COMPOSITIONS AND METHODS FOR TASTE MODULATION

TECHNICAL FIELD

The present disclosure relates to compositions containing norditerpenoids. The present disclosure further extends to consumables containing sweeteners and at least one norditerpenoid to improve sweetness, improve mouthfeel and/or mask off-notes of consumables.

BACKGROUND

Compounds for modifying the taste of consumable products, that is, products taken orally either for ingestion or spitting out, such as foodstuffs, beverages, confectionery, oral care products and the like are widely used. They do not themselves add flavor to the consumable, but they provide desirable ancillary benefits, such as enhanced mouthfeel and/or sweetness or masking undesirable characteristics of other ingredients, such as the distinctive tastes and textures perceived as unappealing of products containing sugar replacers.

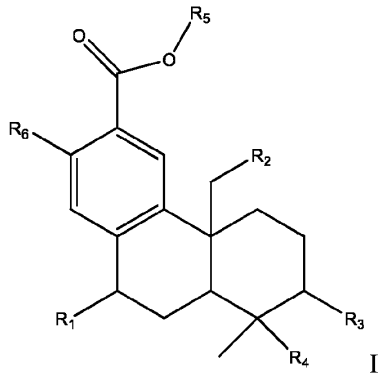
In the case of sugar replacers, the tastes they impart can present different temporal profiles, flavor-profiles or adaptation behaviors compared with the sugars which they replace, in whole or in part. For example, the sweet taste of natural and synthetic high-intensity sweeteners (HIS), is generally slower in onset and longer in duration than the sweet taste produced by sugar (sweet, short-chain, soluble carbohydrates, including glucose, fructose, sucrose, maltose and lactose) or high fructose corn syrups (HFCS) which is known as a replacement for sugar, and this can change the taste balance of an edible composition containing them. This can create unbalanced temporal taste profiles. In addition to the difference in temporal profile, high-intensity sweeteners generally exhibit lower maximal response than sugar; off-tastes including bitter, metallic, cooling, astringent, licorice-like taste and/or sweetness, which diminishes on iterative tasting.

However, all high-intensity sweeteners have undesirable after-taste in the form of off-notes, such as liquorice-like after-taste and/or lingering sweetness. In the particular case of Rebaudioside A ("Reb A"), this takes the form of a combination of an undesirable lingering sweetness and a liquorice-like after-taste. This after-taste detracts from the desired sugar-like sweetness, and thus effectively masking undesirable tastes or off-tastes in edible compositions is key to consumer acceptance of many edible compositions.

Accordingly, there remains a need to provide taste modifying ingredients, extracts or fractions which are natural and/or suitable for vegans, i.e. "cleaner label", while at the same time improving mouthfeel, masking off-notes, and/or improving sweetness of consumables.

SUMMARY

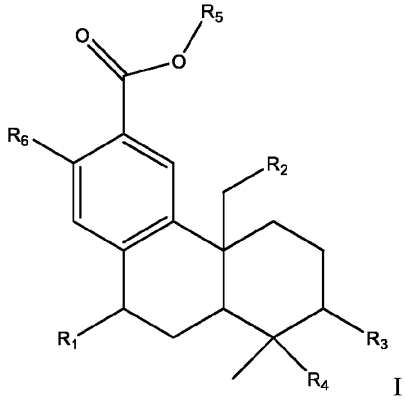
In one illustrative embodiment, a composition comprises a flavor-providing substance and at least one norditerpenoid of Formula I:



I

wherein R_1, R_2 and R_3 are each independently selected from hydrogen, hydroxyl or oxo; wherein R_4 is selected from methyl, hydroxymethyl, aldehyde, carboxylic acid or ester with C_{1-6} alkyl; wherein R_5 is selected from hydrogen, C_{1-6} alkyl, a furanose moiety, a pyranose moiety or an oligosaccharide moiety having two to six saccharide moieties; and wherein R_6 is selected from hydrogen, hydroxyl or C_{1-6} alkyl.

In another illustrative embodiment, a consumable comprises (a) at least one sweetener, and (b) a sweetness modifier including at least one norditerpenoid of Formula I:



I

wherein R_1, R_2 and R_3 are each independently selected from hydrogen, hydroxyl or oxo; wherein R_4 is selected from methyl, hydroxymethyl, aldehyde, carboxylic acid or ester with C_{1-6} alkyl; wherein R_5 is selected from hydrogen, C_{1-6} alkyl, a furanose moiety, a pyranose moiety or an oligosaccharide moiety having two to six saccharide moieties; wherein R_6 is selected from hydrogen, hydroxyl or C_{1-6} alkyl; and wherein the at least one sweetener is present in a sweetening amount.

These and other features, aspects and advantages of specific embodiments will become evident to those skilled in the art from a reading of the present disclosure.

DETAILED DESCRIPTION

The following text sets forth a broad description of numerous different embodiments of the present disclosure. The description is to be construed as exemplary only and does not describe every possible embodiment since describing every possible embodiment would be impractical, if not impossible. It will be understood that any feature, characteristic, component, composition, ingredient, product, step or methodology described herein can be deleted, combined with or substituted for, in whole or part, any other feature, characteristic, component, composition, ingredient, product, step or methodology described herein. Numerous alternative embodiments could be implemented, using either current technology or technology developed after the filing date of this patent, which would still fall within the scope of the claims. All publications and patents cited herein are incorporated herein by reference.

The present disclosure relates to the surprising finding that certain norditerpenoids and the extracts or fractions containing these compounds exhibit a sweet modifying effect as well as mouthfeel modifying properties without introducing unpleasant off-notes. In particular, the present disclosure relates to the surprising finding that certain norditerpenoids and the extracts or fractions containing these compounds are useful for enhancing the sweetness and/or modulating the taste of certain sweeteners, particularly reduced sugar or non-caloric sweeteners in consumables such as beverages. In one embodiment, norditerpenoid compounds of the formulae disclosed herein enhance sweetness. In another embodiment, norditerpenoid compounds of the formulae disclosed herein are taste modulators/modifiers, with or without simultaneously enhancing sweetness.

According to the present disclosure, certain norditerpenoids of the formulae disclosed herein may be isolated from the root barks of *Jasminum giraldii*. *Jasminum giraldii* Diels (Oleaceae), is an endemic plant found in China's Shaanxi Province. Its dried root barks, named as "quan pi" in Chinese, are used as a traditional Chinese medicine for the treatment of various diseases such as fever, rheumatic pain and irregular menstruation. Certain norditerpenoids of the formulae disclosed herein can be derived from an extract, or can be synthetic, or can be a combination of extract and synthetic.

In one embodiment, the root barks of *Jasminum giraldii* are dried prior to extraction. In some embodiments, the root barks are optionally milled prior to extraction.

The root barks of *Jasminum giraldii* may be extracted by any suitable extraction process, such as, for example, continuous or batch reflux extraction, supercritical fluid extraction,

enzyme-assisted extraction, microorganism-assisted extraction, ultrasound-assisted extraction, microwave- assisted extraction, etc. The methods may be deployed at any scale.

The solvent used for the extraction can be any suitable solvent, such as for example, polar organic solvents (degassed, vacuumed, pressurized or distilled), non-polar organic solvents, water (degassed, vacuumed, pressurized, deionized, distilled, carbon-treated or reverse osmosis) or a mixture thereof. In a particular embodiment, the solvent comprises water and one or more alcohols. In a particular embodiment, the solvent comprises water and an alcohol selected from methanol, ethanol, n-propanol, 2-propanol, 1 butanol, 2-butanol and mixtures thereof.

The amount of alcohol in the solvent can vary from about 10% to about 100%, such as, for example, about 20%, about 30%, about 40%, about 50%, about 60%, about 70%, about 80%, about 90% or any range between. In a particular embodiment, alcohol comprises from about 80% to about 100% of the solvent, with the remainder being water.

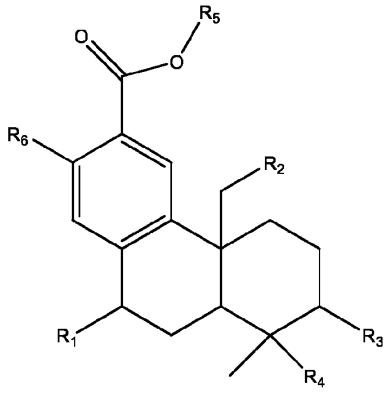
In some embodiments, the extraction process takes place at elevated temperatures, such as, for example, from about 50 °C to about 100 °C. In a more particular embodiment, the extraction process takes place at a temperature of about 100°C.

Those skilled in the art will understand that the duration of the extraction will vary based on the amount of solvent and plant material used. In some embodiments, the extraction is carried out for about 10 minutes to about 24 hours. Water and/or any insoluble material can be removed from the extraction mixture to provide **a "crude extract."**

Insoluble plant material may be separated from the extracted mixture by, e.g., filtration. Other suitable separation methods include, but are not limited to, gravity filtration, a plate-and-frame filter press, cross flow filters, screen filters, Nutsche filters, belt filters, ceramic filters, membrane filters, microfilters, nanofilters, ultrafilters or centrifugation. Optionally, various filtration aids such as diatomaceous earth, bentonite, zeolite, etc., may be used in this process.

The crude extract is then subjected to one or more chromatographic separations to provide a solution of one or more norditerpenoid compounds described herein. The crude extract is passed over one or more columns, e.g. those packed with polymeric adsorbent resins. Elution of the one or more columns with aqueous methanol provides a solution containing fractions of the plant extract. In one embodiment, 10% ethanol is first applied to the column and the eluent collected. Fractions can be collected based on % methanol used for elution, e.g., 0% methanol, 30% methanol, 50% methanol, 70% methanol and 100% methanol. Typically, the product of the chromatographic step is collected in multiple fractions, which may then be analyzed using any suitable technique, for example, thin layer chromatography or mass spectrometry.

In one embodiment, norditerpenoid compounds of Formula I are useful for enhancing and/or modifying/modulating sweetness of a consumable containing a sweetener:



I

wherein R_1, R_2 and R_3 are each independently selected from hydrogen, hydroxyl or oxo; wherein R_4 is selected from methyl, hydroxymethyl, aldehyde, carboxylic acid or ester with C_{1-6} alkyl; wherein R_5 is selected from hydrogen, C_{1-6} alkyl, a furanose moiety, a pyranose moiety or an oligosaccharide moiety having two to six saccharide moieties; and wherein R_6 is selected from hydrogen, hydroxyl or C_{1-6} alkyl.

"Saccharide", as used herein, refers to monosaccharides, disaccharides, oligosaccharides and polysaccharides. A saccharide comprises at least one carbohydrate. Exemplary carbohydrates include, but are not limited to, sucrose, glyceraldehyde, dihydroxyacetone, erythrose, threose, erythrulose, arabinose, lyxose, ribose, xylose, ribulose, xylulose, allose, altrose, galactose, glucose, gulose, idose, mannose, talose, fructose, psicose, sorbose, tagatose, mannoheptulose, sedoheltulose, octolose, fucose, rhamnose, arabinose, turanose and sialose.

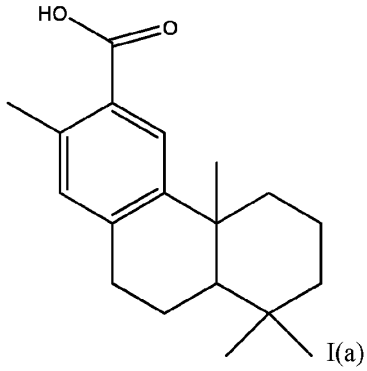
In one embodiment, norditerpenoid compounds of Formula I according to the present disclosure are sweetness modifiers. The term "sweetness modifier", as used herein, refers to a compound that modifies, enhances, amplifies or potentiates the perception of sweetness of a consumable when the compound is present in the consumable in a concentration at or below the compound's sweetness recognition threshold, i.e. a concentration at which the compound does not contribute any noticeable sweet taste in the absence of additional sweetener(s).

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

In another embodiment, new norditerpenoid compounds of Formula I according to the present disclosure are taste modulators, with or without simultaneously acting as sweetness modifiers. That is, in some embodiments, the norditerpenoid compounds of Formula I modify sweetness and modulate one or more taste attributes of a sweetener. In other embodiments, the norditerpenoid compounds of Formula I modify the sweetness of a sweetener without modulating

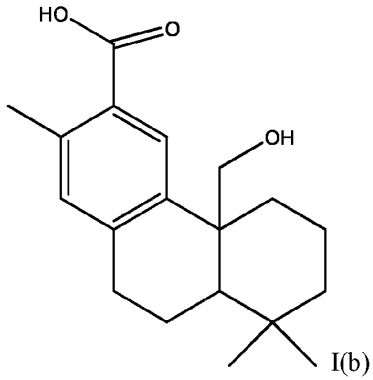
one or more taste attributes of the sweetener. In still other embodiments, the norditerpenoid compounds of Formula I modulate one or more taste attributes of a sweetener without modifying the sweetness of the sweetener.

In another particular embodiment, the norditerpenoid compound is a compound of Formula I(a):



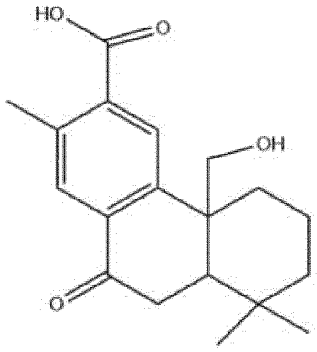
I(a)

In yet another particular embodiment, the norditerpenoid compound is a compound of Formula I(b):



I(b)

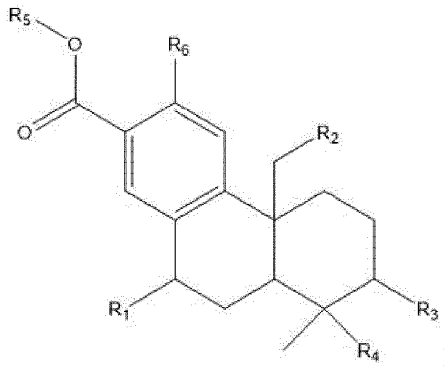
In yet another particular embodiment, the norditerpenoid compound is a compound of Formula I(c):



I(c)

In another embodiment, new norditerpenoid compounds of Formula II according to the present disclosure are taste modulators, with or without simultaneously acting as sweetness modifiers. That is, in some embodiments, the norditerpenoid compounds of Formula II modify sweetness and modulate one or more taste attributes of a sweetener. In other embodiments, the norditerpenoid compounds of Formula II modify the sweetness of a sweetener without modulating one or more taste attributes of the sweetener. In still other embodiments, the norditerpenoid compounds of Formula II modulate one or more taste attributes of a sweetener without modifying the sweetness of the sweetener.

In one embodiment, norditerpenoid compounds of Formula II are useful for enhancing and/or modifying/modulating sweetness of a consumable containing a sweetener:



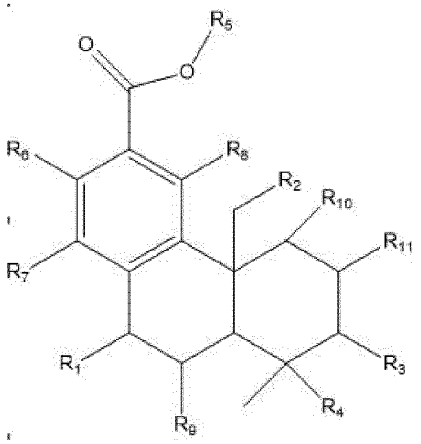
II

wherein R_1, R_2 and R_3 are each independently selected from hydrogen, hydroxyl or oxo; wherein R_4 is selected from methyl, hydroxymethyl, aldehyde, carboxylic acid or ester with C_{1-6} alkyl; wherein R_5 is selected from hydrogen, C_{1-6} alkyl, a furanose moiety, a pyranose moiety or

an oligosaccharide moiety having two to six saccharide moieties; and wherein R_6 is selected from hydrogen, hydroxyl or C_{1-6} alkyl.

In another embodiment, new norditerpenoid compounds of Formula III according to the present disclosure are taste modulators, with or without simultaneously acting as sweetness modifiers. That is, in some embodiments, the norditerpenoid compounds of Formula III modify sweetness and modulate one or more taste attributes of a sweetener. In other embodiments, the norditerpenoid compounds of Formula III modify the sweetness of a sweetener without modulating one or more taste attributes of the sweetener. In still other embodiments, the norditerpenoid compounds of Formula III modulate one or more taste attributes of a sweetener without modifying the sweetness of the sweetener.

In one embodiment, norditerpenoid compounds of Formula III are useful for enhancing and/or modifying/modulating sweetness of a consumable containing a sweetener:

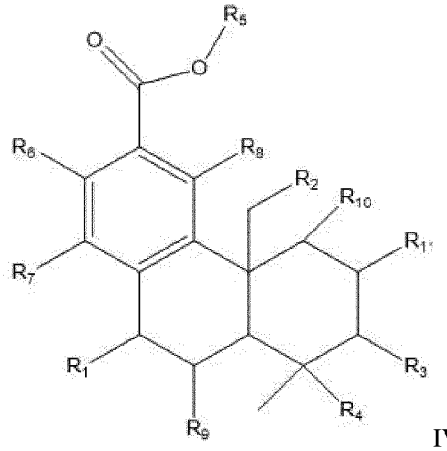


III

wherein R1, R2, R3, R9, R10 and R11 are independently selected from hydrogen, hydroxyl or oxo groups; R4 is selected from methyl group, hydroxymethyl group, aldehyde, carboxylic acid, or ester with C_{1-6} alky; R5 is independently selected from hydrogen, C_{1-6} alkyl, a furanose moiety, a pyranose moiety, or an oligosaccharide moiety having two to six saccharide moieties; R6, R7 and R8 are selected from hydrogen, hydroxyl or C_{1-6} alkyl.

In another embodiment, new norditerpenoid compounds of Formula IV according to the present disclosure are taste modulators, with or without simultaneously acting as sweetness modifiers. That is, in some embodiments, the norditerpenoid compounds of Formula IV modify sweetness and modulate one or more taste attributes of a sweetener. In other embodiments, the norditerpenoid compounds of Formula IV modify the sweetness of a sweetener without modulating one or more taste attributes of the sweetener. In still other embodiments, the norditerpenoid compounds of Formula IV modulate one or more taste attributes of a sweetener without modifying the sweetness of the sweetener.

In one embodiment, norditerpenoid compounds of Formula IV are useful for enhancing and/or modifying/modulating sweetness of a consumable containing a sweetener:



IV

wherein R1, R2, R3, R9, R10 and R11 are independently selected from hydrogen, hydroxyl or oxo groups; R4 is selected from methyl group, hydroxymethyl group, aldehyde, carboxylic acid or ester with C_{1-6} alky; R5 is independently selected from hydrogen, C_{1-6} alkyl, a furanose moiety, a pyranose moiety, or an oligosaccharide moiety having two to six saccharide moieties; R6, R7 and R8 are selected from hydrogen, hydroxyl or C_{1-6} alkyl.

In another embodiment, the flavor composition according to the present disclosure may also comprise additional sweetness modifiers. According to certain illustrative embodiments, the additional sweetness modifiers are selected from the group consisting of steviol glycosides, mogrosides, dihydrochalcones and combinations thereof. According to certain embodiments, the amount of these sweetness modifiers present in the flavor composition may be in a concentration of from about 1,000 ppm to about 200,000 ppm, in another embodiment from 2,000 ppm to about 100,000 ppm, and in another embodiment from about 5,000 ppm to about 50,000 ppm.

In one embodiment, the flavor composition according to the present disclosure may also comprise a flavor-providing substance. By "flavor-providing substance" it is meant a composition created by a flavorist using methods known to the skilled person that is a mixture of tastants, aroma compounds and sensates. Examples of suitable flavorants include natural flavors, artificial flavors, spices, seasonings, and the like. Exemplary flavor-providing substances include synthetic flavor oils and flavoring aromatics and/or oils, oleoresins, essences, and distillates, and a combination comprising at least one of the foregoing.

Flavor oils include spearmint oil, cinnamon oil, oil of wintergreen (methyl salicylate), peppermint oil, Japanese mint oil, clove oil, bay oil, anise oil, eucalyptus oil, thyme oil, cedar leaf oil, oil of nutmeg, allspice, oil of sage, mace, oil of bitter almonds, and cassia oil; useful flavoring agents include artificial, natural and synthetic fruit flavors such as vanilla, and citrus

oils including lemon, orange, lime, grapefruit, yuzu, sudachi, and fruit essences including apple, pear, peach, grape, raspberry, blackberry, gooseberry, blueberry, strawberry, cherry, plum, prune, raisin, cola, guarana, neroli, pineapple, apricot, banana, melon, apricot, cherry, tropical fruit, mango, mangosteen, pomegranate, papaya, and so forth.

Additional exemplary flavors imparted by a flavor-providing substance include a milk flavor, a butter flavor, a cheese flavor, a cream flavor, and a yogurt flavor, a vanilla flavor, tea or coffee flavors, such as a green tea flavor, an oolong tea flavor, a tea flavor, a cocoa flavor, a chocolate flavor, and a coffee flavor; mint flavors, such as a peppermint flavor, a spearmint flavor, and a Japanese mint flavor; spicy flavors, such as an asafetida flavor, an ajowan flavor, an anise flavor, an angelica flavor, a fennel flavor, an allspice flavor, a cinnamon flavor, a chamomile flavor, a mustard flavor, a cardamom flavor, a caraway flavor, a cumin flavor, a clove flavor, a pepper flavor, a coriander flavor, a sassafras flavor, a savory flavor, a Zanthoxyli Fructus flavor, a perilla flavor, a juniper berry flavor, a ginger flavor, a star anise flavor, a horseradish flavor, a thyme flavor, a tarragon flavor, a dill flavor, a capsicum flavor, a nutmeg flavor, a basil flavor, a marjoram flavor, a rosemary flavor, a bayleaf flavor, and a wasabi (Japanese horseradish) flavor; a nut flavor such as an almond flavor, a hazelnut flavor, a macadamia nut flavor, a peanut flavor, a pecan flavor, a pistachio flavor, and a walnut flavor; floral flavors; and vegetable flavors, such as an onion flavor, a garlic flavor, a cabbage flavor, a carrot flavor, a celery flavor, mushroom flavor, and a tomato flavor.

According to some embodiments, flavor-providing substances may also include aldehydes and esters such as cinnamyl acetate, cinnamaldehyde, citral diethylacetal, dihydrocarvyl acetate, eugenyl 49 formate, p-methylamisol, and so forth can be used. Further examples of aldehyde flavourings include acetaldehyde (apple), benzaldehyde (cherry, almond), anisic aldehyde (licorice, anise), cinnamic aldehyde (cinnamon), citral, i.e., alpha-citral (lemon, lime), neral, i.e., beta-citral (lemon, lime), decanal (orange, lemon), ethyl vanillin (vanilla, cream), heliotrope, i.e., piperonal (vanilla, cream), vanillin (vanilla, cream), alpha-amyl cinnamaldehyde (spicy fruity flavours), butyraldehyde (butter, cheese), valeraldehyde (butter, cheese), citronellal (modifies, many types), decanal (citrus fruits), aldehyde C-8 (citrus fruits), aldehyde C-9 (citrus fruits), aldehyde C-12 (citrus fruits), 2-ethyl butyraldehyde (berry fruits), hexenal, i.e., trans-2 (berry fruits), tolyl aldehyde (cherry, almond), veratraldehyde (vanilla), 2,6-dimethyl-5-heptenal, i.e., melonal (melon), 2,6-dimethyloctanal (green fruit), and 2-dodecenal (citrus, mandarin), and the like.

Generally any flavor-providing substance or food additive such as those described in "Chemicals Used in Food Processing", Publication No 1274, pages 63-258, by the National Academy of Sciences, can be used. This publication is incorporated herein by reference.

In certain embodiments, the at least one flavor-providing substance is present in an amount of about 1 to about 95 wt.%, based on the total weight of the flavor composition. In certain embodiments, the at least one flavor-providing substance is present in an amount of about 1 to about 70 wt.%, based on the total weight of the flavor composition. In certain embodiments, the at least one flavor-providing substance is present in an amount of about 5 to about 60 wt.%, based on the total weight of the flavor composition. In certain embodiments, the at least one flavor-providing substance is present in an amount of about 10 to about 50 wt.%, based on the total weight of the flavor composition.

The flavor composition may also contain one or more adjuvants. Adjuvants are ingredients that do not influence the flavor or other organoleptic properties of flavor composition, but which can affect its quality in other ways. Adjuvants may include colorants, which can add desirable color or replace color lost through processing; pH buffers; preservatives; anti-oxidants, and the like. Without limitation, adjuvants may also include solvents, emulsifiers, disintegrating agents and lubricants. Other examples of adjuvants for flavor compositions may be found in for example, "Perfume and Flavour Materials of Natural Origin", S. Arctander, Ed., Elizabeth, N.J., 1960; in "Perfume and Flavour Chemicals", S. Arctander, Ed., Vol. I & II, Allured Publishing Corporation, Carol Stream, USA, 1994; in "Flavourings", E. Ziegler and H. Ziegler (ed.), Wiley-VCH Weinheim, 1998, and "CTFA Cosmetic Ingredient Handbook", J. M. Nikitakis (ed.), 1st ed., The Cosmetic, Toiletry and Fragrance Association, Inc., Washington, 1988.

The norditerpenoid compounds described herein can be provided in pure form or as part of a mixture. The mixture can be an extract or fraction prepared from the plant or portion of a plant, as described herein.

The norditerpenoid compounds described herein modify and/or modulate the taste of at least one sweetener. The at least one sweetener can be any known sweetener, for example, a natural sweetener, a natural high potency sweetener or a synthetic sweetener.

The at least one sweetener is present in a sweetening amount. "Sweetening amount", as used herein, refers to the amount of compound required to provide detectable sweetness when present in a consumable, e.g. a beverage.

As used herein, the phrase "natural high potency sweetener" refers to any sweetener found naturally in nature and characteristically has a sweetness potency greater than sucrose, fructose, or glucose, yet has less calories. The natural high potency sweetener can be provided as a pure compound or, alternatively, as part of an extract. As used herein, the phrase "synthetic sweetener" refers to any composition which is not found naturally in nature and characteristically has a sweetness potency greater than sucrose, fructose, or glucose, yet has less calories.

In other embodiments, the at least one sweetener is a carbohydrate sweetener. Suitable carbohydrate sweeteners are selected from, but not limited to, the group consisting of sucrose, glyceraldehyde, dihydroxyacetone, erythrose, threose, erythrulose, arabinose, lyxose, ribose, xylose, ribulose, xylulose, allose, altrose, galactose, glucose, gulose, idose, mannose, talose, fructose, psicose, sorbose, tagatose, mannoheptulose, sedoheltulose, octolose, fucose, rhamnose, turanose, cellobiose, sialose and combinations thereof. In other embodiments, the at least one sweetener does not comprise a carbohydrate sweetener.

In another embodiment, the additional sweetener is a rare sugar selected from sorbose, lyxose, ribulose, xylose, xylulose, D-allose, L-ribose, D-tagatose, L-glucose, L-fucose, L-arabinose, turanose and combinations thereof. Other sweeteners include siamenoside I, monatin and its salts (monatin SS, RR, RS, SR), curculin, glycyrrhizic acid and its salts, thaumatin, monellin, mabinlin, brazzein, tamatin, hemandulcin, phyllodulcin, glycyphyllin, trilobatin, baiyunoside, osladin, polypodoside A, pterocaryoside A, pterocaryoside B, mukurozioside, phlomisoside I, periandrin I, abrusoside A, steviolbioside and cyclocarioside I, sugar alcohols such as erythritol, sucralose, potassium acesulfame, acesulfame acid and salts thereof, aspartame, alitame, saccharin and salts thereof, hesperidin dihydrochalcone glucoside, neohesperidin dihydrochalcone, cyclamate, cyclamic acid and salts thereof, neotame, advantame, glucosylated steviol glycosides (GSGs) and combinations thereof.

In one embodiment, the sweetener is a caloric sweetener or mixture of caloric sweeteners. In another embodiment, the caloric sweetener is selected from sucrose, fructose, glucose, high fructose com/starch syrup, a beet sugar, a cane sugar and combinations thereof.

In other embodiments, the sweetener comprises at least one steviol glycoside, wherein the at least one steviol glycoside is present in a sweetening amount. The steviol glycoside can be natural, synthetic or a combination of natural and synthetic. The steviol glycoside can be provided in pure form or as part of a mixture, i.e. a steviol glycoside blend. Exemplary steviol glycosides include, but are not limited to, rebaudioside M, rebaudioside D, rebaudioside A, rebaudioside N, rebaudioside O, rebaudioside E, steviolmonoside, steviolbioside, rubusoside, dulcoside B, dulcoside A, rebaudioside B, rebaudioside G, stevioside, rebaudioside C, rebaudioside F, rebaudioside I, rebaudioside H, rebaudioside L, rebaudioside K, rebaudioside J, rebaudioside M2, rebaudioside D2, rebaudioside S, rebaudioside T, rebaudioside U, rebaudioside V, rebaudioside W, rebaudioside Zl, rebaudioside Z2, rebaudioside IX, enzymatically glucosylated steviol glycosides and combinations thereof.

The steviol glycoside blend sweetener typically has a total steviol glycoside content of about 95% by weight or greater on a dry basis. The remaining 5% comprises other non-steviol glycoside compounds, e.g. by-products from extraction or purification processes. In some

embodiments, the steviol glycoside blend sweetener has a total steviol glycoside content of about 96% or greater, about 97% or greater, about 98% or greater or about 99% or greater. "Total steviol glycoside content", as used herein, refers to the sum of the relative weight contributions of each steviol glycoside in a sample.

In one embodiment, the sweetener comprises at least one mogroside, wherein the at least one mogroside is present in a sweetening amount. The mogroside can be natural, synthetic or a combination of natural and synthetic. The mogroside can be provided in pure form or as part of mixture, i.e. a mogroside blend. Exemplary mogrosides include, but are not limited to, any of grosmogroside I, mogroside IA, mogroside IE, 1 l-oxomogroside IA, mogroside II, mogroside II A, mogroside II B, mogroside II E, 7-oxomogroside II E, mogroside III, Mogroside Hie, 1 l-oxomogroside HIE, 11- deoxymogroside III, mogroside IV, Mogroside IVA 1 l-oxomogroside IV, 1 l-oxomogroside IV A, mogroside V, isomogroside V, 1 l-deoxymogroside V, 7-oxomogroside V, 11- oxomogroside V, isomogroside V, mogroside VI, mogrol, 1 l-oxomogrol, siamenoside I, and combinations thereof.

In one embodiment, the weight ratio of the at least one sweetener to the norditerpenoid compound described herein can vary.

Products

According to the present disclosure, the norditerpenoid compounds may be added to a sweetened consumable (i.e. a consumable having at least one sweetener therein), or may be provided as part of a flavor composition for consumables.

In one embodiment, the norditerpenoid compounds described herein are present in the flavor composition in an amount such that, when the flavor composition is added to a sweetened consumable, the sucrose equivalence of the consumable is increased compared to the consumable in the absence of the norditerpenoid compound.

When added to a consumable, the norditerpenoid compounds are used in an amount effective to modify the sweetness or mouthfeel of a sweetener without exhibiting any off-taste. According to certain embodiments, the amount of the norditerpenoid compound present in the consumable may be in a concentration of from about 0.01 ppm to about 100 ppm, in another embodiment from 0.01 ppm to about 50 ppm, such as, for example, from about 0.01 ppm to about 45 ppm, from about 0.01 ppm to about 40 ppm, from about 0.01 ppm to about 35 ppm, from about 0.01 ppm to about 30 ppm, from about 0.01 ppm to about 25 ppm, from about 0.01 ppm to about 20 ppm, from about 0.01 ppm to about 15 ppm, from about 0.01 ppm to about 10 ppm and from about 0.01 ppm to about 5 ppm.

In one embodiment, the at least one sweetener described herein is present in the consumable in a concentration from about 50 ppm to about 600 ppm, such as, for example, about

50 ppm to about 500 ppm, from about 50 ppm to about 400 ppm, from about 50 ppm to about 300 ppm, from about 50 ppm to about 200 ppm, from about 50 ppm to about 100 ppm, about 100 ppm to about 600 ppm, about 100 ppm to about 500 ppm, about 100 ppm to about 400 ppm, about 100 ppm to about 300 ppm, about 100 ppm to about 200 ppm, about 200 ppm to about 600 ppm, about 200 ppm to about 500 ppm, about 200 ppm to about 400 ppm, about 200 ppm to about 300 ppm, about 300 ppm to about 600 ppm, about 300 ppm to about 500 ppm, about 300 ppm to about 400 ppm, about 400 ppm to about 600 ppm, about 400 ppm to about 500 ppm and about 500 ppm to about 600 ppm. In another embodiment, for full and reduced sugar applications, the at least one sweetener may be present in the consumable in a concentration up to 100,000 ppm.

When expressed as "ppm", the concentration is parts per million by weight based on the total weight of the consumable. It should be understood that when a range of values is described in the present disclosure, it is intended that any and every value within the range, including the end points, is to be considered as having been disclosed. For example, "a range of from 0.01 ppm to 100 ppm" of the at least one norditerpenoid is to be read as indicating each and every possible number along the continuum between 0.01 and 100. It is to be understood that the inventors appreciate and understand that any and all values within the range are to be considered to have been specified, and that the inventors have possession of the entire range and all the values within the range.

In the present disclosure, the term "about" used in connection with a value is inclusive of the stated value and has the meaning dictated by the context. For example, it includes at least the degree of error associated with the measurement of the particular value. One of ordinary skill in the art would understand the term "about" is used herein to mean that an amount of "about" of a recited value produces the desired degree of effectiveness in the compositions and/or methods of the present disclosure. One of ordinary skill in the art would further understand that the metes and bounds of "about" with respect to the value of a percentage, amount or quantity of any component in an embodiment can be determined by varying the value, determining the effectiveness of the compositions or methods for each value, and determining the range of values that produce compositions or methods with the desired degree of effectiveness in accordance with the present disclosure.

The consumable may include a base. As used herein, the term "base" refers to all the ingredients necessary for the consumable, apart from the norditerpenoid compound. These will naturally vary in both nature and proportion, depending on the nature and use of the consumable or additive, but they are all well known to the art and may be used in art-recognized proportions.

The formulation of such a base for every conceivable purpose is therefore within the ordinary skill of the art.

Without limitation, and only by way of illustration, suitable bases may include, anti-caking agents, anti-foaming agents, anti-oxidants, binders, colourants, diluents, disintegrants, emulsifiers, encapsulating agents or formulations, enzymes, fats, flavor-enhancers, flavoring agents, gums, polysaccharides, preservatives, proteins, solubilisers, solvents, stabilisers, sugar-derivatives, surfactants, sweetening agents, vitamins, waxes, and the like. Solvents which may be used are known to those skilled in the art and include e.g. water, ethanol, ethylene glycol, propylene glycol, glycerine and triacetin. Encapsulants and gums include maltodextrin, gum arabic, alginates, gelatine, modified starch, other polysaccharides, and proteins.

According to the present disclosure, the term "consumable" refers to products for consumption by a subject, typically via the oral cavity (although consumption may occur via non-oral means such as inhalation), for at least one of the purposes of enjoyment, nourishment, or health and wellness benefits. Consumables may be present in any form including, but not limited to, liquids, solids, semi-solids, tablets, capsules, lozenges, strips, powders, gels, gums, pastes, slurries, solutions, suspensions, syrups, aerosols and sprays. The term also refers to, for example, dietary and nutritional, and health and wellness supplements. Consumables include compositions that are placed within the oral cavity for a period of time before being discarded but not swallowed. It may be placed in the mouth before being consumed, or it may be held in the mouth for a period of time before being discarded.

Broadly, consumables include, but are not limited to, comestibles of all kinds, confectionery products, baked products, sweet products, savoury products, fermented products, dairy products, non-dairy products, beverages, nutraceuticals and pharmaceuticals.

Non-limiting examples of consumables include: wet/liquid soups regardless of concentration or container, including frozen soups. For the purpose of this definition soup(s) means a food prepared from meat, poultry, fish, vegetables, grains, fruit and other ingredients, cooked in a liquid which may include visible pieces of some or all of these ingredients. It may be clear (as a broth) or thick (as a chowder), smooth, pureed or chunky, ready-to-serve, semi-condensed or condensed and may be served hot or cold, as a first course or as the main course of a meal or as a between meal snack (sipped like a beverage), soup may be used as an ingredient for preparing other meal components and may range from broths (consomme) to sauces (cream or cheese-based soups); dehydrated and culinary foods, including cooking aid products such as: powders, granules, pastes, concentrated liquid products, including concentrated bouillon, bouillon and bouillon like products in pressed cubes, tablets or powder or granulated form, which are sold separately as a finished product or as an ingredient within a product, sauces and recipe

mixes (regardless of technology); meal solutions products such as: dehydrated and freeze dried soups, including dehydrated soup mixes, dehydrated instant soups, dehydrated ready-to-cook soups, dehydrated or ambient preparations of ready-made dishes, meals and single serve entrees including pasta, potato and rice dishes; meal embellishment products such as: condiments, marinades, salad dressings, salad toppings, dips, breading, batter mixes, shelf stable spreads, barbecue sauces, liquid recipe mixes, concentrates, sauces or sauce mixes, including recipe mixes for salad, sold as a finished product or as an ingredient within a product, whether dehydrated, liquid or frozen; beverages, including beverage mixes and concentrates, including but not limited to, alcoholic and non-alcoholic ready to drink and dry powdered beverages, carbonated and non-carbonated beverages, e.g., sodas, fruit or vegetable juices, alcoholic and non-alcoholic beverages, teas such as green tea and black tea, wine such as red wine; confectionery products, e.g., cakes, cookies, pies, candies, chewing gums, gelatins, ice creams, sorbets, puddings, jams, jellies, salad dressings, and other condiments, cereal, and other breakfast foods, canned fruits and fruit sauces and the like.

Methods of enhancing the sweetness of a consumable and/or modulating one or more taste attributes of the sweetener to make the consumable taste more like a sucrose-sweetened consumable are provided.

In one embodiment, a method of enhancing the sweetness of a consumable comprises (i) providing a consumable comprising at least one sweetener and (ii) adding a sweetness modifier including at least one norditerpenoid compound as disclosed herein to the consumable to provide a consumable with enhanced sweetness.

In another embodiment, a method of enhancing the sweetness of a consumable comprises (i) providing a consumable base and (ii) adding at least one sweetener and a sweetness modifier including at least one norditerpenoid compound as disclosed herein to the consumable base to provide a consumable with enhanced sweetness. The at least one sweetener and the at least one norditerpenoid compound can be added together in the form of a flavor, or separately.

The disclosure is further described with reference to the following non-limiting examples.

EXAMPLES

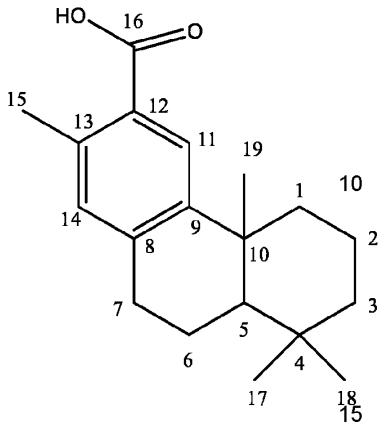
The following examples are given solely for the purpose of illustration and are not to be construed as limitations of the present invention, as many variations of the invention are possible without departing from the spirit and scope of the present disclosure.

Example 1: Extraction and Isolation of Norditerpenoids from *Jasminum giraldii*

Jasminum giraldii powder (100 g) was extracted with 80% methanol with ASE extraction system to give 31.6 g of extract, the extract was suspended in water and partitioned with hexane

to give 1.58 g of a fraction. Thereafter, the extract was purified by preparative HPLC with a gradient from 60% acetonitrile to 100% acetonitrile to give three compounds Formula I(a) (29 mg), Formula I(b) (112 mg) and Formula I(c) (36 mg).

Characterization of chemical structure of compound of Formula I(a)



I(a)

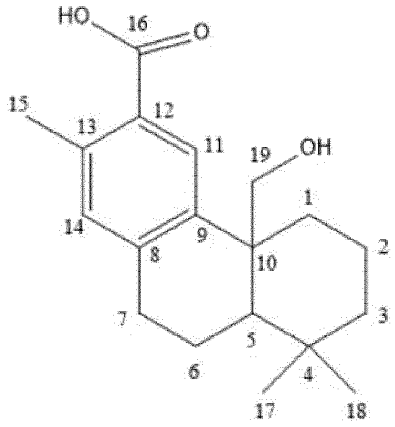
The compound of Formula I(a) was obtained as a yellowish amorphous powder and had a molecular formula $C_{19}H_{26}O_2$ by HRESIMS analysis ($[M+H]^+$ at m/z 287.1942 calcd 287.1933). The structure of the compound of Formula I(a) was established as shown above and all the ^1H and ^{13}C NMR spectroscopic signals of the compound of Formula I(a) were assigned on the basis of the ^1H NMR, ^{13}C NMR, ^1H-^1H COSY, HSQC, and HMBC spectra (Table 1).

Table 1. NMR Spectroscopic Data of the Compound of Formula I(a)*

Position	H^1, *J* in Hz	C^{13}	Position	H^1	C^{13}
1	1.37, 1H, m 2.38, 1H, m	40.5	11	7.57, 1H, s	119.4
2	1.66, 1H, m 1.70, 1H, m	20.6	12		140.4
3	1.28, 1H, m 1.51, 1H, m	42.3	13		138.2
4		34.8	14	7.57, 1H, s	145.1
5	1.29, 1H, m	50.9	15	2.37, 3H, s	22.8
6	1.92, 2H, m	20.2	16		176.4
7	2.98, 2H, m	36.4	17	0.99, 3H, s	33.8
8		162.6	18	0.97, 3H, s	22.3
9		158.0	19	1.28, 3H, s	24.1
10		42.1			

*NMR data were recorded on Bruker 300 in methanol-d_6 ^1H: 300 MHz, ^{13}C: 75 MHz

Characterization of chemical structure of compound of Formula I(b)



I(b)

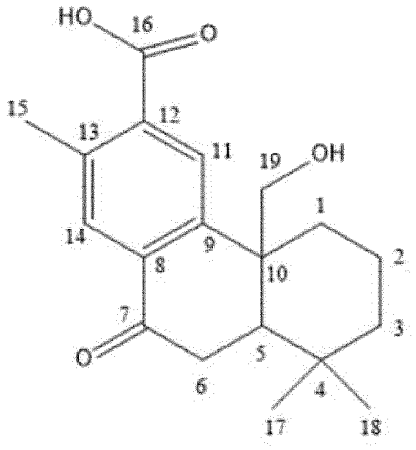
The compound of Formula I(b) was obtained as a yellowish amorphous powder. Its HRESIMS exhibited a molecular ion peak at m/z 303.1941 $[M+H]^+$, calcd. 303.1960, which was compatible with the molecular formula $C_{19}H_{26}O_3$. The structure of the compound of Formula I(b) was established as shown above and all the ^1H and ^{13}C NMR spectroscopic signals of the compound of Formula I(b) were assigned on the basis of the ^1H NMR, ^{13}C NMR, ^1H-^1H COSY, HSQC, and HMBC spectra (Table 2).

Table 2. NMR Spectroscopic Data of Compound of Formula I(b)*

Position	H^1, J in Hz	C^{13}	Position	H^1, J in Hz	C^{13}
1	1.23, 1H, m 2.72, 1H, m	35.3	11	7.67, 1H, s	122.4
2	1.69, 1H, m 1.74, 1H, m	20.4	12		140.0
3	1.27, 1H, m 1.53, 1H, m	42.5	13		139.7
4		35.0	14	7.59, 1H, s	144.8
5	1.40, 1H, m	50.3	15	2.38, 3H, s	22.6
6	1.93, 2H, m	19.7	16		176.8
7	3.04, 2H, m	35.3	17	0.99, 3H, s	33.8
8		162.4	18	0.99, 3H, s	23.0
9		154.9	19	3.74, 1H, d, J=11.4 4.01, 1H, d, J=11.4	64.1
10		46.6			

*NMR data were recorded on Bruker 300 in methanol-d_6 ^1H: 300 MHz, ^{13}C: 75 MHz

Characterization of chemical structure of compound of Formula I(c)



I(c)

The compound of Formula I(c) was obtained as a yellowish amorphous powder, the molecular formula $C_{19}H_{24}O_4$ was deduced from the positive-ion mode HRESIMS (m/z 317.1727 $[M+H]^+$, calcd. 317.11753). The structure of the compound of Formula I(c) was established as shown above, and all the ^1H and ^{13}C NMR spectroscopic signals of the compound of Formula I(c) were assigned on the basis of the ^1H NMR, ^{13}C NMR, ^1H-^1H COSY, HSQC, and HMBC spectra (Table 3).

Table 3. NMR Spectroscopic Data of Compound of Formula I(c)*

Position	H^1, *J* in Hz	C^{13}	Position	H^1, *J* in Hz	C^{13}
1	1.45, 1H, m 2.55, 1H, m	35.1	11	7.54, 1H, s	117.3
2	1.65, 1H, m 1.78, 1H, m	20.4	12		138.9
3	1.31, 1H, m 1.59, 1H, m	42.5	13		136.4
4		34.8	14	8.43, 1H, s	137.2
5	2.01, 1H, m	49.0	15	2.41, 3H, s	22.9
6	2.65, 1H, m 2.91, 1H, m	36.3	16		178.3
7		200.9	17	0.98, 3H, s	33.1
8		167.5	18	1.09, 3H, s	22.5
9		161.8	19	3.87, 1H, d, *J*=11.4 3.99, 1H, d, *J*=11.4	66.2
10		47.3			

*NMR data were recorded on Bruker 300 in methanol-d_6 ^1H: 300 MHz, ^{13}C: 75 MHz

Example 2: Taste Modulation Using Compounds from *Jasminum giraldii* Fraction

Descriptive sensory evaluations were carried out using different amounts of compounds isolated from *Jasminum giraldii* fractions in the same base. The results of this analysis, as compared to the same base in the absence of the compounds, are presented in Table 4.

Table 4

Base	Compound	Taste Evaluation
30 ppm Reb A in 0.05% citric acid and 5% sucrose	10 ppm of I(a)	Sweeter, more juicy, less bitter, more sugary
30 ppm Reb A in 0.05% citric acid and 5% sucrose	10 ppm of I(b)	Sweeter
30 ppm Reb A in 0.05% citric acid and 5% sucrose	10 ppm of I(c)	Sweeter, more sugary, less bitter, less mouth drying
30 ppm Reb A in 0.05% citric acid and 5% sucrose	20 ppm of I(c)	Much sweeter, less astringent

Compounds of Table 4 demonstrate a positive overall contribution to sweet modulation effects.

Example 3: Taste Modulation Using *Jasminum giraldii* Fraction

The root barks of *Jasminum giraldii* (10 g) were extracted with 200 mL of 25%, 50% and 75% ethanol/water to give three ethanol/water extracts at room temperature or at a temperature from 20 to 100 °C, the extract was then filtered and dried down with Rotovap at reduced pressure to give three extracts. The *J. giraldii* extracts were analyzed by LC/MS and found to include compounds of Formulas I(a), I(b) and I(c). Sensory evaluations were carried out using the extracts. The results of this analysis, as compared to the same applications in the absence of the *J. giraldii* fraction, are presented in Table 5.

Table 5

Base	Compound	Taste Evaluation
30 ppm Reb A in 0.05% citric acid and 5% sucrose water	5 ppm of *J. giraldii* 25% ethanol extract	Sweeter, sugary, less bitter, less acidic
30 ppm Reb A in 0.05% citric acid and 5% sucrose water	5 ppm of *J. giraldii* 50% ethanol extract	Sweeter, more sugary, less burning, less bitter, less acidic
30 ppm Reb A in 0.05% citric acid and 5% sucrose water	5 ppm of *J. giraldii* 75% ethanol extract	Sweeter, more sugary, sweet, less burning

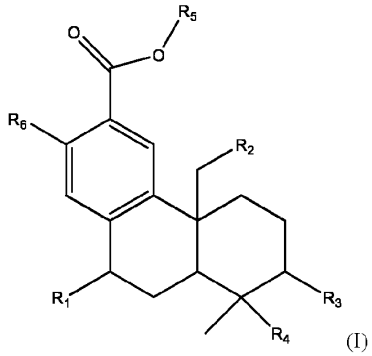
Compounds of Table 5 demonstrate a positive overall contribution to sweet modulation effects.

While particular embodiments of the present invention have been illustrated and described, it would be obvious to those skilled in the art that various other changes and modifications can be made without departing from the spirit and scope of the invention. It is

therefore intended to cover in the appended claims all such changes and modifications that are within the scope of this invention.

What is claimed is:

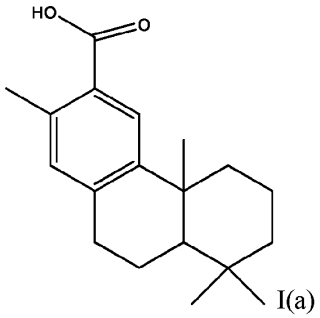
1. A composition comprising,
a flavor-providing substance; and
at least one norditerpenoid of Formula I:



(I)

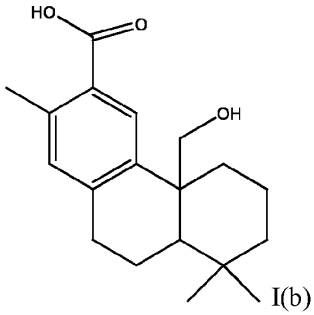
wherein R_1, R_2 and R_3 are each independently selected from hydrogen, hydroxyl or oxo;
wherein R_4 is selected from methyl, hydroxymethyl, aldehyde, carboxylic acid or ester with C_{1-6} alkyl;
wherein R_5 is selected from hydrogen, C_{1-6} alkyl, a furanose moiety, a pyranose moiety or an oligosaccharide moiety having two to six saccharide moieties; and
wherein R_6 is selected from hydrogen, hydroxyl or C_{1-6} alkyl.

2. The composition according to claim 1, wherein the at least one norditerpenoid has the structure of Formula I(a):



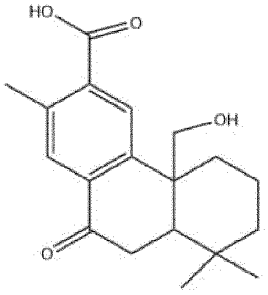
I(a)

3. The composition according to claim 1, wherein the at least one norditerpenoid has the structure of Formula I(b):



I(b)

4. The composition according to claim 1, wherein the at least one norditerpenoid has the structure of Formula I(c)



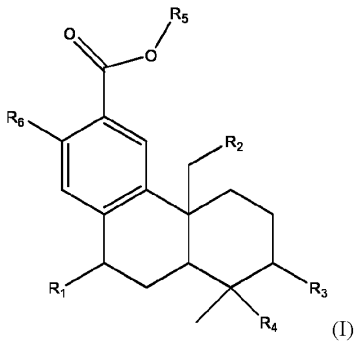
I(c)

5. The composition of claim 1 in the form of an emulsion.

6. The composition of claim 1 in the form of a powder.

7. The composition of claim 1 further comprising at least one sweetness modifier selected from the group consisting of steviol glycosides, mogrosides, dihydrochalcones and combinations thereof.

8. A consumable comprising,
   (a) at least one sweetener, and
   (b) a sweetness modifier including at least one norditerpenoid of Formula I:



(I)

wherein R_1, R_2 and R_3 are each independently selected from hydrogen, hydroxyl or oxo;

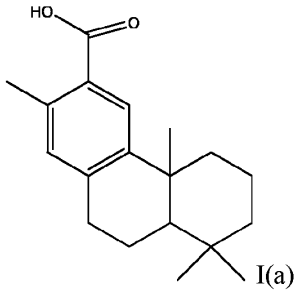
wherein R_4 is selected from methyl, hydroxymethyl, aldehyde, carboxylic acid, or ester with C_{1-6} alkyl;

wherein R_5 is selected from hydrogen, C_{1-6} alkyl, a furanose moiety, a pyranose moiety, or an oligosaccharide moiety having two to six saccharide moieties;

wherein R_6 is selected from hydrogen, hydroxyl or C_{1-6} alkyl; and

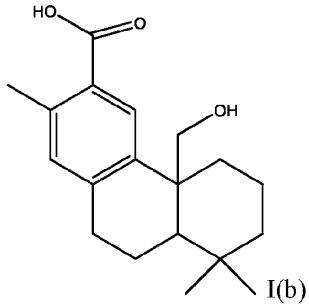
wherein the at least one sweetener is present in a sweetening amount.

9. The consumable according to claim 8, wherein the at least one norditerpenoid has the structure of Formula I(a):



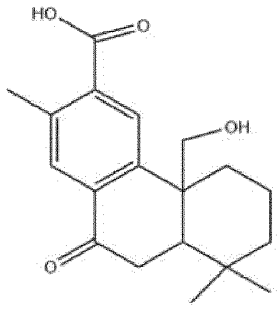
I(a)

10. The consumable according to claim 8, wherein the at least one norditerpenoid has the structure of Formula I(b):



I(b)

11. The consumable according to claim 8, wherein the at least one norditerpenoid has the structure of Formula I(c)



I(c)

12. The consumable of claim 8, wherein the at least one sweetener is selected from the group consisting of sucrose, fructose, glucose, xylose, arabinose, rhamnose, tagatose, allulose, trehalose, isomaltulose, steviol glycosides, mogrosides, stevia, trilobatin, rubusoside, aspartame, advantame, agave syrup, acesulfame potassium (AceK), high fructose corn syrup, neotame, saccharin, sucralose, high fructose corn syrup, starch syrup, Luo Han Guo extract, neohespiridin dihydrochalcone, naringin dihydrochalcone, HDG, sugar alcohols cellobiose, psicose, cyclamate, brazzein, tamatin, molasses, rice syrup and combinations thereof.

13. The consumable of claim 12, wherein the steviol glycosides are selected from the group consisting of rebaudioside M, rebaudioside D, rebaudioside A, rebaudioside N, rebaudioside O, rebaudioside E, steviolmonoside, steviolbioside, rubusoside, dulcoside B, dulcoside A, rebaudioside B, rebaudioside G, stevioside, rebaudioside C, rebaudioside F, rebaudioside I, rebaudioside H, rebaudioside L, rebaudioside K, rebaudioside J, rebaudioside M2, rebaudioside D2, rebaudioside S, rebaudioside T, rebaudioside U, rebaudioside V, rebaudioside W, rebaudioside Zl, rebaudioside Z2, rebaudioside IX, enzymatically glucosylated steviol glycosides and combinations thereof.

14. The consumable of claim 12, wherein the mogrosides are selected from the group consisting of grosmogroside I, mogroside IA, mogroside IE, 1 l-oxomogroside IA, mogroside II, mogroside II A, mogroside II B, mogroside II E, 7-oxomogroside II E, mogroside III, Mogroside Hie, 1 l-oxomogroside HIE, 11- deoxymogroside III, mogroside IV, Mogroside IVA 1 l-oxomogroside IV, 1 l-oxomogroside IV A, mogroside V, isomogroside V, 1 l-deoxymogroside V, 7-oxomogroside V, 11- oxomogroside V, isomogroside V, mogroside VI, mogrol, 1 l-oxomogrol, siamenoside I, and combinations thereof.

15. The consumable of claim 8, wherein the sweetness modifier is present in a concentration of from 0.01 ppm to 100 ppm.

16. The consumable of claim 8, wherein the consumable is a beverage.

17. The consumable of claim 8, wherein the sweetness modifier further comprises a compound selected from the group consisting of steviol glycosides, mogrosides, dihydrochalcones and combinations thereof.