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LLC, Hoffman Estates, IL (US)(57) **ABSTRACT**(21) Appl. No.: **14/777,047**(22) PCT Filed: **Mar. 14, 2014**(86) PCT No.: **PCT/GB2014/050814**

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A low or zero calorie sweetener composition with sweetness synergy, providing a reduction in off-taste and a desirable temporal profile. The sweetener composition is suitable for use as a substitute for high calorie sugars. The sweetener composition is for use in food and beverage products, pharmaceutical products, nutritional product and cosmetic products.

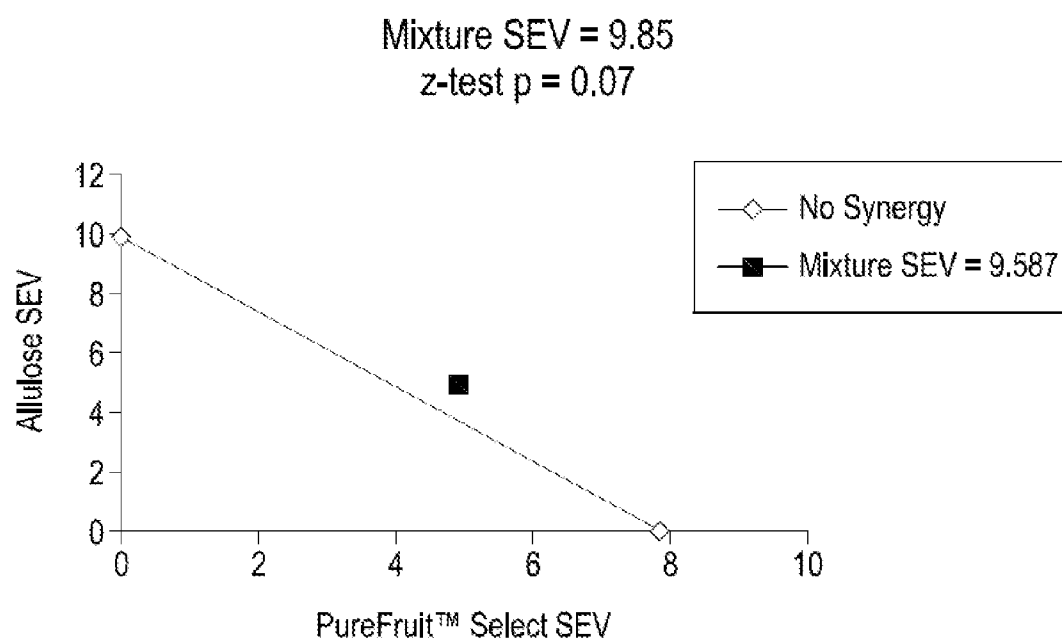


Fig. 1

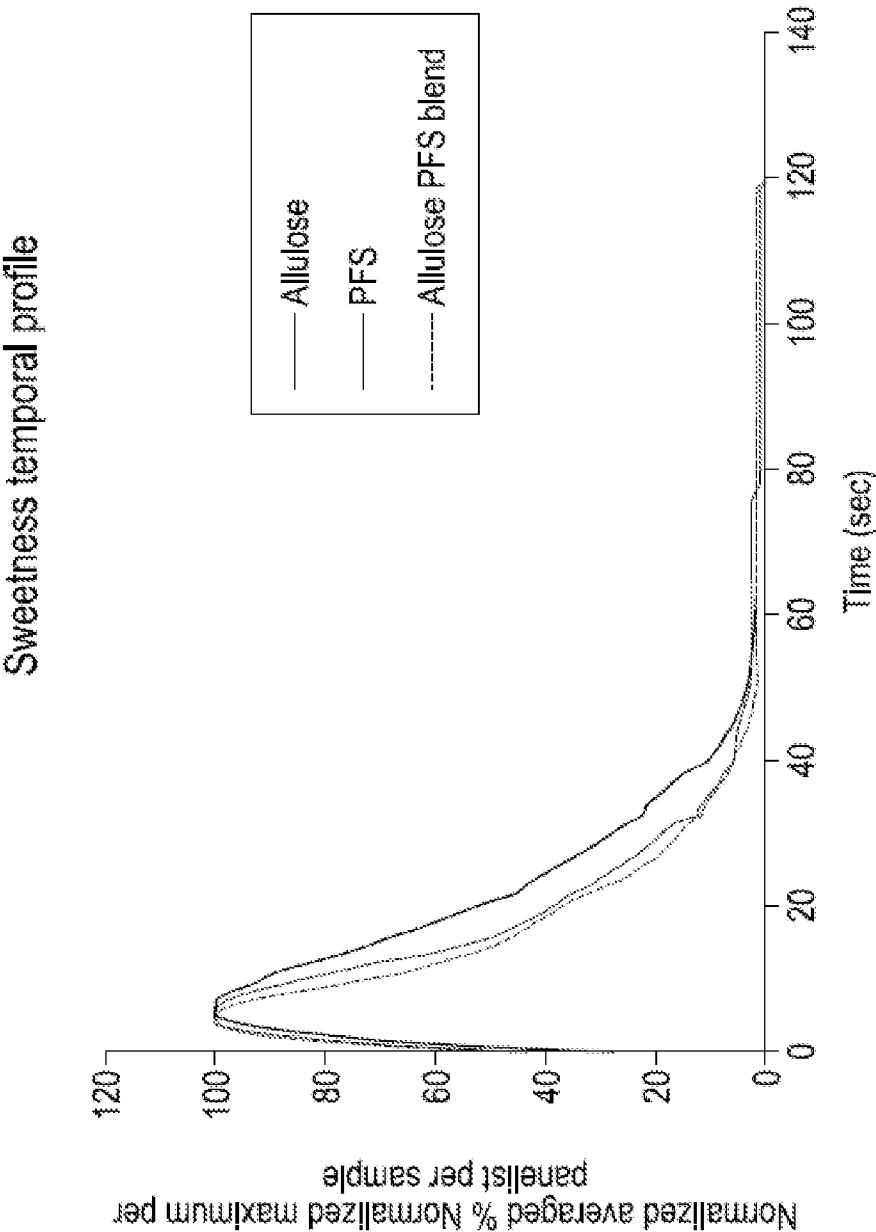


Fig. 2

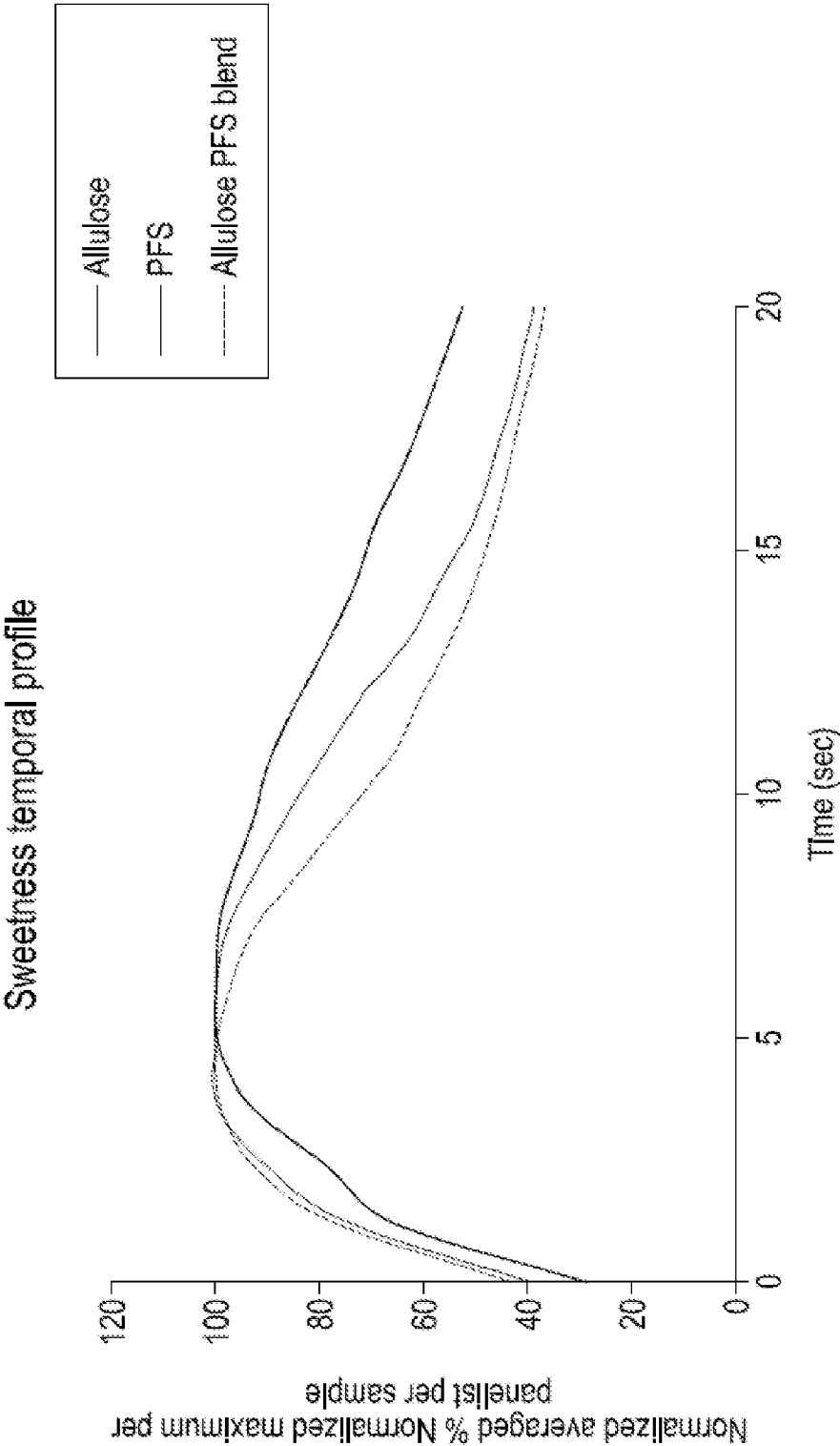


Fig. 3

IMPROVED SWEETENER

FIELD OF THE INVENTION

[0001] The present invention relates generally to a low or “zero”-calorie synergistic sweetener composition. In particular, the present invention relates to a sweetener composition with sweetness synergy, a reduction of off-taste and a desirable temporal profile. The present invention also relates to food or beverage products comprising said sweetener composition.

BACKGROUND OF THE INVENTION

[0002] Many food and beverage products contain nutritive sweeteners such as sucrose (generally referred to as ‘sugar’ or ‘table sugar’), glucose, fructose, corn syrup, high fructose corn syrup and the like. Such sweeteners supply not only sweetness to the food and beverage products, but also bulk, texture and desirable functional properties such as browning, humectancy, freezing point depression and the like. They also produce a favorable sensory response, for example in terms of quality of sweetness, lack of bitterness and off taste, desirable temporal profile and desirable mouthfeel.

[0003] Although desirable in terms of taste and functional properties, excess intake of nutritive sweeteners, such as sucrose, has long been associated with an increase in diet-related health issues, such as obesity, heart disease, metabolic disorders and dental problems. This worrying trend has caused consumers to become increasingly aware of the importance of adopting a healthier lifestyle and reducing the level of nutritive sweeteners in their diet.

[0004] In recent years, there has been a movement towards the development of replacements for nutritive sweeteners, with a particular focus on the development of low or zero-calorie sweeteners. An ideal replacement for a nutritive sweetener is a sweetener that has the same desirable taste characteristics and functional properties as the nutritive sweetener, but which also has fewer or substantially no calories. Aiming to meet this growing need, the market has been flooded with possible candidates to replace conventional nutritive sweeteners. Unfortunately, however, many of the low or zero calorie replacements offered on the market lack one or all of the necessary characteristics, and often exhibit bitterness or off-taste. Therefore, many of the proposed sweeteners are not an ideal replacement for nutritive sweeteners.

[0005] One proposed alternative to nutritive sweeteners is allulose (also known as D-psicose). Allulose is known as a “rare sugar”, since it occurs in nature in only very small amounts. It provides around 70% of the sweetness of sucrose, but only around 5% of the calories (approximately 0.2 kcal/g). It may therefore essentially be considered to be a ‘zero calorie’ sweetener.

[0006] In view of its scarcity in nature, production of allulose relies on the epimerization of readily available fructose. Ketose-3-epimerases can interconvert fructose and allulose, and various ketose-3-epimerases are known for carrying out this conversion.

[0007] U.S. Pat. No. 8,030,035 and PCT publication no. WO2011/040708 disclose that D-psicose can be produced by reacting D-fructose with a protein derived from *Agrobacterium tumefaciens*, and having psicose 3-epimerase activity.

[0008] US patent publication no. 2011/0275138 discloses a ketose 3-epimerase derived from a microorganism of the

Rhizobium genus. This protein shows a high specificity to D- or L-ketopentose and D- or L-ketohexose, and especially to D-fructose and D-psicose. This document also discloses a process for producing ketoses by using the protein.

[0009] Korean patent no. 100832339 discloses a *Sinorhizobium* YB-58 strain which is capable of converting fructose into psicose (i.e. allulose), and a method of producing psicose using a fungus body of the *Sinorhizobium* YB-58 strain.

[0010] Korean patent application no. 1020090098938 discloses a method of producing psicose using *E. coli* wherein the *E. coli* expresses a polynucleotide encoding a psicose 3-epimerase.

[0011] Allulose is present in processed cane and beet molasses, steam treated coffee, wheat plant products and high fructose corn syrup. D-allulose is the C-3 epimer of D-fructose and the structural differences between allulose and fructose result in allulose not being metabolized by the human body to any significant extent, and thus having “zero” calories. Thus, allulose is thought to be a promising candidate as a replacement for nutritive sweeteners and as a sweet bulking agent, as it has no calories and is reported to be sweet while maintaining similar properties to sucrose.

[0012] One of the most recently proposed alternatives to table sugar is Monk Fruit extract. Monk Fruit is a fruit from the plant species *Siraitia grosvenorii*, of the Cucurbitaceae family, and is a type of small melon which grows exclusively in tropical and subtropical regions of Southeast Asia. This fruit is also known as “Luo han guo”, is roughly 200 times sweeter than cane sugar, and provides calorie-free sweetness. The main sweet components of Monk Fruit leading to its sweet taste are known as mogrosides. Mogrosides are members of the family of triterpene glycosides. The sweet taste of mogrosides is thought to be related to the number of glucose units present in the mogroside. Examples of mogrosides found in Monk Fruit are Mogroside V, Mogroside IV, Mogroside VI, Oxomogroside V, Mogroside IIIE and Siamenoside I.

[0013] However, more recent studies have shown that some mogrosides may exhibit an off-taste and a less desirable temporal profile. Furthermore, allulose may have limitations in use due to cost and digestive tolerance in some applications. Therefore, there is a need to provide an improved replacement for sucrose and other nutritive sweeteners that has low or zero-calories and is without limitations in use, but which also has taste characteristics similar to those of sucrose.

[0014] The present invention seeks to provide a solution to the above mentioned problem by providing a sweetener composition having taste characteristics comparable to sucrose but having low or no calories. Advantageously, the present invention also seeks to provide a sweetener composition which provides a reduction in off-taste or off-flavor, a desirable temporal profile and improved mouth feel, compared with known proposed sweeteners.

SUMMARY OF THE INVENTION

[0015] According to a first aspect of the present invention, there is provided a sweetener composition comprising allulose and at least one mogroside.

[0016] Preferably, the at least one mogroside is selected from the group consisting of mogroside V, mogroside IV, mogroside VI, oxomogroside V, mogroside IIIE and siamenoside I, or mixtures thereof.

[0017] Advantageously, the at least one mogroside is a mogroside from a fruit of a plant of the Cucurbitaceae family.

Preferably, the plant is the species *Siraitia grosvenorii*. It is particularly preferred that the fruit is a Monk Fruit.

[0018] Conveniently, the at least one mogroside is present in the sweetener composition in a fruit extract from a fruit of a plant of the Cucurbitaceae family. Preferably, the plant is the species *Siraitia grosvenorii*.

[0019] Preferably, the sweetener composition comprises allulose and a fruit extract from a fruit of a plant of the Cucurbitaceae family.

[0020] Preferably, the fruit extract comprises a mogroside composition in an amount of at least 50% by weight relative to the total weight of the fruit extract.

[0021] Preferably, the fruit extract comprises a mogroside composition in an amount of about 50% to about 90% by weight relative to the total weight of the fruit extract.

[0022] Preferably, the mogroside composition comprises at least one mogroside selected from the group consisting of mogroside V, mogroside IV, mogroside VI, oxomogroside V, mogroside IIIE and siamenoside I, or mixtures thereof.

[0023] Preferably, the fruit extract comprises about 40% to about 65% by weight of mogroside V and about 0% to about 30% by weight of mogroside IV, mogroside VI, oxomogroside V, mogroside IIIE and siamenoside I or mixtures thereof, relative to the total weight of the fruit extract. In another embodiment, the fruit extract comprises about 48% to about 52% mogroside V by weight and about 25% to about 30% by weight of mogroside IV, oxomogroside V and siamenoside I, relative to the total weight of the fruit extract.

[0024] Advantageously, the fruit extract comprises about 50% to about 60% by weight of mogroside V relative to the total weight of the fruit extract.

[0025] According to an embodiment, the sweetener composition comprises allulose in an amount of at least about 97% by weight and fruit extract in an amount of at least about 0.05% by weight relative to the total weight of allulose and fruit extract in the composition.

[0026] According to an embodiment, the sweetener composition comprises allulose in an amount of about 97% to about 99.95% by weight and fruit extract in an amount of about 0.05% to about 3% by weight relative to the total weight of allulose and fruit extract in the composition.

[0027] In a preferred embodiment, the sweetener composition comprises allulose in an amount of about 98% to about 99.9% by weight and fruit extract in an amount of about 0.1% to 2% by weight, relative to the total weight of allulose and fruit extract in the composition. Preferably, the sweetener composition comprises allulose in an amount of about 99.5% by weight and fruit extract of about 0.5% by weight relative to the total weight of allulose and fruit extract in the composition.

[0028] According to an embodiment, the sweetener composition comprises allulose in an amount of about 98% by weight and fruit extract in an amount of about 2% by weight relative to the total weight of allulose and fruit extract in the composition.

[0029] According to an embodiment, the sweetener composition comprises allulose in an amount of about 99.94% by weight and fruit extract in an amount of about 0.06% by weight relative to the total weight of allulose and fruit extract in the composition.

[0030] According to an embodiment, the sweetener composition comprises allulose in an amount of about 99.83% by

weight and fruit extract in an amount of about 0.17% by weight relative to the total weight of allulose and fruit extract in the composition.

[0031] According to an embodiment, the sweetener composition comprises allulose in an amount of about 97% by weight and fruit extract in an amount of about 3% by weight relative to the total weight of allulose and fruit extract in the composition.

[0032] According to an embodiment, the sweetener composition comprises allulose in an amount of about 98.5% by weight and fruit extract in an amount of about 1.5% by weight relative to the total weight of allulose and fruit extract in the composition.

[0033] According to an embodiment, the sweetener composition comprises allulose in an amount of about 99.6% by weight and fruit extract in an amount of about 0.4% by weight relative to the total weight of allulose and fruit extract in the composition.

[0034] In some embodiments, the sweetener composition may further comprise a sweet taste improving additive, a bulking agent, a flavoring agent, and/or a stabilizer.

[0035] Preferably, the Monk Fruit extract is the commercially available product PureFruit™ Select, available from Tate & Lyle.

[0036] Preferably, the Monk Fruit extract is the commercially available product PureFruit™, available from Tate & Lyle.

[0037] A second aspect of the present invention provides a food or beverage product comprising the sweetener composition of the invention.

[0038] According to an embodiment, the food or beverage product comprises allulose and fruit extract in a total amount of about 1% to about 12% by weight based on the total weight of the food or beverage product.

[0039] According to an embodiment, the food or beverage product comprises allulose and fruit extract in a total amount of about 1% to about 5% by weight based on the total weight of the food or beverage product.

[0040] According to an embodiment, the food or beverage product comprises allulose and fruit extract in a total amount of about 4% to about 10% by weight based on the total weight of the food or beverage product.

[0041] According to an embodiment, the food or beverage product comprises and fruit extract in a total amount of about 6% to about 12% by weight based on the total weight of the food or beverage product.

[0042] According to an embodiment, the food or beverage product is a food product and the sweetener composition is provided as a coating or frosting on the surface of the food product.

[0043] According to an embodiment, the food or beverage product is a carbonated or non-carbonated beverage.

[0044] A further aspect of the present invention provides a table-top sweetener comprising the sweetener composition of the invention.

[0045] According to an embodiment, the table-top sweetener is a dry table-top sweetener. For example, it may take the form of tablets, granules or a powder.

[0046] According to an embodiment, the sweetener composition of the table-top sweetener comprises allulose in an amount of about 97.5% to about 99.2% and fruit extract in an amount of about 0.8% to about 2.5% by weight relative to the total weight of allulose and fruit extract in the composition.

[0047] According to an embodiment, the sweetener composition of the table-top sweetener comprises allulose in an amount of about 98.7% and fruit extract in an amount of about 1.3% by weight relative to the total weight of allulose and fruit extract in the composition.

[0048] According to an embodiment, the sweetener composition of the table-top sweetener comprises allulose in an amount of about 98.87% and fruit extract in an amount of about 1.13% by weight relative to the total weight of allulose and fruit extract in the composition.

[0049] According to an embodiment, the sweetener composition of the table-top sweetener comprises allulose in an amount of about 97.68% and fruit extract in an amount of about 2.32% by weight relative to the total weight of allulose and fruit extract in the composition.

[0050] According to an embodiment, the table-top sweetener further comprises one or more nutritive sweetener. The nutritive sweetener may be selected from the group consisting of sucrose, glucose, glucose syrup, isoglucose, fructose, glucose-fructose syrup, maltose, lactose, corn syrup, high fructose corn syrup, invert sugar, molasses, honey and agave. The nutritive sweetener is sucrose in one preferred embodiment. Where the table-top product includes a nutritive sweetener, said nutritive sweetener may be present in an amount of up to about 30% by weight based on the total weight of the table-top sweetener. For example, the nutritive sweetener may be present in an amount of about 26% by weight based on the total weight of the table-top sweetener.

[0051] According to an embodiment, the table-top sweetener further comprises one or more co-sweetener selected from the group consisting of high intensity sweeteners and sugar alcohols. The one or more co-sweetener may comprise *stevia* extracts. Alternatively or additionally, the one or more co-sweetener may be selected from the group consisting of sucralose, aspartame and acesulfame potassium. Alternatively or additionally, the one or more co-sweetener is selected from the group consisting of maltitol, xylitol and erythritol.

[0052] Further aspects of the present invention provide: a bulking agent comprising the sweetener composition of the invention; a coating agent comprising the sweetener composition of the invention; a cosmetic product comprising the sweetener composition of the invention; a pharmaceutical product comprising the sweetener composition of the invention; a nutritional product comprising the sweetener composition of the invention; and a sports product comprising the sweetener composition of the invention.

[0053] Another aspect of the present invention provides the use of the sweetener composition of the invention in a food product, a beverage product, a pharmaceutical product, a nutritional product, a sports product, or a cosmetic product.

[0054] Another aspect of the present invention provides the use of the sweetener composition of the invention as a bulking agent.

[0055] Another aspect of the present invention provides the use of the sweetener composition of the invention as a coating agent.

BRIEF DESCRIPTION OF THE DRAWINGS

[0056] FIG. 1: Graph illustrating the SEV level of a composition comprising allulose and PureFruit™ Select.

[0057] FIG. 2: Graph illustrating the sweetness temporal profile of allulose alone, PureFruit™ Select alone and a composition comprising allulose and PureFruit™ Select.

[0058] FIG. 3: Graph illustrating the sweetness temporal profile of allulose alone, PureFruit™ Select alone and a composition comprising allulose and PureFruit™ Select.

DETAILED DESCRIPTION

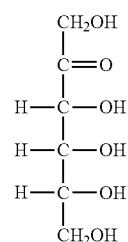
[0059] The present invention is based on the finding that allulose and at least one mogroside, when present in a composition, exhibit sweetness synergy whereby the blend is sweeter than the expected sweetness based on the sweetness of its components. Furthermore, it has been found that this blend of allulose and at least one mogroside addresses problems associated with the individual components, in particular, with regard to the off-flavor and/or undesirable temporal profile that may be associated with some mogrosides.

[0060] Due to the presence of the zero calorie sweeteners, the sweetener composition is low or “zero” calorie. Furthermore, as a consequence of the sweetness synergy exhibited by the composition, the amount of the composition required to provide a given level of sweetness is less than would be expected in the absence of synergy, thereby allowing a further reduction in calories. Thus, the sweetener of the present invention provides enhanced sweetness, improves the balance of flavor by reducing off-taste or off-flavor, and provides a more desirable temporal profile, while at the same time allowing a significant reduction in calories compared to a sweet-equivalent amount of a conventional nutritive sweetener.

[0061] Using the sweetener composition of the present invention allows delivery of an increased sweetness in food or beverage products when compared to the individual components used separately. This enhanced sweetness means that a smaller amount of sweetener can be used in these products, to provide a temporal and taste profile that closely matches that of sucrose.

[0062] In general terms, the present invention relates to a sweetener composition comprising allulose and at least one mogroside.

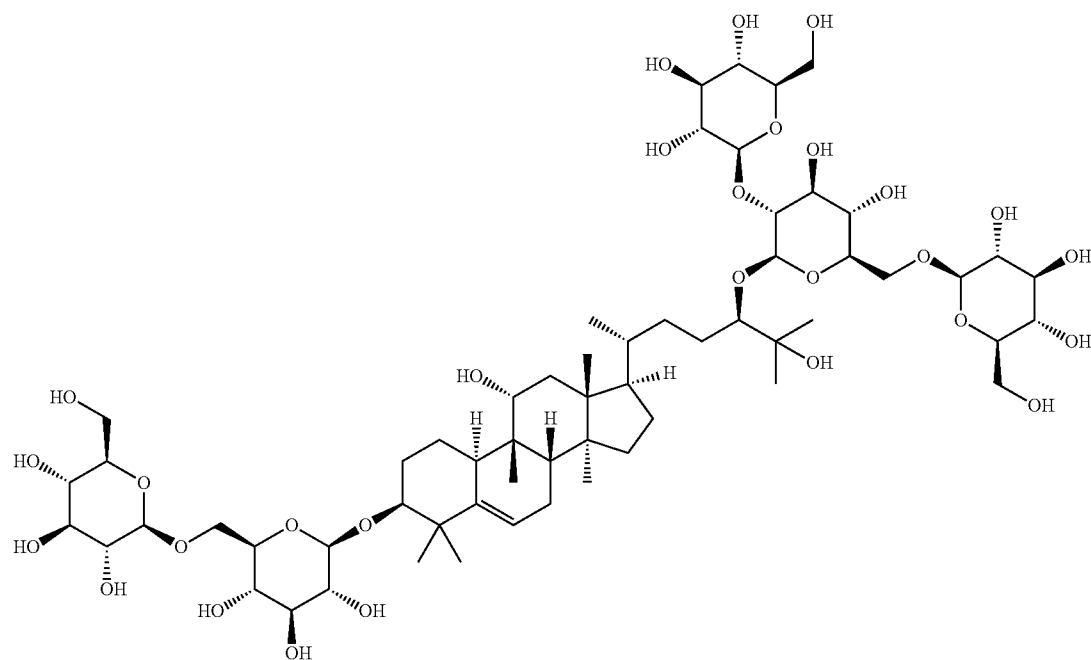
[0063] The term “allulose” as used herein refers to a monosaccharide sugar of the structure shown as a Fischer projection in below Formula I. It is also known as “D-psi-cose”:



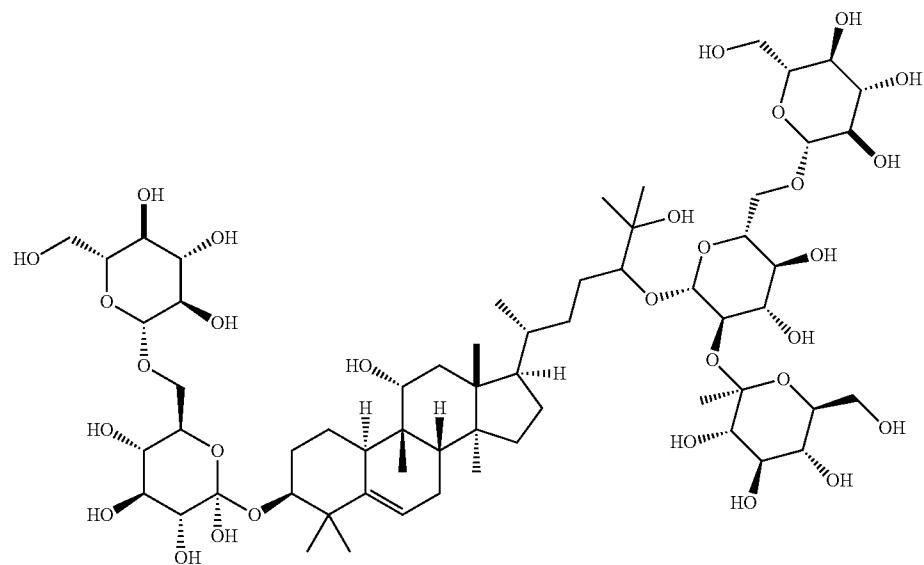
Formula (I)

[0064] The term “mogroside” as used herein refers to a family of compounds found in plants such as Monk Fruit. Mogrosides are glycosides of cucurbitane derivatives.

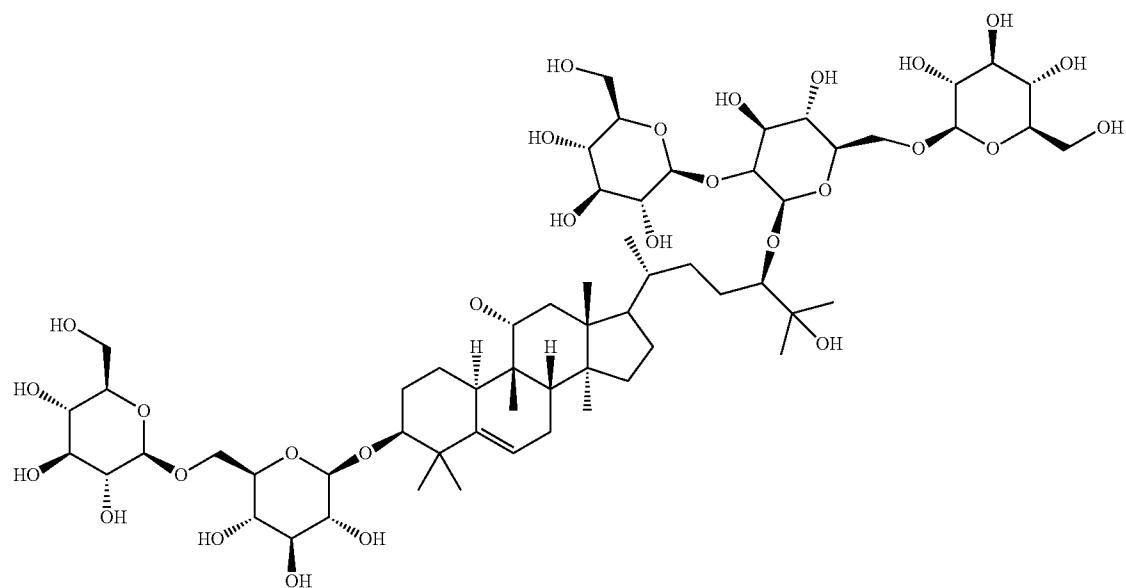
[0065] Mogroside V (also known as esgoside) has the following formula:



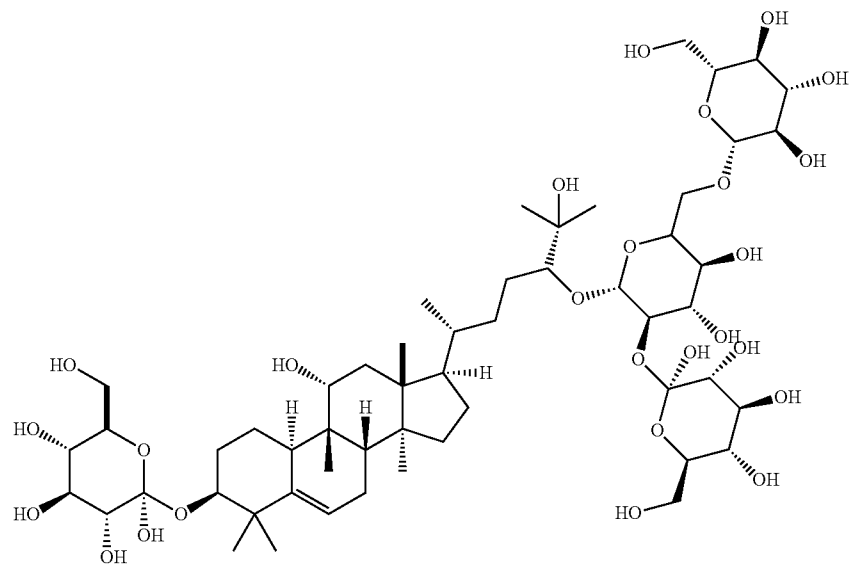
[0066] Mogroside IV has the following formula:



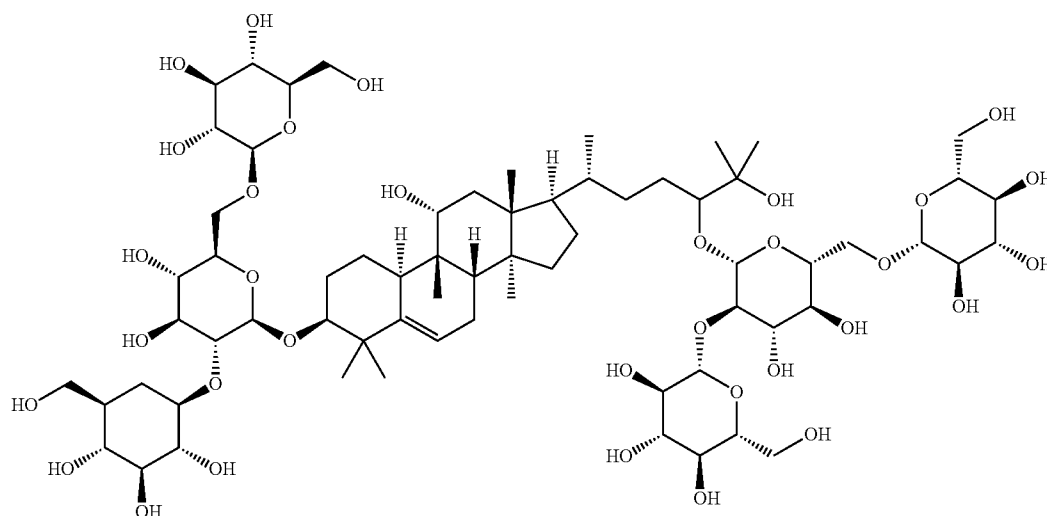
[0067] 11-Oxomogroside V has the following formula:



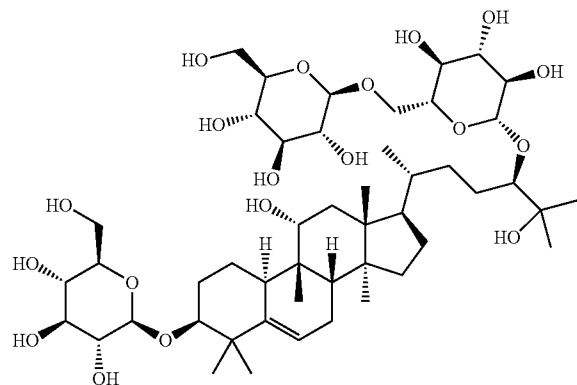
[0068] Siamenoside I has the following formula:



[0069] Mogroside VI has the following formula:



[0070] Mogroside III E has the following formula:



[0071] The term “fruit extract” as used herein refers to a fruit extract or a sample taken from a fruit of a plant of the Cucurbitaceae family, comprising at least one mogroside.

[0072] The term “Monk Fruit extract” as used herein refers to an extract or sample taken from a Monk Fruit from the Monk Fruit plant, *Siraitia grosvenorii*, comprising at least one mogroside.

[0073] The term “mogroside composition” as used herein refers to a composition comprising at least one mogroside.

[0074] The term “temporal profile” of a composition, sugar or sweetener, as used herein, is a measure of the perceived sweetness intensity of said composition, sugar or sweetener over time. A desirable or advantageous temporal profile is one wherein sweetness is observed quickly and has a short linger similar to that of sucrose.

[0075] The term “sucrose equivalent value” or “SEV” as used herein refers to the sweetness equivalent of a sweetener related to the sweetness of sucrose. For example, a sweetener at an SEV value of 5 would have a sweetness similar to a 5% by weight solution of sucrose.

[0076] The term “zero calorie” as used herein refers to a sweetener with less than 5 calories per reference amount customarily consumed (RACC) and per labeled serving.

[0077] The term “low calorie” as used herein refers to a sweetener having 40 calories or fewer per reference amount customarily consumed (RACC) and per labeled serving.

[0078] All amounts given in % by weight are quoted on a dry solids (ds) basis unless specifically stated otherwise. Thus, where components are provided other than in their pure form, the amount added should be adjusted to provide the required amount on a dry solids basis. For example, where allulose is provided as a syrup, the amount of syrup used should be adjusted to supply the required amount of allulose on a dry solids basis.

[0079] The present invention provides a sweetener composition comprising allulose and at least one mogroside.

[0080] In a preferred embodiment, the mogroside is selected from the group consisting of mogroside V, mogroside IV, mogroside VI, oxomogroside V, mogroside III E and siamenside I or mixtures thereof. It is generally preferred that at least four mogrosides are present in the sweetener composition namely, Mogroside V, Mogroside IV, 11-Oxo-mogroside V and Siamenside I. It is particularly preferred that the at least one mogroside is mogroside V.

[0081] In a further preferred embodiment, the at least one mogroside is from a fruit from a plant of the Cucurbitaceae family. The Cucurbitaceae family of plants includes the plant species *Siraitia grosvenorii*, which is also known as the Monk Fruit plant. The mogroside may be present in the sweetener composition of the present invention in an extract from a fruit of a plant of the Cucurbitaceae family. The fruit extract comprises at least one mogroside. It is particularly preferred that the fruit is the Monk Fruit from the species *Siraitia grosvenorii*.

[0082] The fruit extract or Monk Fruit extract for use in the present invention may be prepared as follows: The fruit is crushed to release its natural juices. The crushed fruit is then infused with hot water to extract the vitamins, antioxidants and sweet components. The infusion is then passed through a series of filters to obtain a pure, sweet fruit concentrate.

[0083] In a still preferred embodiment, the sweetener composition of the present invention comprises allulose and a fruit extract from a fruit of a plant of the Cucurbitaceae family. Preferably, the fruit extract is a Monk fruit extract.

[0084] In a particularly preferred embodiment, the fruit extract comprises a mogroside composition in an amount of at least about 50% by weight relative to the total weight of the fruit extract. Preferably, the fruit extract comprises a mogroside composition in an amount of about 50% to about 90% by weight relative to the total weight of the fruit extract.

[0085] In a preferred embodiment, the mogroside composition comprises at least one mogroside selected from the group consisting of mogroside V, mogroside IV, mogroside VI, oxomogroside V, mogroside IIIE and siamenoside I or mixtures thereof.

[0086] It is generally preferred that at least four mogrosides are present in the mogroside composition, namely, Mogroside V, Mogroside IV, 11-Oxomogroside V and Siamenoside I.

[0087] It is particularly preferred that the fruit extract comprises about 40% to about 65% by weight of mogroside V and about 0% to about 30% by weight of mogroside IV, mogroside VI, oxomogroside V, mogroside IIIE or siamenoside I, or mixtures thereof.

[0088] In a further embodiment, the fruit extract comprises about 50% to about 60% by weight of mogroside V and about 0% to about 30% by weight of mogroside IV, mogroside VI, oxomogroside V, mogroside IIIE or siamenoside I, or mixtures thereof.

[0089] In a further preferred embodiment, the fruit extract comprises about 40%, 41%, 42%, 43%, 44%, 45%, 46%, 47%, 48%, 49%, 50%, 51%, 52%, 53%, 54%, 55%, 56%, 57%, 58%, 59%, or 60% by weight of mogroside V. Furthermore, the fruit extract preferably comprises about 0%, 1%, 2%, 3%, 4%, 5%, 6%, 7%, 8%, 9%, 10%, 11%, 12%, 13%, 14%, 15%, 16%, 17%, 18%, 19%, 20%, 21%, 22%, 23%, 24%, 25%, 26%, 27%, 28%, 29%, or 30% by weight of mogroside IV, mogroside VI, oxomogroside V, mogroside IIIE or siamenoside I, or mixtures thereof.

[0090] Suitable fruit extracts or mogroside compositions for use in the present invention may be obtained following the methods of producing such extracts described in U.S. Pat. No. 5,411,755 and U.S. Publication. No. 2006/0003053.

[0091] According to an embodiment, the sweetener composition comprises allulose in an amount of at least about 97% by weight and fruit extract in an amount of at least about 0.05% by weight relative to the total weight of allulose and fruit extract in the composition.

[0092] According to an embodiment, the sweetener composition comprises allulose in an amount of about 97% to about 99.95% by weight and fruit extract in an amount of about 0.05% to about 3% by weight relative to the total weight of allulose and fruit extract in the composition.

[0093] In an embodiment, the sweetener composition comprises allulose in an amount of about 98% to about 99.9% by weight and fruit extract in an amount of about 0.1% to about 2% by weight, preferably relative to the total weight of allulose and fruit extract in the composition. Alternatively, the sweetener composition comprises allulose in an amount of about 99.5% by weight and fruit extract of about 0.5% by weight, preferably relative to the total weight of allulose and fruit extract in the composition.

[0094] According to an embodiment, the sweetener composition comprises allulose in an amount of about 98% by

weight and fruit extract in an amount of about 2% by weight relative to the total weight of allulose and fruit extract in the composition.

[0095] According to an embodiment, the sweetener composition comprises allulose in an amount of about 99.94% by weight and fruit extract in an amount of about 0.06% by weight relative to the total weight of allulose and fruit extract in the composition.

[0096] According to an embodiment, the sweetener composition comprises allulose in an amount of about 99.83% by weight and fruit extract in an amount of about 0.17% by weight relative to the total weight of allulose and fruit extract in the composition.

[0097] According to an embodiment, the sweetener composition comprises allulose in an amount of about 97% by weight and fruit extract in an amount of about 3% by weight relative to the total weight of allulose and fruit extract in the composition.

[0098] According to an embodiment, the sweetener composition comprises allulose in an amount of about 98.5% by weight and fruit extract in an amount of about 1.5% by weight relative to the total weight of allulose and fruit extract in the composition.

[0099] According to an embodiment, the sweetener composition comprises allulose in an amount of about 99.6% by weight and fruit extract in an amount of about 0.4% by weight relative to the total weight of allulose and fruit extract in the composition.

[0100] In a preferred embodiment, the sweetener composition comprises allulose in an amount of 97%, 97.1%, 97.2%, 97.3%, 97.4%, 97.5%, 97.6%, 97.7%, 97.8%, 97.9%, 98%, 98.1%, 98.2%, 98.3%, 98.4%, 98.5%, 98.6%, 98.7%, 98.8%, 99%, 99.1%, 99.2%, 99.3%, 99.4%, 99.5%, 99.6%, 99.7%, 99.8%, or 99.9% by weight and fruit extract in an amount of about 0.1%, 0.2%, 0.3%, 0.4%, 0.5%, 0.6%, 0.7%, 0.8%, 0.9%, 1.0%, 1.1%, 1.2%, 1.3%, 1.4%, 1.5%, 1.6%, 1.7%, 1.8%, 1.9%, 2%, 2.1%, 2.2%, 2.3%, 2.4%, 2.5%, 2.6%, 2.7%, 2.8%, 2.9% or 3% by weight, preferably relative to the total weight of allulose and fruit extract in the composition.

[0101] In a further embodiment, the sweetener composition comprises allulose and a fruit extract in an amount of between 70/30 to 30/70 by percentage of added sweetness in terms of relative sugar equivalent value (SEV), preferably 50/50.

[0102] Preferably, the Monk Fruit extract is the commercially available product PureFruit™, available from Tate & Lyle or the commercially available product PureFruit™ Select, available from Tate & Lyle.

[0103] A further aspect of the present invention provides a food product comprising the sweetener composition of the invention. Non-limiting examples of a food product include a confectionary product (including, but not limited to, jelly candies, hard candies and gums), a dessert product such as, yogurt (including, but not limited to, full fat, reduced fat and fat-free dairy yoghurts, as well non-dairy and lactose-free yoghurts and frozen equivalents of all of these), frozen desserts (including, but not limited to, frozen dairy desserts such as ice-cream—including regular ice cream, soft-serve ice cream and all other types of ice cream—and frozen non-dairy desserts such as non-dairy ice cream, sorbet and the like), sweet bakery products (including, but not limited to, biscuits, cakes, rolls, pies, pastries, and cookies), pre-made sweet bakery mixes for preparing sweet bakery products, pie fillings (including, but not limited to, fruit pie fillings and nut pie fillings such as pecan pie filling), a cereal product such as

sweetened breakfast cereals (including, but not limited to, extruded (kix type) breakfast cereals, flaked breakfast cereals and puffed breakfast cereals), cereal coating compositions, baked goods including bread products (including, but not limited to, leavened and unleavened breads, yeasted and unyeasted breads such as soda breads, breads comprising any type of wheat flour, breads comprising any type of non-wheat flour (such as potato, rice and rye flours), gluten-free breads), pre-made bread mixes for preparing bread products, frozen dairy products, meats, dairy products, condiments, snack bars (including, but not limited to, cereal, nut, seed and/or fruit bars), soups, dressings, mixes, prepared foods, baby foods, diet preparations, syrups, food coatings, dried fruit, sauces, gravies, spreads (including, but not limited to, jams/jellies, butters and other spreadable preserves, conserves and the like). Other types of food product not mentioned here but which conventionally include one or more nutritive sweetener may also be contemplated in the context of the present invention, especially those which are reduced sugar or low sugar products. The food product may be an animal feed product. The food product of the invention may comprise the sweetener composition as a coating or frosting formed on the surface of the product. This coating improves the flavor of the food product as well as its shelf life.

[0104] Another aspect of the invention provides a beverage product comprising the sweetener composition of the present invention. Non-limiting examples of a beverage product include a carbonated beverage (including, but not limited to, soft carbonated beverages), a non-carbonated beverage (including, but not limited to, soft non-carbonated beverages such as flavored waters and sweet tea or coffee based beverages), fruit-flavored beverage, fruit-juice, tea, milk, coffee especially those which are reduced sugar or low sugar products. Other types of beverage product not mentioned here but which conventionally include one or more nutritive sweetener may also be contemplated in the context of the present invention, especially those which are reduced sugar or low sugar products.

[0105] A further aspect of the present invention provides a table-top sweetener comprising the sweetener composition of the invention.

[0106] According to an embodiment, the table-top sweetener is a dry table-top sweetener. For example, it may take the form of tablets, granules or a powder. Liquid table-top sweeteners may also be contemplated, and typically take the form of an aqueous solution of the components.

[0107] According to an embodiment, the sweetener composition of the table-top sweetener comprises allulose in an amount of about 97.5% to about 99.2% and fruit extract in an amount of about 0.8% to about 2.5% by weight relative to the total weight of allulose and fruit extract in the composition.

[0108] According to an embodiment, the sweetener composition of the table-top sweetener comprises allulose in an amount of about 98.7% and fruit extract in an amount of about 1.3% by weight relative to the total weight of allulose and fruit extract in the composition.

[0109] According to an embodiment, the sweetener composition of the table-top sweetener comprises allulose in an amount of about 98.87% and fruit extract in an amount of about 1.13% by weight relative to the total weight of allulose and fruit extract in the composition.

[0110] According to an embodiment, the sweetener composition of the table-top sweetener comprises allulose in an amount of about 97.68% and fruit extract in an amount of about 2.32% by weight relative to the total weight of allulose and fruit extract in the composition.

[0111] According to an embodiment, the table-top sweetener further comprises one or more nutritive sweetener. The nutritive sweetener may be selected from the group consisting of sucrose, glucose, glucose syrup, isoglucose, fructose, glucose-fructose syrup, maltose, lactose, corn syrup, high fructose corn syrup, invert sugar, molasses, honey and agave. The nutritive sweetener is sucrose in one preferred embodiment. Where the table-top product includes a nutritive sweetener, said nutritive sweetener may be present in an amount of up to about 30% by weight based on the total weight of the table-top sweetener. For example, the nutritive sweetener may be present in an amount of about 26% by weight based on the total weight of the table-top sweetener.

[0112] According to an embodiment, the table-top sweetener further comprises one or more co-sweetener selected from the group consisting of high intensity sweeteners and sugar alcohols.

[0113] Various natural high intensity sweeteners may be used as the one or more co-sweetener of the present invention. A specific example is *stevia* extracts, as well as any sweet compounds isolated from such extracts (including synthetic equivalents of such compounds). *Stevia*, or *stevia rebaudiana*, contains sweet compounds in its leaves. These compounds may be extracted to provide *stevia* extracts. The sweet taste of *stevia* extracts is mainly attributed to a family of compounds known as 'steviol glycosides', examples of which include rebaudiosides (i.e., rebaudioside A to F, M, N and X), rubusoside, stevioside, and dulcosides. *Stevia* extracts, as well as sweeteners comprising any one or more steviol glycoside, may be used as the one or more co-sweetener of the present invention. Extracts or sweeteners comprising rebaudioside A (Reb A) are particularly preferred.

[0114] Various synthetic high potency sweeteners may also be used as the one or more co-sweetener of the present invention. Specific examples include sucralose, aspartame and acesulfame potassium (Ace K).

[0115] Various sugar alcohols may also be used as the one or more co-sweetener of the present invention. Specific examples include maltitol, xylitol and erythritol.

[0116] Table-top sweeteners according to the present invention may typically be used to sweeten beverages, especially hot beverages such as tea and coffee. It has been found that the taste provided by the table-top product is similar to the taste provided by sucrose, and is superior to many known table-top sweeteners.

[0117] Another aspect of the present invention provides a bulking agent comprising the sweetener composition of the invention.

[0118] A further aspect of the present invention provides a coating agent comprising the sweetener composition of the invention.

[0119] A separate aspect of the present invention provides a pharmaceutical product comprising the sweetener composition of the invention.

[0120] Another aspect of the present invention provides a nutritional or sports product comprising the sweetener composition of the invention.

[0121] Another aspect of the present invention provides a cosmetic product comprising the sweetener composition of the invention.

[0122] It will be appreciated that the amount of the sweetener composition of the invention present in a food product, a beverage product, a pharmaceutical product, a nutritional product, a sports product, or a cosmetic product, will depend upon the type and amount of sweetener present in the sweetener composition and the desired sweetness of the food or beverage product.

[0123] According to an embodiment, the food or beverage product comprises allulose and fruit extract in a total amount of about 1% to about 12% by weight based on the total weight of the food or beverage product.

[0124] According to an embodiment, the food or beverage product comprises allulose and fruit extract in a total amount of about 1% to about 5% by weight based on the total weight of the food or beverage product.

[0125] According to an embodiment, the food or beverage product comprises allulose and fruit extract in a total amount of about 4% to about 10% by weight based on the total weight of the food or beverage product.

[0126] According to an embodiment, the food or beverage product comprises and fruit extract in a total amount of about 6% to about 12% by weight based on the total weight of the food or beverage product.

[0127] An alternative aspect of the present invention provides the use of the sweetener composition of the invention in a food product, a beverage product, a pharmaceutical product, a nutritional product, a sports product, or a cosmetic product, as a bulking agent or as a coating agent.

[0128] The sweetener composition may be formulated in any ingestible form, for example, as a syrup, in powder form, tablet form, as granules, in a solution or in any other suitable form including beverages and food products.

[0129] As outlined in the below examples, the sweetener composition of the invention exhibits a sucrose equivalent value (SEV) greater than the predicted value based on its individual components. Therefore, the sweetener composition of the present invention displays sweetness synergy.

[0130] The following examples are exemplary only and are not intended to be limiting in any way.

EXAMPLES

Example 1

Evaluation of the Sensory Properties of the Sweetener Composition of the Invention

[0131] Materials and Methods

[0132] Round table evaluations were performed with a number of test panelists. Equal sweet 10 SEV concentrations in neutral pH water were made for allulose and PureFruit™ Select and as well as equal (50/50) mixture of allulose and PureFruit™ Select. PureFruit™ Select is commercially available from Tate & Lyle. All mixtures were calculated using the Beidler mixture equation for the sweeteners. The Beidler mixture equation for sweeteners is as follows:

$$SEV = \frac{conc \cdot R_{max}}{conc + 1/K}$$

[0133] The concentration of each component in the mixture in ppm is divided by SEV (c/R) and is plotted against concentration, c. The slope of the linear regression is the maximum SEV (R_{max}). The y-intercept of the linear regression multiplied by R_{max} is the half-maximal sweetness concentration, $1/K$. R_{max} and $1/K$ are the two parameters used in the Beidler equation.

[0134] The equal-molar mixtures were tested against reference samples for the panelists to determine SEV values. Reference mixtures were 4%, 6%, 8%, 10%, 12%, and 14% sucrose in neutral pH water.

[0135] The solutions were served in 2 ounce (approximately 60 ml) soufflé cups coded with 3-digit codes at room temperature. A two minute wait period between samples was enforced. RO water and unsalted crackers were available for the panelists to clear their palates before and during testing. EyeQuestion was used for ballot development and recording of results.

[0136] Results were collected in EyeQuestion for calculating approximate SEV level of each test sample. Z-test statistics with $\alpha=0.07$ was used to determine significant difference from the 50/50 SEV mixture predicted value.

Sweetener Compositions Tested

[0137]

INGREDIENT	Allulose	Allulose	PureFruit	PureFruit	Allulose	Allulose
	10%	10%	Select	Select	PureFruit	PureFruit
	%	GRAMS	%	GRAMS	%	GRAMS
Allulose 89%	17.02	40.848	0	0	8.51	20.424
DS syrup						
PureFruit	0	0	0.0725	0.3480	0.03625	0.087
Select						
RO Water	82.98	199.152	99.9275	479.652	91.45375	219.489
TOTAL	100	240	100	480	100	240

Results

[0138] FIG. 1 illustrates the SEV yielded for the sweetener composition of the invention. This value was compared with the predicted SEV for each of the individual component parts (as illustrated by the straight shaded line on each graph). Surprisingly, the composition of the invention, comprising allulose and PureFruit™ Select exhibited sweetness synergy. The composition yielded an SEV of 9.85, which was a higher SEV via p-value for z-test above predicted 50/50 SEV values for the blend at a greater than 90% confidence interval.

CONCLUSION

[0139] The sweetener composition of the present invention exhibits a statistically significant sweetness synergy.

overall temporal profile data for that sample was then calculated using normalization as % of maximum (e.g. maximum value is 100%, and all intensity values are rated as a % based on value divided by maximum intensity value). Once normalized data was calculated for each panelist, averaged response across panelists was calculated. Based on these normalized values, the averaged normalized % temporal profile was then calculated as using normalization as % of maximum (e.g. max value is 100%, all intensity values are rated as a % based on value divided by maximum intensity value), and plotted for each sample.

Sweetener Compositions Tested

[0143]

INGREDIENT	Allulose SEV 7.67 %	Allulose SEV 7.67 GRAMS	PureFruit Select SEV 7.67 %	PureFruit Select SEV 7.67 GRAMS	Allulose PureFruit Select blend %	Allulose PureFruit Select blend GRAMS
Allulose 68% DS syrup	16.35	245.25	0	0	8.175	122.625
PureFruit Select	0	0	0.0400	0.6000	0.02	0.3
RO Water	83.65	1254.75	99.96	1499.4	91.805	1377.075
TOTAL	100	1500	100	1500	100	1500

Example 2

Determination of the Temporal Profile of the Sweetness Composition of the Invention

[0140] As the composition of the invention exhibited statistically significant sweetness synergy, the temporal profile of this composition was also determined. This experiment was undertaken to determine if allulose had any influence on the temporal profile of PureFruit™ Select when both components are present as a blend in a sweetener composition.

Materials and Methods

[0141] Temporal profile was completed with a trained descriptive panel. Panelists had several orientation rounds of the test samples to familiarize themselves with the protocol and the test samples. The tests were conducted as complete block designs in 3 replicates with the trained panel and were done over two testing days (one for each formula set). The presentation order was rotated. The solutions were served in 2 ounce (56 g) soufflé cups labeled with 3-digit codes, and panelists received 20 ml of each sample and were instructed to use the entire sample. Panelists were instructed to sample the product by placing the sample in their mouths and swallowing or spitting out the sample immediately while starting their intensity rating for sweetness at the same time using EyeQuestion. Intensity ratings for sweetness were collected for 2 minutes. Panelists had a two minute wait time between samples and at least a 10 minute break in-between repetitions. Panelists cleaned their palates with bottled water and unsalted crackers.

[0142] The maximum intensity of each panelist for each sample was determined for the entire temporal profile, and the

Results

[0144] The sweetness temporal profile reported for the composition of the invention is shown in FIGS. 2 and 3. FIG. 2 illustrates sweetness onset and reports the normalized maximum intensity for each sample over a time period 0 to 140 seconds. FIG. 3 illustrates sweetness linger and reports the normalized maximum intensity for each sample over a time period 0 to 20 seconds.

[0145] As illustrated in FIGS. 2 and 3, the composition of the invention improves the temporal profile relative to PureFruit Select™ alone. As illustrated in FIG. 2, the temporal onset is quicker and as illustrated in FIG. 3 the temporal linger is shorter, in the composition comprising allulose and PureFruit Select™ mixture. The temporal profile is similar to that of allulose alone and sucrose. The temporal profile of sucrose is illustrated in FIGS. 4 and 5.

CONCLUSION

[0146] Mixing PureFruit™ Select with allulose improves the temporal profile onset and linger properties of PureFruit™ Select.

Example 3

Table-Top Sweeteners

[0147] Three combinations of allulose and monk fruit extract (Luo Han Guo) were prepared. One combination included only allulose and monk fruit extract (PureFruit™ Select); one combination additionally included a *stevia* extract (Tasteva™) and Rebaudioside A (Reb A); and one combination additionally included sucrose:

Sample	Table top composition	Total dry weight of each table-top sample in 200 mL of coffee
1	98.7% Allulose + 1.3% PureFruit™ Select	3.53 gram
2	97.24% Allulose + 1% Tasteva™ + 1.11% PureFruit™ Select + 0.65% Reb A	1.66 gram
3	72.28% Allulose + 1.72% PureFruit™ Select + 26% sucrose	2.4 gram
	Truvia™ (comparative)	3.5 gram
	Sucrose (control)	8.4 gram

[0148] Each combination was dissolved in hot coffee. The total weight of each combination was designed such that the sweetness of each combination in 200 ml of coffee is similar to that of 8-10 grams of sucrose in the same amount of coffee. The coffee was made by brewing 91.9 grams of Starbucks™ Blounde Veranda Blend ground coffee with about 1600 mL of water. The calorie content of each combination was targeted to be less than 5 kcal/200 mL coffee. Five panelists were asked to compare the sweetness and taste profile of each combination against sucrose control and Truvia™ (a commercially available *stevia*-based sweetener) in hot coffee on a scale of 1 to 5:

	Sample 1	Sample 2	Sample 3	Truvia™
Average rating	2.4	2.2	2.2	1.2

[0149] It was unexpectedly found that allulose can make low calorie table-top sweetener taste more like sugar (sucrose). It is also unexpectedly found that allulose-based low or zero calorie table top sweetener taste significantly better than an erythritol-based table top product.

1. A sweetener composition comprising allulose and at least one mogroside.

2. The sweetener composition according to claim 1, wherein the at least one mogroside is selected from the group consisting of mogroside V, mogroside IV, mogroside VI, oxomogroside V, mogroside IIIIE or siamenoside I, and mixtures thereof.

3. The sweetener composition according to claim 1, wherein the at least one mogroside is from a fruit of a plant of the Cucurbitaceae family.

4. The sweetener composition according to claim 1, wherein the at least one mogroside is in a fruit extract from a fruit of a plant of the Cucurbitaceae family.

5. The sweetener composition according to claim 3, wherein the plant is *Siraitia grosvenorii*.

6. The sweetener composition according to claim 4, comprising allulose and a fruit extract.

7. The sweetener composition according to claim 6, wherein the fruit extract comprises a mogroside composition in an amount of at least 50% by weight relative to the total weight of the fruit extract.

8. The sweetener composition according to claim 7, wherein the mogroside composition comprises at least one mogroside selected from the group consisting of mogroside V, mogroside IV, mogroside VI, oxomogroside V, mogroside IIIIE and siamenoside I, and mixtures thereof.

9. The sweetener composition according to claim 4, wherein the fruit extract comprises about 40% to about 65%

by weight of mogroside V and about 0% to about 30% by weight of mogroside IV, mogroside VI, oxomogroside V, mogroside IIIIE or siamenoside I, or a mixture thereof.

10. The sweetener composition according to claim 4, wherein the fruit extract comprises about 48% to about 52% mogroside V by weight and about 25% to about 30% by weight in total of mogroside IV, oxomogroside V and siamenoside I.

11. The sweetener composition according to claim 4, wherein the fruit extract comprises about 50% to about 60% by weight of mogroside V relative to the total weight of the fruit extract.

12. The sweetener composition according to claim 4, comprising allulose in an amount of at least about 97% by weight and fruit extract in an amount of at least about 0.05% by weight relative to the total weight of allulose and fruit extract in the composition.

13. The sweetener composition of claim 4, comprising allulose in an amount of about 97% to about 99.95% by weight and fruit extract in an amount of about 0.05% to about 3% by weight relative to the total weight of allulose and fruit extract in the composition.

14. The sweetener composition of claim 4, comprising allulose in an amount of about 98% to about 99.9% by weight and fruit extract in an amount of about 0.1% to about 2% by weight relative to the total weight of allulose and fruit extract in the composition.

15. (canceled)

16. (canceled)

17. (canceled)

18. (canceled)

19. (canceled)

20. (canceled)

21. (canceled)

22. The sweetener composition according to claim 1, further comprising at least one of a sweet taste improving additive, a bulking agent, a flavoring agent, or a stabilizer.

23. The sweetener composition according to claim 4, wherein the fruit extract is PureFruit™ or PureFruit™ Select.

24. A food or beverage product comprising the sweetener composition according to claim 1.

25. The food or beverage product according to claim 24, wherein the food or beverage product comprises allulose and fruit extract in a total amount of about 1% to about 12% by weight based on the total weight of the food or beverage product.

26. The food or beverage product according to claim 25, wherein the food or beverage product comprises allulose and fruit extract in a total amount of about 1% to about 5% by weight based on the total weight of the food or beverage product.

27. The food or beverage product according to claim 25, wherein the food or beverage product comprises allulose and fruit extract in a total amount of about 4% to about 10% by weight based on the total weight of the food or beverage product.

28. The food or beverage product according to claim 25, wherein the food or beverage product comprises and fruit extract in a total amount of about 6% to about 12% by weight based on the total weight of the food or beverage product.

29. The food or beverage product according to claim 24, wherein the product is a food product and the sweetener composition is provided as a coating or frosting on the surface of the food product.

30. The food or beverage product according to claim **24**, wherein the product is a carbonated or non-carbonated beverage.

31. A table-top sweetener comprising the sweetener composition according to claim **1**.

32. The table-top sweetener according to claim **31**, wherein the table-top sweetener is a dry table-top sweetener.

33. The table-top sweetener according to claim **32**, wherein the table-top sweetener is provided as tablets, granules or as a powder.

34. The table-top sweetener according to claim **31**, wherein the sweetener composition comprises allulose in an amount of about 97.5% to about 99.2% and fruit extract in an amount of about 0.8% to about 2.5% by weight relative to the total weight of allulose and fruit extract in the composition.

35. (canceled)

36. (canceled)

37. (canceled)

38. The table-top sweetener according to claim **31**, wherein the table-top sweetener further comprises at least one nutritive sweetener.

39. The table-top sweetener according to claim **38**, wherein the at least one nutritive sweetener includes a nutritive sweetener selected from the group consisting of sucrose, glucose, glucose syrup, isoglucose, fructose, glucose-fructose syrup, maltose, lactose, corn syrup, high fructose corn syrup, invert sugar, molasses, honey and agave.

40. The table-top sweetener according to claim **39**, wherein the nutritive sweetener is sucrose.

41. The table-top sweetener according to claim **38**, wherein the table-top sweetener comprises a nutritive sweetener in an amount of up to about 30% by weight based on the total weight of the table-top sweetener.

42. (canceled)

43. The table-top sweetener according to claim **31**, wherein the table-top sweetener further comprises at least one co-sweetener selected from the group consisting of high intensity sweeteners and sugar alcohols.

44. The table-top sweetener according to claim **43**, wherein the one or more co-sweetener comprises *stevia* extracts.

45. The table-top sweetener according to claim **43**, wherein the at least one co-sweetener includes a co-sweetener selected from the group consisting of sucralose, aspartame and acesulfame potassium.

46. The table-top sweetener according to claim **43**, wherein the at least one co-sweetener includes a co-sweetener selected from the group consisting of maltitol, xylitol and erythritol.

47. A method, comprising using, the sweetener composition according to claim **1** in a food product, a beverage product, a pharmaceutical product, a nutritional product, a sports product, or a cosmetic product.

48. A method, comprising using the sweetener composition according to claim **1** as a bulking agent.

49. A method, comprising using the sweetener composition according to claim **1** as a coating agent.

* * * * *