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Inventor(s)

KENNISON; Deborah et al.

MIXTURE COMPRISING D-ALLULOSE AND TASTE MODIFYING COMPOUNDS

Abstract

The present invention primarily relates to a mixture comprising or consisting of a) D-allulose and b) a taste modifying compound selected from the group consisting of hesperetin, hesperetindihydrochalcone, phloretin, glycosylated rubusosides, balansines, phyllodulcin, eriodictyol, homoeriodictyol, matairesinol, and mixtures thereof. A further aspect of the present invention relates to a food or beverage product comprising a mixture according to the present invention.

Inventors: KENNISON; Deborah (Teterboro, NJ), CROCE; Melanie (Teterboro, NJ), RIESS; Thomas (Holzminden, DE), KRAMMER; Gerhard (Holzminden, DE), LEY; Jakob Peter (Holzminden, DE), REICHEL; Katharina (Holzminden, DE), PAETZ; Susanne (Höxter, DE), SOMERS; Tom (Ede, NL), VERWOHLT; Morine (Wangelnstedt, DE)

Applicant: SYMRISE AG (Holzminden, DE)

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] This application claims priority to and is a divisional of U.S. patent application Ser. No. 17/435,777, filed on Sep. 2, 2021, which is a national stage application (under 35 U.S.C. § 371) of PCT/EP2020/054424, filed Feb. 20, 2020, which claims benefit of European Application No. 19160796.9, filed Mar. 5, 2019, the entirety of which is herein incorporated by reference.

[0002] The present invention primarily relates to a mixture comprising or consisting of a) D-allulose and b) a taste modifying compound selected from the group consisting of hesperetin, hesperetindihydrochalcone, phloretin, glycosylated rubusosides, balansines, phyllodulcin, eriodictyol, homoeriodictyol, matairesinol, and mixtures thereof. A further aspect of the present invention relates to a food or beverage product comprising a mixture according to the present invention.

[0003] Further aspects of the present invention and preferred embodiments thereof will emerge from the following description and accompanying claims.

[0004] Consumers generally have a strong preference for foodstuffs or indulgence foods which have a large amount of high caloric sugar (particularly sucrose=saccharose, glucose or fructose or mixtures thereof) due to the sweetness and sweetness profile thereof. On the other hand, it is generally known that a large content of readily metabolizable carbohydrates causes a steep rise in blood sugar levels, leads to the formation of fat deposits and ultimately can result in health problems such as being overweight, obesity, insulin resistance, age-onset diabetes and complications thereof. Another particular aggravating factor is that many of the above-mentioned carbohydrates can also have an adverse effect on dental health, as they are decomposed by specific types of bacteria in the oral cavity into lactic acid, for example, and can attack the enamel of milk teeth or adult teeth (caries).

[0005] Therefore, it has long been an objective to reduce the high caloric sugar content of food or beverage products to the level which is absolutely necessary or below. A suitable measure is to use sweeteners: these are chemically uniform substances which themselves have no, or only a very low calorific value, while at the same time providing a strong sweet taste sensation; in general, the substances are non-cariogenic (a review can be found, for example in Journal of the American Dietetic Association 2004, 104 (2), 255-275).

[0006] Although so-called bulk sweeteners such as sorbitol, mannitol or other sugar alcohols are to some extent excellent sweeteners and can also replace to some extent the other foodstuff characteristics of high caloric sugars, when ingested too frequently by a proportion of the population they lead to osmotically conditioned digestion problems.

[0007] Due to their low application concentration, non-nutritive, high-intensity sweeteners are indeed very suitable for introducing sweetness into foodstuffs, however they often exhibit problems in respect of taste due to dissimilar time-intensity profiles (i.e. sweetness profiles) compared to high caloric sugars, in particular to sucrose, (for example sucralose, steviosides, cyclamate), a bitter and/or astringent aftertaste (for example acesulfame-K, saccharin or its salts, steviosides, rebaudiosides) and/or pronounced additional flavor sensations such as “licorice” (for example glycyrrhizic acid ammonium salt). Some of the sweeteners are not particularly heat-stable (for example thaumatin, brazzein, monellin), are not stable in every application (for example aspartame) and some have a very long-lasting sweet effect (strong sweet aftertaste, for example saccharin, sucralose, rebaudiosides).

[0008] One possibility—without using non-nutritive sweeteners—is to reduce the high caloric sugar content of food or beverage products and to add substances which are sensorially faintly detectable or undetectable and which indirectly or directly enhance the sweetness, as described, for example in WO 2005/041684. However, the substances described in WO 2005/041684 are explicitly of a non-natural origin and thus, from a toxicological point of view, are more difficult to assess than substances of a natural origin, particularly if the latter occur in foodstuffs or indulgence foods or originate from raw materials for the production of food or beverage products. EP 1 291 342 describes such substances of a natural origin (pyridinium betaines); however, these substances do not influence the sweet taste selectively, but also influence other taste flavors such as umami or saltiness. Furthermore, the disclosed substances can only be purified with great effort.

[0009] A different approach to reduce the high caloric sugar content of food or beverage products is to replace high caloric sugar by allulose (synonym to psicose). Allulose contains almost no calories content and yields less than about 5% of the calories of the equivalent amount of sucrose but exhibits about 70% of the sweetness intensity of sucrose. However, even if allulose is a natural sugar and the taste and sweetness profile of allulose is very close to that of sucrose there are also differences. The start of the sweetness of allulose is slower than of sucrose. Furthermore, it is possible that allulose imparts (mostly undesirable) off-tastes to food or beverage products, typically bitter, rindy, zesty, astringent, or an undesirable lingering sweetness. Moreover, the use of allulose alone as a replacement for high caloric sugar has some limitations due to cost and digestive tolerance in some applications at higher concentrations.

[0010] JP 2014/176323 A describes a fruit-juice containing drink containing the fruit juice derived from a citrus fruit, wherein the timing of an organic-functions peak of a sweet taste component is adjusted by adding the rare sugar D-psicose.

[0011] US 2014/0170083 A1 describes the use of naturally occurring triterpenes and triterpene glycosides from *Mycetia balansae* for generating a sweet impression in an orally consumable formulation or for reinforcing the sweet impression of an orally consumable formulation comprising at least one further naturally occurring, sweet-tasting substance.

[0012] WO 2017/036518 A1 describes a foodstuff, containing: a) juice, pith, flesh, skins; or other constituents of at least one citrus fruit, b) at least one 4-hydroxyflavanone, and also, if applicable, c) further flavorings or flavoring preparations, with the proviso that the constituent (b) is present in a sufficient quantity to improve the acidic and/or bitter taste of the constituent (a).

[0013] WO 2018/001703 A1 describes a method of enhancing the sweetness of sweetener in a beverage or food product comprising adding Hesperetin Dihydrochalcone to the product in an amount of 2 ppm to 50 ppm by weight of the total weight of the product.

[0014] The primary object of the present invention was to provide mixtures that can be used in food or beverage products that have a reduced amount of high caloric sugars to improve the sweet impact and mouthfeel and to reduce the sweet lingering profile and bitter after-taste of the food or beverage products while the food or beverage products show the same or a similar sweetness taste as products with a high amount of high caloric sugars.

[0015] The primary object of the present invention is achieved by a mixture comprising or

consisting of [0016] a) D-allulose [0017] and [0018] b) a taste modifying compound selected from the group consisting of hesperetin, hesperetindihydrochalcone, phloretin, alpha-glycosyl rubusosides, balansines, phyllodulcin, eriodictyol, homoeriodictyol, matairesinol, and mixtures thereof.

[0019] Hesperetin including its enantiomers and salts and their mixtures as used in mixtures according to the present invention are known to the person skilled in the art and are for example described in the European patent EP 1 909 599 B1.

[0020] Hesperetindihydrochalcone including salts and their mixtures as used in mixtures according to the present invention are known to the person skilled in the art and are for example described in the patent application WO 2017/186299.

[0021] Phloretin including salts and their mixtures as used in mixtures according to the present invention are known to the person skilled in the art and are for example described in the European patent EP 1 998 636 B1.

[0022] Eriodictyol, homoeriodictyol including their enantiomers and salts and their mixtures as used in mixtures according to the present invention are known to the person skilled in the art and are for example described in the European patent EP 1 258 200 B1.

[0023] Matairesinol including its enantiomers and salts and their mixtures as used in mixtures according to the present invention are known to the person skilled in the art and are for example described in the patent application WO 2012/146584.

[0024] Phyllodulcin including its enantiomers and salts and their mixtures as used in mixtures according to the present invention are known to the person skilled in the art and are for example described in the European patent EP 2 298 084 B1.

[0025] alpha-Glycosyl rubusosides as used in mixtures according to the present invention are known to the person skilled in the art and are for example described in the patent application WO 2015/189346 (A1).

[0026] Balansines as used in mixtures according to the present invention are compounds of the formula (I) or the physiologically acceptable salts of the compounds of the formula (I)

##STR00001## [0027] where the dotted line represents a single or a double bond, and [0028] R.sup.1, R.sup.2, R.sup.3 and R.sup.4 each represent independently of each other hydrogen or a sugar residue, preferably a monosaccharide residue or an oligosaccharide residue, [0029] characterised in that the counteraction of the physiologically acceptable salt of the compound of the formula (I) is preferably selected from the group consisting of single positively charged cations from the first primary and secondary group, ammonium ion, trialkyl ammonium ions, divalently charged cations from the second secondary group, trivalent cations from the third primary and secondary group, and preferably selected from the group consisting of Na.sup.+, K.sup.+, NH.sub.4.sup.+, Ca.sup.2+, Mg.sup.2+, Al.sup.3+ and Zn.sup.2+. Balansines as used according to the present inventions are for example described in the patent application WO 2012/164062 (A1). The preferred balansines as described on page 5, line 7 to page 12, line 4 of the WO 2012/164062 (A1) are also preferred balansines according to the present invention.

[0030] According to the invention, the two following stereoisomers (hereinafter called Balansin A and Balansin B) are most particularly preferred balansines.

##STR00002##

[0031] It was surprisingly found that a mixture of D-allulose and the above specified taste modifying compounds can be used as replacement of a part of the otherwise used amount of high caloric sugars in food or beverage products to reduce the caloric value of such products. At the same time the resulting food or beverage products shows an improved sweet impact and mouthfeel and a reduced sweet lingering profile and reduced off-tastes.

[0032] A mixture according to the present invention is preferred, wherein the mixture comprises

[0033] b1) a taste modifying compound selected from the group consisting of hesperetin, homoeriodictyol, eriodictyol, phloretin, matairesinol, and mixtures thereof [0034] and [0035] b2) a

taste-modifying compound selected from the group consisting of hersperetindihydrochalcone, alpha-glycosyl rubusosides, balansines, phyllodulcin, and mixtures thereof.

[0036] It was surprisingly found that a mixture of D-allulose with a taste modifying compound from the group b1 and b2 leads to a further improved sweet impact and mouthfeel and a reduced sweet lingering profile and reduced off-tastes or the resulting food or beverage products.

[0037] A mixture according to the present invention is preferred, wherein the weight ratio of D-allulose to the total mass of all compounds of group b) ranges from 100,000:1 to 10:1, preferably ranges from 50,000:1 to 50:1, more preferably ranges from 50,000:1 to 100:1.

[0038] A mixture according to the present invention is preferred, wherein the weight ratio of the total mass of all compounds of group b1) to the total mass of all compounds of group b2) ranges from 100:1 to 1:100, preferably ranges from 10:1 to 1:10, more preferably, from 5:1 to 1:5.

[0039] A mixture according to the present invention is preferred, further comprising one or more substances, selected from the group consisting of flavorings and/or aromatic (aroma) substances.

[0040] Mixtures according to the invention preferably contain at least one, two, three, four, five, six, seven, eight or more flavorings and/or aromatic substances.

[0041] In the context of the present invention, the (one or more) flavorings and/or aromatic substances to be used are preferably selected from the following group consisting of: [0042]

aliphatic flavouring substances, especially saturated aliphatic alcohols, such as ethanol, isopronanol, butanol, isoamyl alcohol, hexanol, 2-heptanol, octanol (1/2/3), decanol, unsaturated aliphatic alcohols, such as cis-2 pentenol, cis-3 hexenol, trans-2 hexenol, trans-3 hexenol, cis-2 octenol, 1-octen-3-ol, cis-6 nonen-1-ol, trans-2, cis-6 Nonadienol, aliphatic aldehydes such as saturated aliphatic aldehydes (e.g. acetaldehyde, propionaldehyde, butyraldehyde, isobutyraldehyde, valeraldehyde, isovaleraldehyde, hexanal, 3-methyl hexanal, octanal, nonanal, or mono- or multi-unsaturated aliphatic aldehydes, such as 2-methyl but-2-enal, trans-2 hexenal, cis-3 hexenal, cis-4 hexenal, trans-2 octenal, trans-2 nonenal, cis-6 nonenal, trans-2, cis-6 nonadienal, trans 2 decenal, trans-2, trans-decadienal, aliphatic ketones, e.g. saturated ketones (such as 2-butanone, 2-pentanone, 2-heptanone, 2-octanone, 2-methylheptan-3-one, 2-decanone, 2-undecanone), unsaturated ketones (such as 1-penten-3-one, 1-hexen-3-one, 5-methyl-3-hexenone, 3-hepten-2-one, 1-octen-3-one, 2-octen-4-one, 3-octen-2-one, 3-nonen-2-one), aliphatic diketones and aliphatic diketoles, e.g. diacetyl, acetyl methyl carbinol, 2,3-hexanedione, aliphatic acids, such as straight-chain saturated acids, such as acetic acid, propionic acid, butyric acid, isobutyric acid, valeric acid, heptanoic acid, octanoic acid, decanoic acid, branched-chain saturated acids, such as 2-methyl heptanoic acid, 4-ethyl octanoic acid, and unsaturated acids, such as 2-butenic acid, 2-pentenoic acid, 4-pentenoic acid, 2-methyl pentenoic acid, trans-3 hexenoic acid, cis-3 hexenoic acid, 3-octenoic acid, linoleic acid), aliphatic esters, such as saturated esters, e.g. methyl acetate, methylbutyrate, methyl-2-methylbutyrate, methyl hexanoate, ethylacetate, ethylbutyrate, ethyl-2-methylbutyrate, ethyl-3-methylbutyrate, ethyl hexanoate, ethyl decanoate, isopropyl acetate, isobutyl acetate, isobutyl valerate, isoamyl acetate, isoamyl butyrate, isoamyl isovalerate, hexyl acetate, hexyl hexanoate, 3-octyl acetate and unsaturated esters, such as methyl 2-hexenoate, allyl hexanoate, cis-3 hexenyl acetate, cis-3 hexenyl butyrate, aliphatic thiols and dithiols (e.g. propane thiol, allyl mercaptan, 1-methoxy-3-methylbutane-3-thiol, dimethyl sulfide, dimethyl trisulfide, dipropyl sulfide, diallyl trisulfide, other aliphatic sulfur compounds, such as 2-mercapto-3-butanol, methyl thio propanal, 3-mercapto-pentanone, 4-methoxy-2-methyl-2-mercaptobutanone, methyl thiobutyrate, methyl thiobutyrate, methyl 3-methylthiopropionate, aliphatic nitrogen compounds, such as butyl amine, trimethyl amine, allyl isothiocyanate, isopropyl isothiocyanate, alicyclic compounds, such as alicyclic ketones, e.g. cis-jasmone, isophorone, 4-ketoisophorone, alicyclic esters such as methyl jasmonate, hedione, terpenes, e.g. terpene alcohols, such as linalool, citronellol, geraniol, nerol, alpha terpineol, menthol, 8-p-menthene-1,2-diol, fenchol, borneol, nerolidol, hotrienol, terpene aldehydes such as geranial, neral, citronellal, beta-sinensal, terpene ketones, such as alpha-ionone, (D)-carvone, (L)-carvone, nootkatone, piperitone, menthone, alpha

damascone, beta damascene, damascenone, terpene esters, such as linalyl acetate, geranyl acetate, citronellyl acetate, carvyl acetate, fenchyl acetate, terpene sulphur compounds, 4-mentha-8-thiol-3-one, thiogeraniol, para-menth-1-ene-8-thiol, mercapto p-menthan-3-one, terpene hydrocarbons, such as D-limonene, L-limonene, alpha-pinene, beta-pinene, ocimene, alpha-terpinene, gamma-terpinene, beta-bisabolene, valencene, terpene oxides, such as 1,8-cineole, rose oxide, mint lactone, menthofuran, aromatic compounds, e.g. aromatic alcohols, such as benzyl alcohol, cinnamyl alcohol, 2-phenyl alcohol, aromatic aldehydes, such as benzaldehyde, cinnamic aldehyde, 5-methyl-2-phenylhexenal, salicylaldehyde, 4-hydroxy benzaldehyde, cyclamen aldehyde, 2-phenyl-2-butenal, aromatic acids, such as 2-phenyl acetic acid, cinnamic acid, aromatic esters such as benzyl acetate, benzyl salicylate, anisyl acetate, methyl phenyl acetate, methyl benzoate, methyl salicylate, methyl cinnamate, aromatic phenols, such as phenol, ortho-cresol, para-cresol, 2,3-dimethyl phenyl, 2-ethyl phenol, 2,3,5-trimethyl phenol, 4-vinyl phenol, guaiacol, 4-vinyl guaiacol, eugenol, thymol, carvacrol, aromatic sulphur compounds, such as thiophenol, diphenyl disulphide, aromatic nitrogen compounds, such as methyl anthranilate, methyl N-methyl anthranilate, aromatic ethers such as vanillin, ethylvanillin, anethol, aromatic oxides, such as heliotropine, diphenyl oxide, aromatic lactones, such as coumarin, dihydro coumarin, heterocyclic compounds, such as heterocyclic lactones, e.g. gamma butyrolactone, gamma-nonalactone, gamma decalactone, delta decalactone, jasmin lactone, delta dodecalactone, ambrettolide, heterocyclic furanes, such as furfuryl alcohol, furfural, 2-acetyl furan, theaspirane, 2-methyl tetrahydro furan-3-one, furfuryl mercaptane, 2-methyl 3-furanthiol, 2-methyl 3-tetrahydro furanthiol, difurfuryl sulfide, difurfuryl disulfide, heterocyclic pyrans, such as maltol, ethyl maltol, rose oxide, maltol isobutyrate, heterocyclic pyrroles such as indole, 2-acetyl pyrrole, pyrrolidine, heterocyclic pyrazines, such as 2-methyl pyrazine, 2,3-dimethyl pyrazine, 2-methyl 3-ethyl pyrazine, trimethyl pyrazine, 2-acetyl pyrazine, 2-methoxy 3-methyl pyrazine, 2-methoxy 3-ethyl pyrazine, 2-methoxy 3-isobutyl pyrazine, 2-ethyl 3-methylthio pyrazine, heterocyclic thiazoles, such as thiazole, 2-methyl thiazole, 4-methyl 5-vinyl thiazole, 2-isobutyl thiazole, 2-acetyl thiazole, [0043] flavouring raw materials and flavouring preparations, e.g. essential oils, concretes, absolutes, extract or tinctures from raw materials such citrus (e.g. lemon, lime, mandarine, bergamotte, grapefruit bitter orange, peel or essence oils), herbs (dill, parsley, cumin, rosemary, sage, clary sage, basil, tarragon, thyme, oregano, savoury, majoram, all spice, mace, nutmeg, clove leave, clove bud, caraway, cinnamom leaves, cinnamom bark, *cassia*, *cardamom*, ginger, galangal, turmeric, coriander seed, coriander leaf, fenugreek, juniper berry, wormwood, laurel leaves, *eucalyptus*, white pepper, green pepper, white pepper, carrot seed, celery seed, lovage leaf, *Asa foetida*, onion, leek, garlic, mustard, horse radish, *capsicum*, paprika, sea weed, valerian oil, fir needle, spearmint, peppermint, wintergreen, buchu leaf, black currant buds, fennel, star anise, *jambu*, long pepper, *davana*, *orris*, *mimosa*, cassie, violet leaves, ho leaf, jasmin, ylang ylang, *cananga*, *osmanthus*, *angelica*, clary sage, ambrette seed, hops, camomile, lavender, rose, geranium, citronella, palmarosa, *litsea cubeba*, lemon grass, *tagetes*, neroli, petitgrain, mate, cognac oil, coffee, cola nut, cocoa, green tea, black tea, white tea, gentian, *tolu* balm, *benzoe* resin, *peru* balm, *cascarilla*, *galbanum*, vetiver, labdanum, patchouli, sandalwood, cedarwood, guaiac wood, oak wood, massoi bark, vanilla pods, tonka bean, as well as enriched fractions thereof, [0044] juice concentrates, such as orange juice, lemon juice, strawberry, cherry juice, or passion fruit juice concentrates, waterphases and recoveries from raw materials such as citrus (lemon, lime, orange, mandarine, grapefruit), red fruits (raspberry, strawberry, blueberry, blackberry, red and black currant, . . .), yellow fruits (peach, apricot, nectarine, banana, . . .), tropical fruits (mango, passionfruit, pineapple, lychee, . . .), vegetables (e.g. cucumber, tomato) and spices (e.g. ginger), [0045] acetophenone, allyl caproate, alpha-ionone, beta-ionone, anisaldehyde, anisyl acetate, anisyl formate, benzaldehyde, benzothiazole, benzyl acetate, benzyl alcohol, benzyl benzoate, beta-ionone, butyl butyrate, butyl caproate, butylidene phthalide, carvone, camphene, caryophyllene, cineol, cinnamyl acetate, citral, citronellol, citronellal, citronellyl acetate, cyclohexyl acetate, cymene, damascone, decalactone,

dihydrocoumarin, dimethyl anthranilate, dodecalactone, ethoxyethyl acetate, ethylbutyric acid, ethyl butyrate, ethyl caprate, ethyl caproate, ethyl crotonate, ethylfuranol, ethylguaiaicol, ethylisobutyrate, ethylisovalerate, ethyl lactate, ethylmethyl butyrate, ethyl propionate, eucalyptol, eugenol, ethyl heptylate, 4-(p-hydroxyphenyl)-2-butanone, gamma-decalactone, geraniol, geranyl acetate, geranyl acetate, grapefruit aldehyde, methyl dihydrojasmonate (e.g. Hedion®), heliotropin, 2-heptanone, 3-heptanone, 4-heptanone, trans-2-heptenal, cis-4-heptenal, trans-2-hexenal, cis-3-hexenol, trans-2-hexenoic acid, trans-3-hexenoic acid, cis-2-hexenyl acetate, cis-3-hexenyl acetate, cis-3-hexenyl caproate, trans-2-hexenyl caproate, cis-3-hexenyl formate, cis-2-hexyl acetate, cis-3-hexyl acetate, trans-2-hexyl acetate, cis-3-hexyl formate, para-hydroxybenzyl acetone, isoamyl alcohol, isoamyl isovalerate, isobutyl butyrate, isobutyraldehyde, isoeugenol methyl ether, isopropyl methylthiazole, lauric acid, levulinic acid, linalool, linalool oxide, linalyl acetate, menthol, menthofuran, methyl anthranilate, methylbutanol, methylbutyric acid, 2-methylbutyl acetate, methyl caproate, methyl cinnamate, 5-methylfurfural, 3,2,2-methylcyclopentenolone, 6,5,2-methylheptenone, methyl dihydrojasmonate, methyl jasmonate, 2-methylmethyl butyrate, 2-methyl-2-pentenol acid, methylthiobutyrate, 3,1-methylthiohexanol, 3-methylthiohexyl acetate, nerol, nerol acetate, trans,trans-2,4-nonadienal, 2,4-nonadienol, 2,6-nonadienol, 2,4-nonadienol, nootkatone, delta-octalactone, gamma-octalactone, 2-octanol, 3-octanol, 1,3-octenol, 1-octyl acetate, 3-octyl acetate, palmitic acid, paraldehyde, phellandrene, pentanedione, phenylethyl acetate, phenylethyl alcohol, phenylethyl isovalerate, piperonal, propionaldehyde, propyl butyrate, pulegone, pulegol, sinensal, sulfurol, terpinene, terpeneol, terpinolene, 8,3-s thiomenthaneone, 4,4,2-thiomethylpentanone, thymol, delta-undecalactone, gamma-undecalactone, valencene, valeric acid, vanillin, acetoin, ethylvanillin, ethylvanillin isobutyrate (=3-ethoxy-4-isobutyryloxybenzaldehyde), 2,5-dimethyl-4-hydroxy-3 (2H)-furanone and derivatives thereof (here preferably homofuraneol (=2-ethyl-4-hydroxy-5-methyl-3(2H)-furanone), homofuronol (=2-ethyl-5-methyl-4-hydroxy-3(2H)-furanone and 5-ethyl-2-methyl-4-hydroxy-3(2H)-furanone), maltol and maltol derivatives (here preferably ethyl maltol), coumarin and coumarin derivatives, gamma-lactones (here preferably gamma-undecalactone, gamma-nonolactone, gamma-decalactone), delta-lactones (here preferably 4-methyldeltadecalactone, massoilactone, deltadecalactone, tuberolactone), methyl sorbate, divanillin, 4-hydroxy-2(or 5)-ethyl-5 (or 2)-methyl-3 (2H)furanone, 2-hydroxy-3-methyl-2-cyclopentenone, 3-hydroxy-4,5-dimethyl-2(5H)-furanone, acetic acid isoamyl ester, butyric acid ethyl ester, butyric acid-n-butyl ester, butyric acid isoamyl ester, 3-methyl-butyric acid ethyl ester, n-hexanoic acid ethyl ester, n-hexanoic acid allyl ester, n-hexanoic acid-n-butyl ester, n-octanoic acid ethyl ester, ethyl-3-methyl-3-phenylglycidate, ethyl-2-trans-4-cis-decadienoate, 4-(p-hydroxyphenyl)-2-butanone, 1,1-dimethoxy-2,2,5-trimethyl-4-hexane, 2,6-dimethyl-5-hepten-1-al and phenylacetaldehyde, 2-methyl-3-(methylthio)furan, 2-methyl-3-furanthiol, bis(2-methyl-3-furyl)disulphide, furfurylmercaptan, methional, 2-acetyl-2-thiazoline, 3-mercapto-2-pentanone, 2,5-dimethyl-3-furanthiol, 2,4,5-trimethylthiazole, 2-acetylthiazole, 2,4-dimethyl-5-ethylthiazole, 2-acetyl-1-pyrroline, 2-methyl-3-ethylpyrazine, 2-ethyl-3,5-dimethylpyrazine, 2-ethyl-3,6-dimethylpyrazine, 2,3-diethyl-5-methylpyrazine, 3-isopropyl-2-methoxypyrazine, 3-isobutyl-2-methoxypyrazine, 2-acetylpyrazine, 2-pentylpyridine, (E,E)-2,4-decadienal, (E,E)-2,4-nonadienal, (E)-2-octenal, (E)-2-nonenal, 2-undecenal, 12-methyltridecanal, 1-penten-3-one, 4-hydroxy-2,5-dimethyl-3 (2H)-furanone, guaiacol, 3-hydroxy-4,5-dimethyl-2(5H)-furanone, 3-hydroxy-4-methyl-5-ethyl-2(5H)-furanone, cinnamaldehyde, cinnamon alcohol, methyl salicylate, isopulegol and (here not explicitly stated) stereoisomers, enantiomers, positional isomers, diastereomers, cis/trans isomers or epimers of these substances.

[0046] In a preferred embodiment, the total amount of a mixture according to the invention, preferably containing one, two, three, four, five or a plurality of the flavourings from the above-defined group is in the range of 0.01 to 5 wt %, preferably in the range of 0.01 to 1 wt %, further preferably in the range of 0.01 to 0.5 wt %, based on the total mass of the mixture.

[0047] A mixture according to the present invention may be used in a food or beverage product to

replace a part of the high caloric sugar content of the food or beverage product. In this case the mixture according to the present invention is added to the food or beverage product in which the high caloric sugar content is reduced. But it is also possible to add further high caloric sugars directly to the mixture. This resulting mixture (containing further high caloric sugars) may then be used in food or beverage products which until then do not contain high caloric sugars or just in a reduced amount.

[0048] A mixture according to the present invention is preferred, further comprising one or more carbohydrates, selected from the group consisting of sucrose, fructose, glucose, lactose, palatinose, lactulose, D-tagatose, and mixtures thereof.

[0049] A mixture according to the present invention is preferred, wherein the total amount by weight of D-allulose ranges from 0.1 to 95.0%, based upon the total weight of the mixture.

[0050] A mixture according to the present invention may contain one or more carriers, wherein said carriers can be solid or liquid (at 25° C. and 1013 mbar). As carriers, either individual substances or substance mixtures can be used.

[0051] In one embodiment, mixtures according to the invention are present in liquid form, for example as a syrup.

[0052] In one embodiment, mixtures according to the invention are preferably spray dried and the mixtures comprise solid carriers.

[0053] Advantageous solid carriers in these preferred (preferably spray dried) mixtures according to the invention are silicon dioxide (silicic acid, silica gel), carbohydrates and/or carbohydrate polymers (polysaccharides), cyclodextrins, flours, e.g. rice flour (according to WO 2018/219465), starches, degraded starches (hydrolysed starches), chemically or physically modified starches, modified cellulose, gum arabic, gum ghatti, tragacanth, gum karaya, carrageenan, guar germ meal, locust bean gum, alginates, pectin, inulin or xanthan gum. Preferred hydrolysed starch products are maltodextrins and dextrins.

[0054] Preferred solid carriers are silicon dioxide, flours, gum arabic and maltodextrins, wherein maltodextrins with DE values in the range of 5 to 20 are preferred. It is unimportant which plant originally provided the starch for producing the starch hydrolysates. The degree of decomposition of the starch is usually denoted with the characteristic value “Dextrose Equivalent” (DE) which can vary between the limit values 0 for a long-chain glucose polymer and 100 for pure glucose. Maize-based starches are suitable and readily available, as are starches from tapioca, rice, wheat or potatoes. The carriers can also simultaneously serve as anticaking agents, as in the case of silicon dioxide.

[0055] The preferred or particularly preferred carriers are also preferred due to being completely or substantially taste-free. In this way, preferred preliminary products according to the invention can be used in many different product types and preparations because said preliminary products do not, or not substantially, influence the existing sensory profile, particularly the aroma and taste profile—apart from the unpleasant taste impressions to be masked.

[0056] Preferred liquid carriers are water, ethanol, isopropanol, glycerin, 1,2-propylene glycol, 1,3-propandiol, diacetin, triacetin and mixtures thereof. Further suitable carriers are triglycerides, preferably liquid triglycerides, for example, plant oils. Preferable are triglycerides with the same or different C6 to C10-fatty acid groups (MCT, medium-chain triglycerides), since these are also essentially taste-free.

[0057] A further aspect of the present invention relates to a food or beverage product comprising a mixture according to the present invention.

[0058] Food or beverage products in the context of this text are, for example, baked products (e.g. bread, biscuits, cakes, other baked goods), confectionery (e.g. chocolates, chocolate bar products, other bar products, fruit gums, hard and soft toffees, chewing gum), alcoholic or non-alcoholic beverages (e.g. coffee, tea, wine, wine-containing beverages, beer, beer-containing beverages, liqueurs, spirits, brandies, fruit-containing lemonades, isotonic beverages, refreshing beverages,

nectars, fruit and vegetable juices, fruit or vegetable juice preparations), instant beverages (e.g. instant-cocoa beverages, instant-tea beverages, instant-coffee beverages), meat products (e.g. ham, processed sausage or raw sausage preparations, spiced or marinated fresh or cured meat products), eggs or egg products (dried egg, egg white, egg yolk), cereal products (e.g. breakfast cereals, muesli bars, precooked prepared rice products), milk products (e.g. milk beverages, milk ices, yoghurt, kefir, fresh cheese, soft cheese, hard cheese, dried milk powder, whey, butter, buttermilk, partially or fully hydrolyzed lactoprotein-containing products), products from soybean protein or other soybean fractions (e.g. soybean milk and products prepared therefrom, preparations containing soybean lecithin, fermented products such as tofu or tempeh or products prepared therefrom, soy sauces), fruit preparations (e.g. jellies, fruit ices, fruit sauces, fruit fillings), vegetable preparations (e.g. ketchup, sauces, dried vegetables, frozen vegetables, precooked vegetables, vegetables pickled in vinegar, preserved vegetables), nibbles (e.g. baked or fried potato chips or potato dough products, bread dough products, extruded products based on maize or peanuts), fat-based and oil-based products or emulsions thereof (e.g. mayonnaise, remoulade, dressings, seasoning preparations), other ready-meals and soups (e.g. dried soups, instant soups, precooked soups), spices, seasoning mixtures and in particular seasonings which are used, for example, in the making of snacks.

[0059] In particular in cases, where in regular food or beverage products high caloric sugars are used as bulk materials, texturizers, fillers and stabilizers, namely baked products (e.g. bread, biscuits, cakes, other baked goods), confectionery (e.g. chocolates, chocolate bar products, other bar products, fruit gums, hard and soft toffees, chewing gum), cereal products (e.g. breakfast cereals, muesli bars, precooked prepared rice products), fruit preparations (e.g. jellies, fruit ices, fruit sauces, fruit fillings), vegetable preparations (e.g. ketchup, sauces, dried vegetables, frozen vegetables, precooked vegetables, vegetables pickled in vinegar, preserved vegetables), the amount of high caloric sugars can be partly replaced by the mixtures according to the present invention. In a preferred embodiment of these food or beverage products, further technologies to replace high caloric sugar load can be achieved in combinations of a mixture according to the present invention with technologies according to the PCT application with application number PCT/EP2018/069323.

[0060] The food or beverage products within the meaning of the invention can also be present as dietary supplements in the form of capsules, tablets (uncoated and coated tablets, e.g. gastro-resistant coatings), sugar-coated pills, granulates, pellets, solid mixtures, dispersions in liquid phases, as emulsions, as powders, as solutions, as pastes or as other formulations that can be swallowed or chewed.

[0061] Chewing gums (as a further example of food or beverage products) generally comprise a chewing gum base, i.e. a chewing mass that becomes plastic when chewed, other taste correctives for unpleasant taste impressions, taste modulators for further, generally not unpleasant taste impressions, taste-modulating substances (e.g. inositol phosphate, nucleotides such as guanosine monophosphate, adenosine monophosphate or other substances such as sodium glutamate or 2-phenoxypropionic acid), humectants, thickeners, emulsifiers, further flavours and stabilisers or odour correctives.

[0062] A food or beverage product according to the present invention is preferred, wherein the amount of all compounds of group a) and b) contributes less than 2.0% sucrose sweetness equivalents to the food or beverage product, preferably less than 1.5% sucrose sweetness equivalents.

[0063] Sucrose sweetness equivalents means the average sweetness perception of a food or beverage product containing the mixture according to the present invention in comparison to the same food or beverage product containing a certain % level of sucrose but not the mixture according to the present invention. Sweetness is commonly measured by comparison to reference solutions of sucrose. Sucrose is the standard to which all other sweeteners are compared. Taste panellists are often trained to quantitate sweetness on a 15 cm line scale, for convenience, using 2-

15% sucrose solutions as references. Other sweeteners are then tasted at a series of dilutions to determine the concentration that is as sweet as a given percent sucrose reference. The phrase "wherein the amount of a compound contributes less than 2.0% sucrose equivalents to the food or beverage product" is meant to denote an amount to be present such that the compound impart a sweetness that is less than the sweetness that would be imparted by a 2.0% sucrose solution.

[0064] A food or beverage product according to the present invention is preferred, wherein the sum of all compounds of group a) and b) is below its sweetness threshold. The sum of all compounds of group a) and b) is below its sweetness threshold if a food or beverage product in which compounds a) and b) are exchanged by 1.5 wt. % sucrose is compared with the food or beverage product and the food or beverage product according to the present invention is less or equally sweet.

[0065] A food or beverage product according to the present invention is preferred, wherein the amount of D-allulose ranges from 0.01 to 3.0 wt. %, preferably ranges from 0.25 to 2.7 wt. %, more preferably ranges from 1.0 to 2.0 wt. %, based upon the total weight of the food or beverage product.

[0066] In some embodiments of the present invention a food or beverage product according to the present invention may be preferred, wherein the amount of D-allulose ranges from 0.25 to 15.0 wt. %, preferably ranges from 1.0 to 10.0 wt. %, more preferably ranges from 2.0 to 7.5 wt. %, based upon the total weight of the food or beverage product.

[0067] As further constituents for food or beverage products according to the present invention or for mixtures according to the present invention, it is possible to use usual base materials, auxiliaries and additives for foodstuffs and semiluxury food products, for example, water, mixtures of fresh or processed plant or animal basic or raw materials (e.g. raw, roasted, dried, fermented, smoked and/or boiled meat, bone, cartilage, fish, vegetables, fruit, herbs, nuts, vegetable or fruit juices or pastes or mixtures thereof), natural or hardened fats (e.g. tallow, lard, palm oil, coconut oil, hardened plant fat), oils (e.g. sunflower oil, peanut oil, corn oil, olive oil, fish oil, soybean oil, sesame oil), fatty acids or salts thereof (e.g. potassium stearate), proteinogenic or nonproteinogenic amino acids and related compounds (e.g. γ -aminobutyric acid, taurine), peptides (e.g. glutathione), native or processed proteins (e.g. gelatin), enzymes (e.g. peptidases), nucleic acids, nucleotides, other flavour correctants for unpleasant taste impressions, taste modulators for further, as a rule not unpleasant, taste impressions, flavour-modulating substances (e.g. inositol phosphate, nucleotides such as guanosine monophosphate, adenosine monophosphate or other substances such as sodium glutamate or 2-phenoxypropionic acid), emulsifiers (e.g. lecithins, diacylglycerols, gum arabic), stabilisers (e.g. carrageenan, alginate), preservatives (e.g. benzoic acid, sorbic acid), antioxidants (e.g. tocopherol, ascorbic acid), chelating agents (e.g. citric acid), organic or inorganic acidifying agents (e.g. malic acid, acetic acid, citric acid, tartaric acid, phosphoric acid), additional bitter substances (e.g. quinine, caffeine, limonin, amarogentin, humulones, lupulones, catechins, tannins), mineral salts (e.g. sodium chloride, potassium chloride, magnesium chloride, sodium phosphates), substances preventing enzymatic browning (e.g. sulphite, ascorbic acid), essential oils, plant extracts, natural or synthetic dyes or coloured pigments (e.g. carotenoids, flavonoids, anthocyanins, chlorophyll and derivatives thereof), spices, trigeminally effective substances or plant extracts containing said trigeminally effective substances, synthetic, natural or nature-identical aromatic substances or odoriferous substances and odour correctants.

[0068] Preferred according to the invention is a food or beverage product, additionally comprising one, two, three, four, five, six, seven, eight, nine, ten or a plurality of further substances, selected from the following groups (a1) to (a3):

[0069] (a1) flavourings, preferably one, two, three, four, five or a plurality of flavourings being selected from the group consisting of: vanillin, ethyl vanillin, 2-hydroxy-4-methoxybenzaldehyde, ethyl vanillin isobutyrate (=3-ethoxy-4-isobutyryloxybenzaldehyde), Furaneol® (2,5-dimethyl-4-hydroxy-3(2H)-furanone) and derivatives (e.g. homofuraneol, 2-ethyl-4-hydroxy-5-methyl-3(2H)-furanone), homofuronol (2-ethyl-5-methyl-4-hydroxy-3(2H)-furanone) and 5-ethyl-2-methyl-4-

hydroxy-3(2H)-furanone), maltol and its derivatives (e.g. ethyl maltol), coumarin and its derivatives, gamma-lactones (e.g. gamma-undecalactone, gamma-nonolactone), delta-lactones (e.g. 4-methyl delta-lactone, *massoia* lactone, delta-decalactone, tuberolactone), methyl sorbate, divanillin, 4-hydroxy-2(or 5)-ethyl-5(or 2)-methyl-3(2H)furanone, 2-hydroxy-3-methyl-2-cyclopentenone, 3-hydroxy-4,5-dimethyl-2(5H)-furanone, fruit esters and fruit lactones (e.g. acetic acid n-butyl ester, acetic acid isoamyl ester, propionic acid ethyl ester, butyric acid ethyl ester, butyric acid n-butyl ester, butyric acid isoamyl ester, 3-methyl-butyric acid ethyl ester, n-hexanoic acid ethyl ester, n-hexanoic acid allyl ester, n-hexanoic acid n-butyl ester, n-octanoic acid ethyl ester, ethyl-3-methyl-3-phenylglycidate, ethyl-2-trans-4-cis-decadienoate), 4-(p-hydroxyphenyl)-2-butanone, 1,1-dimethoxy-2,2,5-trimethyl-4-hexane, 2,6-dimethyl-5-hepten-1-al and phenylacetaldehyde;

[0070] (a2) sugar alcohols, preferably naturally occurring sugar alcohols selected from the group consisting of glycerine, erythritol, threitol, arabinol, ribitol, xylitol, sorbitol, mannitol, maltitol, isomalt, dulcitol, lactitol, and the physiologically acceptable salts of these sugar alcohols, particularly sodium, potassium, calcium or ammonium salts;

[0071] (a3) extracts or enriched fractions of extracts, selected from the group consisting of *Thaumatococcus* fruit extracts (katemfe bush), extracts from *Stevia* ssp. (particularly *Stevia rebaudiana* leaves), swingle extracts (*Momordica* or *Siratia grosvenorii*, fruit, Luo-Han-Guo, monk fruit), extracts from *Glycyrrhiza* ssp. (particularly *Glycyrrhiza glabra* roots), extracts from *Rubus* ssp. (particularly *Rubus suavissimus*. leaves), extracts from *Lippia dulcis* (leaves and flowers).

[0072] A food or beverage product according to the present invention is preferred, wherein the amount of D-allulose and of all compounds of group b) ranges from 0.01 to 3.0 wt. %, preferably ranges from 0.25 to 2.7 wt. %, more preferably ranges from 1.0 to 2.0 wt. %, based upon the total weight of the food or beverage product.

[0073] A food or beverage product according to the present invention is preferred, further comprising one or more carbohydrates, selected from the group consisting of sucrose, D-fructose, D-glucose, lactose, palatinose, lactulose, D-tagatose, and mixtures thereof.

[0074] A food or beverage product according to the present invention is preferred, further comprising an artificial sweetener and/or natural high-potency sweetener, preferably selected from the group consisting of sucralose, acesulfame potassium or other salts, aspartame, alitame, sodium or calcium salt of saccharin, neohesperidin dihydrochalcone, sodium cyclamate, neotame, advantame, and salts thereof, steviol glycoside, rebaudioside A, rebaudioside B, rebaudioside C (dulcoside B), rebaudioside D, rebaudioside E, rebaudioside F, rebaudioside I, rebaudioside H, rebaudioside L, rebaudioside K, rebaudioside J, rebaudioside N, rebaudioside O, rebaudioside M, rebaudioside X, dulcoside A, rubusoside, *stevia* leaf extract, stevioside, glycosylated steviol glycosides, mogroside V, isomogroside, mogroside IV, Luo Han Guo fruit extract, siamenoside, monatin and its salts (monatin SS, RR, RS, SR), curculin, glycyrrhizic acid and its salts, thaumatin, monellin, mabinlin, brazzein, hernandulcin, glycyphyllin, phloridzin, trilobatin, baiyunoside, osladin, polypodoside A, pterocaryoside A, pterocaryoside B, mukurozioside, phlomisioside I, periandrin I, abrusoside A, cyclocarioside I, and combinations thereof.

[0075] A food or beverage product according to the present invention is preferred, wherein the sum of all carbohydrates, except of D-allulose, and all artificial and natural sweeteners cause a sweet intensity of at least 2% sucrose sweetness equivalents, preferably of at least 3% sucrose sweetness equivalents, more preferably of at least 5% sucrose sweetness equivalents, more preferably of at least 7% sucrose sweetness equivalents.

[0076] A further aspect of the present invention relates to a method for imparting a sweet taste impression and/or reinforcing a sweet taste impression of one, two or a plurality of sweet-tasting substances and/or producing an orally consumable formulation comprising the following steps:

[0077] a) providing a mixture according to the present invention, [0078] b) providing an orally

consumable formulation comprising one, two or a plurality of sweet-tasting substances, and [0079] c) bringing into contact or mixing of the ingredients provided in steps a) and b).

Description

EXAMPLES

Example 1: Ice Tea

[0080] Comparative Example with sucrose (A) [0081] Comparative Example with sucrose and D-allulose (B) [0082] Examples according to the invention with D-allulose and a taste modifying compound (C-H)

TABLE-US-00001 Preparation (wt.-% or ppm if specified accordingly) Ingredients A B C D E F G H sucrose 7 3.5 3.5 3.5 3.5 3.5 1.5 — D-allulose — 2 2 2 2 2 3 7 Hesperetin (HT) — — 5 ppm — — — 7 ppm Phloretin (PH) — — — 15 ppm — — — 15 pmm Hersperetin — — — 15 ppm — 5 ppm — dihydrochalcone (HC) Alpha-glycosylated — — — — 10 ppm 10 ppm — rubusosides (OR) Citric acid 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 ascorbic acid 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0.02 Black tea extrakt 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 natural lemon flavor 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 water to 100%

[0083] The ingredients were mixed in the order listed in the order listed into bottled and sterilized.

[0084] According to sensory studies, the examples C-H show a better sweet impact, intensity, and mouthfeel without significantly increasing sweet lingering effects. The acidity is reduced in the formulations compared to allulose alone (B).

Example 2: Carbonated Soft Drink (Flavour Direction: Cola)

[0085] A: drink containing sugar (comparative drink) [0086] B: low-calorie drink [0087] C: low-calorie drink [0088] D: low-calorie drink [0089] E: low-calorie drink

TABLE-US-00002 A B C D E (% by (% by (% by (% by (% by Ingredient weight) weight) weight) weight) weight) Phosphoric acid 0.635 0.635 0.635 0.635 0.635 85% Citric acid, 0.064 0.064 0.064 0.064 0.064 anhydrous Caffeine 0.064 0.064 0.064 0.064 0.064 Sucrose 63.60 — — — 12.9 Rebaudioside M — 0.200 — — — Glycosylated — — 0.150 — — steviosides Aspartame — — — 0.07 Rebaudioside A — — — 0.150 — Acesulfame K — — — — 0.07 Mogroside V — — — 0.150 — Sugar colouring 0.800 0.800 0.800 0.800 0.800 Cola type drink 1.445 1.445 1.445 1.445 1.445 emulsion Sodium benzoate 0.106 0.106 0.106 0.106 0.106 D-Allulose 10 8 8 12 8 Hesperetin, — 2.0 2.0 — — racemic, 2.5% in 1,2- propylene glycol Phloretin, 2.5% — — 1.0 — — in 1,2-propylene glycol Phyllodulcin, — — — 1.0 — 0.5% in 1,2-propylene glycol Hesperetin — — — — 1.0 dihydrochalcone (I) 0.5% in 1,2-propylene glycol Water ad 100

[0090] The solid components or ingredients are individually mixed with water, combined and made up to 100 g with water. The concentrate obtained is then allowed to age over night at ambient temperature. Finally, 1 part concentrate is mixed with 5 parts carbonated water, filled into bottles and sealed.

Example 3: Sugar-Reduced Tomato Ketchup

[0091] A: Comparative preparation with sugar [0092] B: Comparative preparation with reduced sugar content (compared to A) [0093] C-H: Preparations according to the invention with reduced sugar content (compared to A) and mixture




TABLE-US-00003 Preparation (amounts in % by weight) Ingredient A B C D E F G H Common salt 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 Starch, Farinex WM 55 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 Sucrose 12.0 9.6 9.2 8.4 9.6 9.6 5 — Tomato concentrate × 2 40.0 40.0 40.0 40.0 30.0 30.0 30.0 30.0 Glucose syrup 80 Brix 18.0 18.0 18.0 18.0 18.0 18.0 18.0 18.0 Spirit vinegar 10% 7.0 7.0 7.0 7.0 3.0 3.0 3.0 3.0 Flavoring Part: spice flavour 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 D-Allulose — — 1 1.5 1 1 5 12 Hesperetin 2.5% in 1,2-Propylene glycol — — 0.1 0.1 — 0.1 — 0.1 Phloretin 2.5% in 1,2-Propylene glycol — — 0.1 0.1 — 0.1 — 0.1

Alpha-Glycosylated rubusoside — — — 0.1 0.1 0.05 — — Hesperetin dihydrochalcone 0.5%
in — — — — — 0.2 — 1,2-Propylene glycol Phyllodulcin, 0.5% in ethanol/1,2- — — — —
0.2 0.1 — 0.2 propylene glycol Water ad 100

[0094] The Flavoring Part is mixed first and added to the other ingredients which are mixed in the stated sequence and the finished ketchup is homogenized using an agitator, poured into bottles and sterilized.

Example 4: Reduced-Sugar Fruit Gums

[0095] A: Comparative preparation [0096] B-E: preparation according to the present invention
TABLE-US-00004 A B C D E (% by (% by (% by (% by (% by Ingredient weight) weight) weight) weight) weight) Saccharose 34.50 8.20 8.20 9.0 0 Glucose syrup, 31.89 30.09 30 30 35 DE 40
Iso Syrup C* Tru 1.50 2.10 1.5 2 3 Sweet 01750 (Cerestar GmbH) Gelatin 240 8.20 9.40 10
8.5 9 Bloom Polydextrose — 24.40 25 23 — (Litesse® Ultra, Danisco Cultor GmbH) Green,
yellow and 0.01 0.01 0.01 0.01 0.01 red colorings Citric acid 0.20 0.20 0.20 0.20 0.20 D-
Allulose — 2 2.5 1.5 34 Orange flavour, — 0.5 — — — containing 1% by weight hesperetin
Strawberry — — 0.4 — — flavour, containing 0.5% Phloretin and 0.5%

 Apple flavour, — — — 0.35 — containing 0.5% Phloretin
and 0.5% Hesperetin Cherry flavoring, — — — — 0.10 containing 1% by weight of hesperetin
 Water Quantum satis 25.80 Note: Polydextrose is itself a non-
sweet-tasting polysaccharide with a low calorific value. 
indicates data missing or illegible when filed

Example 5: Spray-Dried Preparation as a Semi-Finished Product for Flavoring of Finished Products

TABLE-US-00005 Ingredient Use in % by weight Preparation A B C D E F Maltodextrin from
wheat 10 5 5 0 — 5 Rice flour according to — — — — 10 — WO 2018 219,465 Gum Arabic 0.5
1 0.5 1 0.3 — D-Allulose, crystalline 20 25 25 0 30 25 D-Allulose, syrup — — — 30 — —
Hesperetin dihydrochalcone (I) 0.05 — — — — — Hesperetin — 0.2 — 0.3 0.3 —
Homoeriodictyol-sodium salt — — — 0.2 — — Phloretin — — 0.5 — 0.2 — Extract from
Hydrangea — — — — — 0.02 dulcis, ctg. 40% Phyllodulcin Drinking water Add to 100
[0097] The drinking water is placed in a container and maltodextrin and gum arabic is dissolved in
it. Then the flavoring is emulsified in the carrier solution with a Turrax. The temperature of the
spray solution should not exceed 30° C. The mixture is then spray-dried (inlet nominal
temperature: 185-195° C., outlet nominal temperature: 70-75° C.). [0098] Typical dosage: 1-3% by
weight depending on the application.

Example 6: Instant Ice Tea Type Peach

[0099] Preparation A: standard preparation [0100] Preparation B-D: preparation according to the present invention

TABLE-US-00006 Use in weight % Preparation Ingredient A B C D Sucrose, extra fine 95.06
70.09 70.25 — Citric acid, 2.2 2.0 2.0 1.8 anhydrous Black Tea extract, 1.34 1.34 1.34 1.34
powdered Peach aroma 0.66 0.66 0.66 0.66 spray dried Tea aroma type 0.27 0.27 0.27 0.27 Ceylon
dried Trisodium citrate 0.25 0.25 0.25 0.25 Ascorbic acid 0.22 0.22 0.22 0.22 Polydextrose — —
— 25 D-Allulose, — 25 25 70 crystalline Hesperetin — — 0.01 0.01 dihydrochalcone (I)
Hesperetin — 0.05 — — Rebaudioside A — — — 0.01 Phloretin — 0.02 — — Rebaudioside M
— — — 0.20 Homoeriodictyol- — 0.1 — 0.05 Sodium salt [0101] Standard dosage in water for
preparing a peach ice tea beverage: 7.5% by weight.

Example 7: Drink Chocolate Instant Powder

[0102] Preparation A: standard preparation [0103] Preparation B-D: preparation according to the present invention

TABLE-US-00007 Use in weight % Preparation Ingredient A B C D Sucrose, extra fine 73.5
48.475 43.69 13.325 Cocoa powder alkalized, 10-12% 25.0 25.0 25.0 25.0 by weight fat
Maltodextrin DE15- 0.43 0.43 0.43 0.43 19 from corn starch Salt (NaCl), extra 0.43 0.43 0.43 0.43

fine Ascorbic acid 0.29 0.29 0.29 0.29 Vitamin mix M8 0.145 0.145 0.145 0.145 40-1507 D-Allulose, — 25 30 60 crystalline Hesperetin — — 0.015 0.01 dihydrochalcone (I) Hesperetin — 0.05 — — Rebaudioside A — — — 0.02 Phloretin — 0.03 — — Rebaudioside M — — — 0.30 Homoeriodictyol- — 0.15 — 0.05 Sodium salt [0104] Standard dosage in milk for preparing an choco beverage: 6.9% by weight.

Example 8: Sensory Tests

[0105] Abbreviations used in the following tables: Hesperetin (HT), Phloretin (PH), Hesperetin dihydrochalcone (HC), alpha-glycosylated rubusosides (OR)

a) Taste Solution: 5% Sucrose+60 ppm Rebaudioside A in Water

TABLE-US-00008 Profile Name Mouth- After- No. Sample Description Impact Intensity feel taste
A1 Base i (5% 5 6 4 3.5 sucrose + 60 ppm rebaudioside A in water) A2 A3 + 1% allulose
6 7 5 4 A3 A1 + 5 ppm HT + 5.5 6.5 5 4 10 ppm OR + 10 ppm PH + 1 ppm HC
A4 A3 + 2% allulose 6.5 7.5 6 4.5 B1 Base i (5% 5 6 4 3.5 sucrose + 60 ppm
rebaudioside A in water) B2 B4 + 5 ppm 6.5 7.5 5 4.5 HC +10 ppm OR B3 B4 + 7 ppm HT +
6 7 5 4 15 ppm PH B4 B1 + 1% allulose 5.25 6.25 4.5 3.5 B1 Base i (5% 5 6 4
3.5 sucrose + 60 ppm rebaudioside A in water) B5 B1 + 2% allulose 5.5 6.5 4.5 3.75 B6 B5 + 7
ppm 7 8 5.5 4.75 HT + 15 ppm PH B7 B5 + 5 ppm 7 8.5 5.5 5.5 HC + 10 ppm OR

TABLE-US-00009 Profile Name Mouth- After- No. Sample Description Impact Intensity feel taste
A1 Base i (5% 5 6 4 3.5 sucrose + 60 ppm rebaudioside A in water) A2 A3 + 1% allulose
6 7 5 4 A3 A1 + 5 ppm HT + 5.5 6.5 5 4 10 ppm OR + 10 ppm PH + 1 ppm HC
A4 A3 + 2% allulose 6.5 7.5 6 4.5 B1 Base i (5% 5 6 4 3.5 sucrose + 60 ppm
rebaudioside A in water) B2 B4 + 5 ppm 6.5 7.5 5 4.5 HC +10 ppm OR B3 B4 + 7 ppm HT +
6 7 5 4 15 ppm PH B4 B1 + 1% allulose 5.25 6.25 4.5 3.5 B1 Base i (5% 5 6 4
3.5 sucrose + 60 ppm rebaudioside A in water) B5 B1 + 2% allulose 5.5 6.5 4.5 3.75 B6 B5 + 7
ppm 7 8 5.5 4.75 HT + 15 ppm PH B7 B5 + 5 ppm 7 8.5 5.5 5.5 HC + 10 ppm OR

TABLE-US-00010 Profile Name Mouth- After- No. Sample Description Impact Intensity feel taste
A1 Base i (5% 5 6 4 3.5 sucrose + 60 ppm rebaudioside A in water) A2 A3 + 1% allulose
6 7 5 4 A3 A1 + 5 ppm HT + 5.5 6.5 5 4 10 ppm OR + 10 ppm PH + 1 ppm HC
A4 A3 + 2% allulose 6.5 7.5 6 4.5 B1 Base i (5% 5 6 4 3.5 sucrose + 60 ppm
rebaudioside A in water) B2 B4 + 5 ppm 6.5 7.5 5 4.5 HC +10 ppm OR B3 B4 + 7 ppm HT +
6 7 5 4 15 ppm PH B4 B1 + 1% allulose 5.25 6.25 4.5 3.5 B1 Base i (5% 5 6 4
3.5 sucrose + 60 ppm rebaudioside A in water) B5 B1 + 2% allulose 5.5 6.5 4.5 3.75 B6 B5 + 7
ppm 7 8 5.5 4.75 HT + 15 ppm PH B7 B5 + 5 ppm 7 8.5 5.5 5.5 HC + 10 ppm OR

b) Taste Solution: 7% Sucrose+0.15% Citric Acid+60 ppm Rebaudioside A

TABLE-US-00011 Name Profile No. Sample Description Impact Intensity Mouthfeel Aftertaste
Acidity A5 Base ii (7% sucrose + 5.5 6.5 4.5 2.75 3 0.15% Citric Acid + 60 ppm rebaudioside A)
A6 A5 + 5 ppm HT + 10 ppm 6.25 8 5.5 3.5 2 OR + 10 ppm PH + 1 ppm HC A7 A6 + 1% allulose
6.25 8 6 3.75 2 A8 A6 + 2% allulose 6.75 8 6.5 3.75 2

TABLE-US-00012 Name Profile No. Sample Description Impact Intensity Mouthfeel Aftertaste
Acidity B8 Base ii (7% sucrose + 5.5 6.5 4.5 2.75 3 0.15% citric Acid + 60 ppm rebaudioside A)
B9 B10 + 7 ppm HT + 50 ppm 6 7 5.5 3.5 2.75 OR B10 B8 + 1% allulose 5.5 6.5 4.5 2.75 3 B11
B10 + 15 ppm PH + 50 ppm 6.5 7.5 5.75 3.5 2 OR

TABLE-US-00013 B8 Base ii (7% sucrose + 5.5 6.5 4.5 2.75 3 0.15% citric Acid + 60 ppm
rebaudioside A) B12 B14 + 15 ppm PH + 50 ppm 6.5 7.5 5.5 3.25 1.75 OR B13 B14 + 7 ppm HT +
50 ppm 6.5 8 6 3.25 1.75 OR B14 B8 + 2% allulose 6 7 5 3 3

Claims

1. A food or beverage product comprising: (a) D-allulose, (b) a taste modifying compound selected from hesperetin, hesperetin dihydrochalcone, phloretin, alpha-glycosyl rubusosides, balansines,

phyllodulcin, eriodictyol, homoeriodictyol, matairesinol, or mixtures thereof, and (c) one or more selected from: (c1) carbohydrates other than D-allulose, and (c2) artificial and natural sweeteners selected from sucralose, acesulfame potassium or other salts, aspartame, alitame, sodium or calcium salt of saccharin, neohesperidin dihydrochalcone, sodium cyclamate, neotame, advantame, and salts thereof, rebaudioside B, rebaudioside C, rebaudioside F, rebaudioside I, rebaudioside H, rebaudioside L, rebaudioside K, rebaudioside J, dulcoside A, rubusoside, mogroside V, isomogroside, mogroside IV, Luo Han Guo fruit extract, siamenoside, monatin and its salts, curculin, glycyrrhizic acid and its salts, thaumatin, monellin, mabinlin, brazzein, Hernan dulcin, glycyphyllin, phloridzin, trilobatin, baiyunoside, osladin, polypodoside A, pterocaryoside A, pterocaryoside B, mukurozioside, phlomisioside I, periandrin I, abrusoside A, cyclocarioside I, or combinations thereof.

2. The food or beverage product of claim 1, wherein (a) and (b), in combination, contribute less than 2.0% sucrose equivalents to the food or beverage product.
3. The food or beverage product of claim 1, wherein a sum of (a) and (b) is below the food or beverage product's sweetness threshold.
4. The food or beverage product of claim 1, wherein (c), in sum, provides a sweet intensity of at least 2% sucrose equivalents.
5. The food or beverage product of claim 1, wherein (b) comprises: (b1) a taste modifying compound selected from hesperetin, homoeriodictyol, eriodictyol, phloretin, matairesinol, or mixtures thereof, and b2) a taste modifying compound selected from hesperetin dihydrochalcone, alpha-glycosyl rubusosides, balansines, phyllodulcin, or mixtures thereof.
6. The food or beverage product of claim 1, wherein (a) and (b) are in a weight ratio of 100,000:1 to 10:1.
7. The food or beverage product of claim 1, wherein (a) and (b) are in a weight ratio of 50,000:1 to 100:1.
8. The food or beverage product of claim 1, wherein (a) and (b) are in a weight ratio of 100:1 to 1:100.
9. The food or beverage product of claim 4, wherein (b1) and (b2) are in a weight ratio of 10:1 to 1:10.
10. The food or beverage product of claim 4, wherein (b1) and (b2) are in a weight ratio of 5:1 to 1:5.
11. The food or beverage product of any of claim 1, wherein the D-allulose of (a) is in an amount of 0.01 to 3.0 wt. %, based on a total weight of the food or beverage product.
12. The food or beverage product of any of claim 1, wherein (a) and (b) are in a combined amount of 0.01 to 3.0 wt. %, based on a total weight of the food or beverage product.
13. The food or beverage product of any of claim 1, wherein (c) comprises one or more artificial sweeteners, natural sweeteners, or mixtures thereof.
14. The food or beverage product of any of claim 1, wherein (c) comprises one or more carbohydrates selected from sucrose, D-fructose, D-glucose, lactose, palatinose, lactulose, D-tagatose, or mixtures thereof.
15. The food or beverage product of any of claim 1, wherein (c) comprises: one or more artificial sweeteners, natural sweeteners, or mixtures thereof; and one or more carbohydrates selected from sucrose, D-fructose, D-glucose, lactose, palatinose, lactulose, D-tagatose, or mixtures thereof.
16. The food or beverage product of any of claim 1, further comprising one or more flavorings and/or aroma substances.
17. The food or beverage product of claim 3, wherein (a) and (b), in combination, contribute less than 2.0% sucrose equivalents to the food or beverage product.
18. The food or beverage product of claim 4, wherein (a) and (b), in combination, contribute less than 2.0% sucrose equivalents to the food or beverage product.
19. The food or beverage product of claim 1, wherein a sum of (a) and (b) is below the food or

beverage product's sweetness threshold.

20. The food or beverage product of claim 1, wherein all carbohydrates, except D-allulose, and all artificial and natural sweeteners, in sum, provide a sweet intensity of at least 2% sucrose equivalents.
