspects, the sensory modifier comprises less than 0.3% (wt) of malonate, malonic acid, oxalate, oxalic acid, lactate, lactic acid, succinate, succinic acid, malate, or malic acid; or less than 0.05% (wt) of pyruvate, pyruvic acid, fumarate, fumaric acid, tartrate, tartaric acid, sorbate, sorbic acid, acetate, or acetic acid; or less than about 0.05% (wt) of chlorophyll.

[0081] The present invention can be better understood by reference to the following examples which are offered by way of illustration. The present invention is not limited to the examples given herein.

EXAMPLES

Materials and Methods

[0082] The tested sensory modifier was a mixture of monocaffeoylquinic and dicaffeoylquinic acids and salts prepared from yerba mate and having a ratio of salt fraction to acid fraction of 65:35. Table 3 lists the contents and source of various components.

Table 3.

Component	Ingredients	Source
Sensory Modifier	Mixture containing mono- and dicaffeoylquinic acids and salts, prepared from Yerba mate 65:35 ratio of salt:acid from	Cargill, Inc. (Wayzata, MN)
Steviol Glycoside (SG) Sweetener	≥ 85 wt% rebaudioside M ≈ 3 -15 wt% rebaudioside D	Cargill, Inc. (Wayzata, MN)

[0083] Assays were carried out to characterize the sensory attributes, e.g., bitterness, of sugar alcohol solutions and samples with various amounts of sensory modifier. Sensory attributes of the compositions were tested by a panel of individuals that are experienced in sensory testing. The experienced panelists assessed sensory attributes such as, but not limited to, bitterness, metallic notes, mouth drying, sweetness intensity, and sweetness linger. Sensory attributes were scored on a scale of 0-9 with 0 indicating no sensory attribute intensity and 9 indicating an extreme sensory attribute intensity (i.e., 0=none, 1=trace, 2=faint, 3=slight, 4=mild, 5=moderate, 6=definite, 7=strong, 8=very strong, 9=extreme). In some Examples, a roundtable methodology was used to assess various flavor attributes. To test each composition, the experienced panelists dispensed approximately 2-4 fl oz of each sample or solution into their own mouths, dispersed the solution by moving their tongues, and individually recorded a sensory attribute scale value. Between tasting solutions, the panelists were able to cleanse their palates with water.

[0084] Assays in which a particular methodology or panel were used are noted in the individual examples below.

Example 1 – Allulose and Erythritol Solutions

[0085] Assays were carried out to characterize the sensory attributes of sugar alcohol solutions. Sensory attributes, for example bitterness, aftertaste, sweetness linger, sweetness intensity, mouth drying, and metallic notes, were analyzed by a panel of two individuals using a roundtable consensus approach. Panelists were experienced in sensory testing. All panelists used the assay method described above. Solutions were prepared by mixing the ingredients indicated in Table 4. The sugar alcohol samples tested are outlined in Table 4 and the sensory assay results are reported in Table 5.

Table 4.

Sample	Water	Allulose	Erythritol	Steviol Glycoside sweetener	Sensory modifier
1.1	97.0%	3.0%	-	-	-
1.2	96.98%	3.0%	-	-	200 ppm
1.3	96.96%	3.0%	-	400 ppm	-
1.4	96.94%	3.0%	-	400 ppm	200 ppm
1.5	97.0%	-	3.0%	-	-
1.6	96.98%	-	3.0%	-	200 ppm
1.7	96.96%	-	3.0%	400 ppm	-
1.8	96.94%	-	3.0%	400 ppm	200 ppm

Table 5.

Sample	Sensory Attribute Comments
1.1	Slight (3) papery taste at beginning and mild (4) overall bitter/metallic aftertaste
1.2	Shift to a more upfront sweetness onset, trace (1) bitter/metallic aftertaste, faint mouth drying, similar overall sweetness intensity to sample 1.1, faint to slight (2.5) brown sugar/caramel notes, improved overall sweetness quality compared to sample 1.1
1.3	Quick sweetness onset, strong (8) sweetness linger, long time at max sweetness, no significant bitter/metallic but faint papery note, faint to slight (2.5) mouth drying
1.4	Not well balanced and not cohesive, mild (4) fruity/pruny characteristic, delayed onset of sweetness, characteristics are sequential, definite (6) sweetness linger
1.5	Faintly less sweet than sample 1.1 but better sweetness onset and much cleaner, faint (2) mouth drying
1.6	No change in sweetness onset compared to 1.5, more brown sugar notes in the middle compared to 1.5 and more overall brown sugar notes compared to 1.5, slight (3) mouth drying, extended and sustained sweetness max

1.7	Better overall sweet quality than 1.5, extended sweetness max, definite (6) sweetness linger, slight mouth drying
1.8	Delayed sweetness onset compared to 1.7, more rounded sweetness, moderate (5) sweetness linger, more significant brown sugar notes in middle but less clean than brown sugar notes in 1.7

Example 2 – Allulose, Sorbitol, and Erythritol Solutions

[0086] Assays were carried out to characterize the sensory attributes of sugar alcohol solutions. Sensory attributes, for example bitterness, aftertaste, sweetness linger, sweetness intensity, mouth drying, and metallic notes, were analyzed by a panel of two individuals using a roundtable consensus approach. Panelists were experienced in sensory testing. All panelists used the assay method described above. Solutions were prepared by mixing the ingredients indicated in Table 6. The sugar alcohol samples tested are outlined in Table 6 and the sensory assay results are reported in Table 7.

Table 6.

Sample	Water	Allulose	Erythritol	Sorbitol	Sensory modifier
2.1	90.0%	10.0%	-	-	-
2.2	89.98%	10.0%	-	-	200 ppm
2.3	89.97%	10.0%	-	-	300 ppm
2.4	90.0%	-	-	10.0%	-
2.5	89.98%	-	-	10.0%	200 ppm
2.6	89.97%	-	-	10.0%	300 ppm
2.7	90.0%	-	10.0%	-	-
2.8	89.98%	-	10.0%	-	200 ppm
2.9	89.97%	-	10.0%	-	300 ppm

Table 7.

Sample	Sensory Attribute Comments
2.1	Fairly rounded sweetness, definite-strong (6.5) bitterness aftertaste (hits in the middle and lingers), no sweetness linger, slightly metallic at the end but bitterness overtakes all other aftertaste
2.2	Quicker sweetness onset than 2.1, better rounded sweetness than 2.1, middle sugar like notes, bitterness reduced to mild-moderate (4.5)
2.3	Quicker sweetness onset than 2.1, better rounded sweetness than 2.1, more sugar like notes (like lite brown sugar), bitterness reduced to slight-mild (3.5) and bitterness delayed further relative to 2.1 and 2.2
2.4	Less sweet than 2.1 or 2.7, slow sweetness onset than 2.1 or 2.7, faint to slight (2.5) sweetness linger, slight (3) metallic notes, faint (2) bitterness, not as rounded in sweetness, not like sugar, shallow climb down from peak sweetness
2.5	More rounded and sugar-like sweetness compared to 2.1 or 2.4, no perceived sweetness linger and no perceived bitterness, trace to faint metallic (1.5)
2.6	Slight shift in sweet attributes compared to 2.5, little hint (faint 2) of floral/honey/molasses, more rounded sweetness than 2.5, faint-slight (2.5) astringency, sweetness profile similar to agave syrup
2.7	Quick onset and spikier sweetness than 2.1 and 2.4, mild (4) metallic aftertaste, trace to faint (1.5) bitter at the end, faint vapory cooling effect, very late trace-faint (1.5) bitterness
2.8	Better onset and more rounded sweetness than 2.7, faint-slight (2.5) metallic aftertaste, faint middle papery notes before metallic kicks in
2.9	Even more rounded sweetness than 2.7 and 2.8, middle brown sugar notes, trace-faint (1.5) metallic aftertaste, faint papery notes, further sweetness profile improvement relative to 2.8

CLAIMS

1. A composition comprising:
a sugar alcohol and/or a rare sugar; and
a sensory modifier comprising
a dicaffeoylquicid acid or salt thereof; and
at least one compound selected from the group consisting of monocaffeoylquinic acids, monoferuloylquinic acids, diferuloylquinic acids, monocoumaroylquinic acids, dicoumaroylquinic acids, and salts thereof.
2. The composition of claim 1, wherein the composition comprises a sugar alcohol and the sensory modifier.
3. The composition of claim 1, wherein the composition comprises a rare sugar and the sensory modifier.
4. The sweetener composition of any one of claims 1-3, wherein the composition comprises a sweetening amount of the sugar alcohol and/or rare sugar.
5. The sweetener composition of any one of claims 1-4, wherein the composition comprises the sugar alcohol and/or rare sugar in an amount such that, when in water to form a solution, sweetness of the solution is at least 1.5 Brix.
6. The composition of any one of claims 1-5, wherein the composition comprises a sugar alcohol selected from the group consisting of glycerol, erythritol, sorbitol, xylitol, mannitol, lactitol, maltitol, isomalt, and combinations thereof.
7. The composition of any one of claims 1-6, wherein the composition comprises a rare sugar selected from the group consisting of allulose, tagatose, and combinations thereof.
8. The composition of any one of claims 1-7, wherein the composition comprises allulose, erythritol, sorbitol, or combinations thereof.

9. The composition of any one of claims 1-8, wherein the ratio of total concentration of sugar alcohol and/or rare sugar to sensory modifier is between 100:1 and 10,000:1, between 2500:1 and 7000:1, between 5000:1 and 10,000:1, between 100:1 and 750:1, between 150:1 and 600:1, or between 250:1 and 550:1.

10. A food or beverage product comprising the composition of any one of claims 1-9.

11. The food or beverage product of claim 10, wherein the food or beverage product comprises 0.001 (wt)% to 1.0 (wt)%, 0.005 (wt)% to 0.5 (wt)%, or 0.075 (wt)% to 0.2 (wt)% of the sensory modifier.

12. The food or beverage product of claim 10 or 11, wherein the food or beverage product comprises at least 1.0 (wt)%, at least 5 (wt)%, at least 10 (wt)%, at least 15 (wt)%, at least 20 (wt)%, at least 30 (wt)%, at least 40 (wt)%, at least 50 (wt)%, at least 60 (wt)%, at least 70 (wt)%, at least 80 (wt)%, at least 90 (wt)%, or at least 95 (wt)% of the sugar alcohol and/or rare sugar.

13. The food or beverage product of any one of claims 10-12, wherein the food or beverage product comprises at least 1.0 (wt)%, at least 5 (wt)%, at least 10 (wt)%, at least 15 (wt)%, at least 20 (wt)%, at least 30 (wt)%, at least 40 (wt)%, at least 50 (wt)%, at least 60 (wt)%, at least 70 (wt)%, at least 80 (wt)%, at least 90 (wt)%, or at least 95 (wt)% of allulose, erythritol, sorbitol, or a combination thereof.

14. A method for reducing bitterness in a sugar alcohol and/or rare sugar composition, the method comprising,

adding to a composition comprising a sugar alcohol and/or a rare sugar a sensory modifier comprising a dicaffeoylquinic acid or salt thereof and at least one compound selected from the group consisting of monocaffeoylquinic acids, monoferuloylquinic acids, diferuloylquinic acids, monocoumaroylquinic acids, dicoumaroylquinic acids, and salts thereof,

wherein, when added in water to form a solution, bitterness of the solution is reduced relative to bitterness of an aqueous solution prepared from an equivalent sugar alcohol composition lacking the sensory modifier.

15. The method of claim 14, wherein the sensory modifier is added to the sugar alcohol and/or rare sugar composition in an amount effective to reduce bitterness such that a bitterness score of the composition is reduced by at least 1 unit, at least 2 units, or at least 3 units relative to a comparable composition without the sensory modifier, wherein bitterness score is determined by at least four panelists experienced in sensory testing using a roundtable methodology using a scale of 0 to 9 with a score of 0 indicating no bitterness and a score of 9 indicating extreme bitterness.

16. The method of claim 14 or 15, wherein the composition is a food or beverage product.

17. The composition, product, or method of any preceding claim, wherein the sensory modifier comprises less than 0.3% (wt) of malonate, malonic acid, oxalate, oxalic acid, lactate, lactic acid, succinate, succinic acid, malate, or malic acid; or less than 0.05% (wt) of pyruvate, pyruvic acid, fumarate, fumaric acid, tartrate, tartaric acid, sorbate, sorbic acid, acetate, or acetic acid; or less than 0.05% (wt) of chlorophyll; or less than 0.1% (wt) of furans, furan-containing chemicals, theobromine, theophylline, or trigonelline as a weight percentage on a dry weight basis of the sensory modifier.

18. The composition, product, or method of any preceding claim, wherein the sensory modifier comprises 0% (wt) of malonate, malonic acid, oxalate, oxalic acid, lactate, lactic acid, succinate, succinic acid, malate, or malic acid; or 0% (wt) of chlorophyll.

19. The composition, product, or method of any preceding claim, wherein the dicaffeoylquinic acid or dicaffeoylquinic salt comprises at least one compound selected from the group consisting of 1,3-dicaffeoylquinic acid, 1,4-dicaffeoylquinic acid, 1,5-dicaffeoylquinic acid, 3,4-dicaffeoylquinic acid, 3,5-dicaffeoylquinic acid, 4,5-dicaffeoylquinic acid, and salts thereof.

20. The composition, product, or method of any preceding claim, wherein the total of all dicaffeoylquinic acids and dicaffeoylquinic salts present in the sensory modifier comprises 10% (wt) or more, 15 wt % or more, 20% (wt) or more, 25% (wt) or more, 30% (wt) or more, 35% (wt) or more, 40% (wt) or more, 45% (wt) or more, 50% (wt) or more, 60% (wt) or more, 70% (wt) or more, 25-75% (wt), or 40-60% (wt) of a total weight of the sensory modifier.

21. The composition, product, or method of any preceding claim, wherein the sensory modifier comprises a monocaffeoylquinic component selected from the group consisting of chlorogenic acid, neochlorogenic acid, cryptochlorogenic acid, and salts thereof.
22. The composition, product, or method of any preceding claim, wherein the sensory modifier comprises a monocaffeoylquinic component and a dicaffeoylquinic component that together comprise more than 50% (wt), preferably more than 60% (wt), more than 70% (wt), more than 80% (wt), more than 90% (wt), or more than 95% (wt) of the sensory modifier.
23. The composition, product, or method of any preceding claim, wherein, when in water to form a solution, bitterness of the solution is reduced by at least 0.5 units, at least 1 unit, at least 2 units, or at least 3 units relative to an aqueous solution prepared from an equivalent composition without the sensory modifier, wherein bitterness is measured by Standardized Bitterness Intensity Test.
24. The composition, product, or method of any preceding claim, wherein, when in water to form a solution, the composition has reduced bitterness, reduced sweetness linger, and/or reduced metallic notes relative to an equivalent composition without the sensory modifier.
25. Use of a sensory modifier comprising a dicaffeoylquicid acid or salt thereof and at least one compound selected from the group consisting of monocaffeoylquinic acids, monoferuloylquinic acids, diferuloylquinic acids, monocoumaroylquinic acids, dicoumaroylquinic acids, and salts thereof to reduce bitterness, reduce metallic flavor, or combinations thereof, in a sugar alcohol and/or rare sugar composition.

INTERNATIONAL SEARCH REPORT

International application No

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A. CLASSIFICATION OF SUBJECT MATTER

INV. A23L2/56 A23L2/60 A23L27/30 A23L27/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A23L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DATABASE GNPD [Online] MINTEL; 2 April 2022 (2022-04-02), anonymous: "Blackberry Yerba Mate Flavoured Zero Sugar Energy Drink", XP093143551, Database accession no. 9494806 the whole document -----	1-13
X	DATABASE GNPD [Online] MINTEL; 15 March 2021 (2021-03-15), anonymous: "Clean Energy Strawberry & Lime Yerba Mate", XP093143558, Database accession no. 8558689 the whole document ----- -/--	1-13



Further documents are listed in the continuation of Box C.



See patent family annex.

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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X,P	WO 2023/115051 A1 (CARGILL INC [US]) 22 June 2023 (2023-06-22) the whole document -----	1-25

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Information on patent family members

International application No

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