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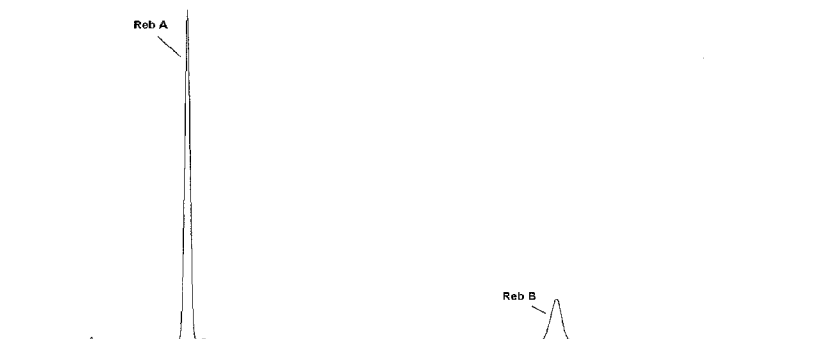


FIG. 3

(57) Abstract: Stevia compositions are prepared from steviol glycosides of *Stevia rebaudiana* Bertoni. The compositions are able to provide a superior taste profile and can be used as sweetness enhancers, flavor enhancers and sweeteners in foods, beverages, cosmetics and pharmaceuticals.

STEVIA COMPOSITION

BACKGROUND OF THE INVENTION

Field Of The Invention

The invention relates to a process for producing a highly purified food ingredient from the extract of the *Stevia rebaudiana* Bertoni plant and its use in various food products and beverages.

Description Of The Related Art

Sugar alternatives are receiving increasing attention due to the awareness of many diseases associated with the consumption of high-sugar foods and beverages. However, many artificial sweeteners such as dulcin, sodium cyclamate and saccharin have been banned or restricted in some countries due to concerns about their safety. As a result, non-caloric sweeteners of natural origin are becoming increasingly popular. The sweet herb *Stevia rebaudiana* Bertoni produces a number of diterpene glycosides which feature high intensity sweetness and sensory properties superior to those of many other high potency sweeteners.

The above-mentioned sweet glycosides, have a common aglycon, steviol, and differ by the number and type of carbohydrate residues at the C13 and C19 positions. The leaves of *Stevia* are able to accumulate up to 10-20% (on dry weight basis) steviol glycosides. The major glycosides found in *Stevia* leaves are rebaudioside *A* (2-10%), stevioside (2-10%), and rebaudioside *C* (1-2%). Other glycosides such as rebaudioside *B*, *D*, *E*, and *F*, steviolbioside and rubusoside are found at much lower levels (approx. 0-0.2%).

Two major glycosides - stevioside and rebaudioside *A* (reb *A*), were extensively studied and characterized in terms of their suitability as commercial high intensity sweeteners. Stability studies in carbonated beverages confirmed their heat and pH stability (Chang S.S., Cook, J.M. (1983) Stability studies of stevioside and rebaudioside *A* in carbonated beverages. *J. Agric. Food Chem.* 31: 409-412.)

Steviol glycosides differ from each other not only in their molecular structures, but also by their taste properties. Usually stevioside is found to be 110-270 times sweeter than sucrose, rebaudioside *A* between 150 and 320 times sweeter than sucrose,, and rebaudioside *C* between 40-60 times sweeter than sucrose. Dulcoside *A* is 30 times sweeter than sucrose. Rebaudioside *A* has the least astringent, the least bitter, and the least persistent aftertaste, thus possessing the most favorable sensory attributes in

major steviol glycosides (Tanaka O. (1987) Improvement of taste of natural sweeteners. *Pure Appl. Chem.* 69:675-683; Phillips K.C. (1989) Stevia: steps in developing a new sweetener. In: Grenby T.H. ed. Developments in sweeteners, vol. 3. Elsevier Applied Science, London. 1-43.) The chemical structure of rebaudioside *A* is shown in Fig. 1.

Methods for the extraction and purification of sweet glycosides from the *Stevia rebaudiana* plant using water or organic solvents are described in, for example, U.S. Patent Numbers 4,361,697; 4,082,858; 4,892,938; 5,972,120; 5,962,678; 7,838,044 and 7,862,845.

However, even in a highly purified state, steviol glycosides still possess undesirable taste attributes such as bitterness, sweet aftertaste, licorice flavor, etc. One of the main obstacles for the successful commercialization of stevia sweeteners are these undesirable taste attributes. It was shown that these flavor notes become more prominent as the concentration of steviol glycosides increases (Prakash I., DuBois G.E., Clos J.F., Wilkens K.L., Fosdick L.E. (2008) Development of rebiana, a natural, non-caloric sweetener. *Food Chem. Toxicol.*, 46, S75–S82.).

Rebaudioside *B* (CAS No: 58543-17-2), or reb *B*, also known as stevioside *A*₄ (Kennelly E.J. (2002) Constituents of *Stevia rebaudiana* In *Stevia: The genus Stevia*, Kinghorn A.D. (Ed), Taylor & Francis, London, p.71), is one of the sweet glycosides found in *Stevia rebaudiana*. Sensory evaluations show that reb *B* was approximately 300-350 times sweeter than sucrose, while for reb *A* this value was approximately 350–450 (Crammer, B. and Ikan, R. (1986) Sweet glycosides from the *Stevia* plant. *Chemistry in Britain* 22, 915–916, and 918). The chemical structure of rebaudioside *B* is shown in Fig. 2.

It was believed that reb *B* forms from the partial hydrolysis of rebaudioside *A* during the extraction process (Kobayashi, M., Horikawa, S., Degrandi, I.H., Ueno, J. and Mitsuhashi, H. (1977) Dulcosides *A* and *B*, new diterpene glycosides from *Stevia rebaudiana*. *Phytochemistry* 16, 1405–1408). However, further research has shown that reb *B* occurs naturally in the leaves of *Stevia rebaudiana* and is currently one of nine steviol glycosides recognized by FAO/JECFA (United Nations' Food and Agriculture Organization/Joint Expert Committee on Food Additives) in calculating total steviol glycosides' content in commercial steviol glycoside preparations (FAO JECFA (2010) Steviol Glycosides, Compendium of Food Additive Specifications, FAO JECFA Monographs 10, 17-21).

Only a few methods are described in literature for preparing reb *B*.

Kohda et al., (1976) prepared reb *B* by hydrolysis of reb *A* with hesperidinase. Reb *B* was also prepared by alkaline saponification of reb *A*. The said saponification was conducted in 10% potassium hydroxide-ethanol. The solution was acidified with acetic acid, and extracted with n-butanol. The butanol layer was washed with water and concentrated at low temperature *in vacuo*. The residue was crystallized from methanol to give reb *B*. (Kohda, H., Kasai, R., Yamasaki, K., Murakami, K. and Tanaka, O. (1976) New sweet diterpene glucosides from *Stevia rebaudiana*. *Phytochemistry* 15, 981–983). The described processes might be suitable for laboratory scale preparation of reb *B*, but are not suitable for any large scale or commercial reb *B* preparation.

Ahmed et al., used mild alkaline hydrolysis of reb *A* to prepare reb *B*. According to the described procedure, reb *A* was hydrolyzed to reb *B* by refluxing with 10% aqueous KOH at 100°C for 1hr. After neutralization with glacial acetic acid, the precipitated substance was recrystallized twice from methanol (Ahmed M.S., Dobberstein R.H., and Farnsworth N.R. (1980) *Stevia rebaudiana*: I. Use of p-bromophenacyl bromide to enhance ultraviolet detection of water-soluble organic acids (steviolbioside and rebaudioside *B*) in high-performance liquid chromatographic analysis, *J. Chromatogr.*, 192, 387-393).

The use of methanol as recrystallization media as described in the literature will require its subsequent removal from the product. It is noted that handling of toxic substances such as methanol requires specialized manufacturing installations and, when applied in food processing, sophisticated food safety measures.

It is also noted that no significant work has been conducted to determine the potential of reb *B* as a sweetener or food ingredient. Moreover, reb *B* is often viewed as process artifact and unnecessary impurity in commercial steviol glycosides preparations. No significant evaluation of the influence of reb *B* on the overall taste profile of steviol glycoside preparations has been conducted.

The water solubility of reb *B* is reported to be about 0.1% (Kinghorn A.D. (2002) *Constituents of Stevia rebaudiana* In *Stevia: The genus Stevia*, Kinghorn A.D. (Ed), Taylor & Francis, London, p.8). In many food processes where highly concentrated ingredients are used, a highly soluble form of reb *B* will be necessary.

Considering the facts mentioned above, there is a need to evaluate reb *B* as a sweetener and food ingredient and to develop a simple and efficient process for food grade reb *B* preparations suitable for food and other applications.

Within the description of this invention we will show that, when applied in specific manner, reb *B* may impact the taste profile and offer significant advantages for the use of stevia sweeteners in various applications.

SUMMARY OF THE INVENTION

The present invention is aimed to overcome the disadvantages of existing Stevia sweeteners. The invention describes a process for producing a high purity food ingredient from the extract of the *Stevia rebaudiana* Bertoni plant and use thereof in various food products and beverages as a sweetness and flavor modifier.

The invention, in part, pertains to an ingredient comprising steviol glycosides of *Stevia rebaudiana* Bertoni plant. The steviol glycosides are selected from the group consisting of stevioside, rebaudioside *A* (FIG. 1), rebaudioside *B* (FIG. 2), rebaudioside *C*, rebaudioside *D*, rebaudioside *E*, rebaudioside *F*, dulcoside *A*, steviolbioside, rubusoside, as well as other steviol glycosides found in *Stevia rebaudiana* Bertoni plant and mixtures thereof.

The invention, in part, pertains to a process for producing an ingredient containing rebaudioside *B*, and stevioside, rebaudioside *A*, rebaudioside *C*, rebaudioside *D*, rebaudioside *E*, rebaudioside *F*, dulcoside *A*, steviolbioside, rubusoside, as well as other steviol glycosides found in *Stevia rebaudiana* Bertoni plant and mixtures thereof.

In the invention, rebaudioside *A* commercialized by PureCircle Sdn. Bhd. (Malaysia), containing, rebaudioside *A* (about 95-100%), stevioside (about 0-1%), rebaudioside *C* (about 0-1%), rebaudioside *F* (about 0-1%), rebaudioside *B* (about 0.1-0.8%), rebaudioside *D* (about 0-1%), and other glycosides amounting to total steviol glycosides' content of at least 95%, may be used as a starting material. Alternatively stevia extracts with different ratios of steviol glycosides may be used as starting materials.

The starting material is subjected to partial conversion into reb *B* using a biocatalyst capable of hydrolyzing β -glucosyl ester bonds. The obtained glycoside mixtures can be used "as-is" as well as by recovering reb *B* from the mixture and using it as a pure ingredient.

The low solubility reb *B* may be subjected to additional thermal treatment to increase solubility.

The obtained products were applied in various foods and beverages as sweeteners, sweetener enhancers and flavor modifiers, including soft drinks, ice cream, cookies, bread, fruit juices, milk products, baked goods and confectionary products.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings are included to provide a further understanding of the invention. The drawings illustrate embodiments of the invention and together with the description serve to explain the principles of the embodiments of the invention.

FIG. 1 shows the chemical structure of rebaudioside *A*.

FIG. 2 shows the chemical structure of rebaudioside *B*

FIG. 3 shows an HPLC chromatogram of a stevia composition comprising rebaudioside *A* and rebaudioside *B*.

DETAILED DESCRIPTION OF THE INVENTION

Advantages of the present invention will become more apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

Rebaudioside *A* commercialized by PureCircle Sdn. Bhd. (Malaysia), containing, rebaudioside *A* (about 95-100%), stevioside (about 0-1%), rebaudioside *C* (about 0-1%), rebaudioside *D* (about 0-1%), rebaudioside *F* (about 0-1%), rebaudioside *B* (about 0.1-0.8%) and other glycosides amounting to total steviol glycosides' content of at least about 95%, may be used as a starting material. Alternatively stevia extracts with different ratios of steviol glycosides may be used as starting materials.

The HPLC analysis of the raw materials and products can be performed on an Agilent Technologies 1200 Series (USA) liquid chromatograph, equipped with Phenomenex Prodigy ODS3, 5 μ m (4.6X250mm) column at 40°C. The mobile phase was 32:68 mixture of acetonitrile and 10 mmol/L sodium phosphate buffer (about pH 2.6) at 1 mL/min. A diode array detector set at 210 nm can be used as the detector. One example of an HPLC chromatogram thus obtained is shown in FIG. 3.

As used herein, unless specified further, "reb *B*" and "reb *B* composition" shall be used interchangeably to refer to purified rebaudioside *B* or rebaudioside *B* in combination with any other chemical entity.

Preparation of Reb B

1. Biocatalytic Conversion

In one embodiment of the invention, reb *A* is dispersed in water to form solution. The concentration of reb *A* is about 0-50% (w/v) preferably about 10-25%. An enzyme preparation selected from group of esterases, lipases, cellulases, hemicellulases, hesperidinases and β -glucosidases, or any enzyme capable of hydrolyzing β -glucosyl ester bonds, or free or immobilized cells, or any other biocatalysts capable of hydrolyzing β -glucosyl ester bonds (the enzyme preparations, enzymes, free or immobilized cells, and other biocatalysts hereinafter collectively referred to as "biocatalysts") are added to reb *A* solution to form the reaction mixture. The mixture is incubated at about 10-150°C, preferably about 30-100°C, for a period of about 0.5-48hrs, preferably about 1-24 hrs. As a result reb *A* is hydrolyzed to reb *B*. The molar yield of conversion of reb *B* is about 5-100%, preferably about 10-90%.

After the reaction, the biocatalyst is inactivated by heating or removal from the reaction mixture. The obtained mixture is neutralized by an acid, preferably by sulfuric acid or ortho-phosphoric acid, until a pH of about 3.0-5.0 is reached, preferably until a pH of about 3.0-4.0 is reached. Upon acidification, a precipitate is formed. The precipitate is separated by any method known in the art such as filtration or centrifugation and washed with water until the water reaches a pH of about 4.0-5.0. The obtained crystalline material is dried under vacuum at about 60-105°C to yield a mixture of reb *A* and reb *B* having a ratio of about 5%:95% to about 95%:5% (w/w), preferably about 50%:50% to about 90%:10% (w/w).

2. Optional Post-Conversion Purification

To obtain purified reb *B*, in one embodiment the separated precipitate described above is suspended in water and the mixture is subjected to continuous agitation over about 0.5-24 hrs, preferably about 1-3 hours, at about 50-100°C, preferably about 60-80°C. The ratio of precipitate to water (w/v) is about 1:5 to about 1:20, preferably about 1:10 to about 1:15. The washed crystals are separated and dried under vacuum at about 60-105°C to yield reb *B* with about 99% purity.

3. Optional Post-Conversion Solubility Enhancement

The following procedure can be used to increase the water solubility of reb *B* or any reb *B* composition. The obtained compositions generally have a water solubility of less than about 0.2% (w/v). In order to increase the solubility of these compositions, the compositions were combined with the water at ratio of about 1:1 (w/w) and the obtained mixture was further subjected to a gradient heat treatment which resulted in a high stability and high concentration solution. The gradient of about 1°C per minute was used in heating the mixture. The mixture was heated to the temperature of about 110-140°C, preferably about 118-125°C and was held at maximum temperature for about 0-120 min, preferably about 50-70 min. After the heat treatment, the solution was cooled down to room temperature at gradient of about 1°C per minute. The solution was spray dried by a laboratory spray drier operating at about 175°C inlet and about 100°C outlet temperatures. An amorphous form of the composition was obtained with greater than about 20% solubility in water at room temperature.

Use of Reb *B* Compositions

The reb *B* compositions described above can be used as a sweetness enhancer, a flavor enhancer and/or a sweetener in various food and beverage products. Non-limiting examples of food and beverage products include carbonated soft drinks, ready to drink beverages, energy drinks, isotonic drinks, low-calorie drinks, zero-calorie drinks, sports drinks, teas, fruit and vegetable juices, juice drinks, dairy drinks, yoghurt drinks, alcohol beverages, powdered beverages, bakery products, cookies, biscuits, baking mixes, cereals, confectioneries, candies, toffees, chewing gum, dairy products, flavored milk, yoghurts, flavored yoghurts, cultured milk, soy sauce and other soy base products, salad dressings, mayonnaise, vinegar, frozen-desserts, meat products, fish-meat products, bottled and canned foods, tabletop sweeteners, fruits and vegetables.

Additionally the compositions can be used in drug or pharmaceutical preparations and cosmetics, including but not limited to toothpaste, mouthwash, cough syrup, chewable tablets, lozenges, vitamin preparations, and the like.

The compositions can be used “as-is” or in combination with other sweeteners, flavors and food ingredients.

Non-limiting examples of sweeteners include steviol glycosides, stevioside, rebaudioside *A*, rebaudioside *B*, rebaudioside *C*, rebaudioside *D*, rebaudioside *E*, rebaudioside *F*, dulcoside *A*, steviolbioside, rubusoside, as well as other steviol glycosides found in *Stevia rebaudiana* Bertoni plant and mixtures thereof, stevia extract, Luo Han Guo extract, mogrosides, high-fructose corn syrup, corn syrup, invert sugar, fructooligosaccharides, inulin, inulooligosaccharides, coupling sugar, maltooligosaccharides, maltodextrins, corn syrup solids, glucose, maltose, sucrose, lactose, aspartame, saccharin, sucralose, sugar alcohols.

Non-limiting examples of flavors include lemon, orange, fruit, banana, grape, pear, pineapple, bitter almond, cola, cinnamon, sugar, cotton candy, vanilla flavors.

Non-limiting examples of other food ingredients include flavors, acidulants, organic and amino acids, coloring agents, bulking agents, modified starches, gums, texturizers, preservatives, antioxidants, emulsifiers, stabilisers, thickeners, gelling agents.

The following examples illustrate various embodiments of the invention. It will be understood that the invention is not limited to the materials, proportions, conditions and procedures set forth in the examples, which are only illustrative.

EXAMPLE 1 Preparation of stevia composition

1g of rebaudioside *A* produced by PureCircle Sdn. Bhd. (Malaysia), containing, 98.1% rebaudioside *A*, 0.3% stevioside, 0.2 rebaudioside *C*, 0.2% rebaudioside *F*, 0.4% rebaudioside *B* and 0.6% rebaudioside *D* was dissolved in 10mL 0.1M phosphate buffer (pH 7.0) and about 1mg of hesperidinase purchased from Sigma-Aldrich (USA) was added. The mixture was incubated at 37°C for 24 hours. Then the mixture was boiled at 100°C for 15 min and filtered through the layer of activated carbon. The filtrate temperature was adjusted to 20°C and the pH was adjusted to pH 4.0 with ortho-phosphoric acid. The solution was held under moderate agitation conditions for 4 hours and a precipitate was formed. The precipitate was filtered and washed on the filter with 2000mL of water. The washed crystals were dried under vacuum to yield 0.9g material containing about 84% reb *A* and 16% reb *B*. The water solubility (at 25°C) of obtained material was about 0.2% (w/v).

EXAMPLE 2 Preparation of stevia composition

1g of rebaudioside *A* produced by PureCircle Sdn. Bhd. (Malaysia), containing, 98.1% rebaudioside *A*, 0.3% stevioside, 0.2 rebaudioside *C*, 0.2% rebaudioside *F*, 0.4% rebaudioside *B* and 0.6% rebaudioside *D* was dissolved in 10mL 0.1M phosphate buffer (pH 7.0) and about 1mg of hesperidinase purchased from Sigma-Aldrich (USA) was added. The mixture was incubated at 37°C for 36 hours. Then the mixture was boiled at 100°C for 15 min and filtered through the layer of activated carbon. The filtrate temperature was adjusted to 20°C and the pH was adjusted to pH 4.0 with ortho-phosphoric acid. The solution was held under moderate agitation conditions for 4 hours and a precipitate was formed. The precipitate was filtered and washed on the filter with 2000mL of water. The washed crystals were dried under vacuum to yield about 0.75g material containing about 9% reb *A* and about 91% reb *B*. The water solubility (at 25°C) of obtained material was about 0.1% (w/v).

EXAMPLE 3 Preparation of stevia composition

1g of rebaudioside *A* produced by PureCircle Sdn. Bhd. (Malaysia), containing, 98.1% rebaudioside *A*, 0.3% stevioside, 0.2 rebaudioside *C*, 0.2% rebaudioside *F*, 0.4% rebaudioside *B* and 0.6% rebaudioside *D* was dissolved in 10mL 0.1M phosphate buffer (pH 7.0) and about 1mg of hesperidinase purchased from Sigma-Aldrich (USA) was added. The mixture was incubated at 37°C for 48 hours. Then the mixture was boiled at 100°C for 15 min and filtered through the layer of activated carbon. The filtrate temperature was adjusted to 20°C and the pH was adjusted to pH 4.0 with ortho-phosphoric acid. The solution was held under moderate agitation conditions for 4 hours and a precipitate was formed. The precipitate was filtered and washed on the filter with 2000mL of water. The washed crystals were dried under vacuum to yield about 0.7g material containing about 99.1% reb *B*. The water solubility (at 25°C) of obtained material was about 0.1% (w/v).

EXAMPLE 4 Preparation of stevia composition

75g of material prepared according to EXAMPLE 2 was suspended in 1000mL water. The mixture temperature was increased to 70°C. The suspension was held under moderate agitation conditions for 4 hours. The crystals were filtered and dried under vacuum to yield about 65g material containing about 99.0% reb *B*. The water solubility (at 25°C) of obtained material was about 0.1% (w/v).

EXAMPLE 5 Preparation of soluble stevia composition

50 g material prepared according to EXAMPLE 1 was mixed with 50g of water and incubated in thermostatted oil bath. The temperature was increased at 1°C per minute to 121°C. The mixture was maintained at 121°C for 1 hour and then the temperature was decreased to room temperature (25°C) at 1°C per minute. The solution was dried using YC-015 laboratory spray drier (Shanghai Pilotech Instrument & Equipment Co. Ltd., China) operating at 175°C inlet and 100°C outlet temperature. About 47g of an amorphous powder was obtained with about 25% (w/v) solubility in water (at 25°C).

EXAMPLE 6 Preparation of soluble stevia composition

42 g of reb *A* produced by PureCircle Sdn. Bhd. (Malaysia) with purity of 99.2% (dry basis) and 8 g of reb *B* prepared according to EXAMPLE 4 were mixed with 50g of water and incubated in thermostatted oil bath. The temperature was increased at 1°C per minute to 121°C. The mixture was maintained at 121°C for 1 hour and then the temperature was decreased to room temperature (25°C) at 1°C per minute. The solution was dried using YC-015 laboratory spray drier (Shanghai Pilotech Instrument & Equipment Co. Ltd., China) operating at 175°C inlet and 100°C outlet temperature. About 48g of an amorphous powder was obtained with about 1.5% (w/v) solubility in water (at 25°C).

EXAMPLE 7 Low-calorie orange juice drink

Orange concentrate (35%), citric acid (0.35%), ascorbic acid (0.05%), orange red color (0.01%), orange flavor (0.20%), and 0.05% stevia composition, were blended and dissolved completely in water (up to 100%) and pasteurized. The stevia composition was selected from a commercial stevia extract (containing stevioside 26%, rebaudioside *A* 55%, and 16% of other glycosides), a commercial rebaudioside *A* (containing 98.2% reb *A*) or material obtained according to EXAMPLE 5.

The sensory evaluations of the samples are summarized in Table 1. The data shows that the best results can be obtained by using the composition obtained according to EXAMPLE 5. Particularly the drinks prepared with said composition exhibited a rounded and complete flavor profile and mouthfeel.

Table 1
Evaluation of orange juice drink samples

Sample	Comments		
	Flavor	Aftertaste	Mouthfeel
Stevia Extract	Sweet, licorice notes	Bitterness and aftertaste	Not acceptable
Reb <i>A</i>	Sweet, slight licorice notes	Slight bitterness and aftertaste	Not acceptable

EXAMPLE 5	High quality sweetness, pleasant taste similar to sucrose, rounded and balanced flavor	Clean, no bitterness and no aftertaste	Full
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The same method can be used to prepare juices and juice drinks from other fruits, such as apples, lemons, apricots, cherries, pineapples, mangoes, etc.

EXAMPLE 8 Zero-calorie carbonated beverage

Carbonated beverages according to the formulas presented in Table 2 were prepared.

Table 2

Carbonated Beverage Formulas

Ingredients	Quantity, %		
	Stevia Extract	Reb A	EXAMPLE 5
Cola flavor	0.340	0.340	0.340
ortho-Phosphoric acid	0.100	0.100	0.100
Sodium citrate	0.310	0.310	0.310
Sodium benzoate	0.018	0.018	0.018
Citric acid	0.018	0.018	0.018
Stevia composition	0.050	0.050	0.050
Carbonated water	to 100	to 100	to 100

The sensory properties were evaluated by 20 panelists. The results are summarized in Table 3.

Table 3

Evaluation of zero-calorie carbonated beverage samples

Taste attribute	Number of panelists detected the attribute		
	Stevia Extract	Reb A	EXAMPLE 5
Bitter taste	15	10	0
Astringent taste	16	9	0
Aftertaste	14	12	0
Comments			
Quality of sweet taste	Bitter aftertaste (15 of 20)	Bitter aftertaste (10 of 20)	Clean (20 of 20)
Overall evaluation	Satisfactory (1 of 20)	Satisfactory (5 of 20)	Satisfactory (20 of 20)

The above results show that the beverages prepared using the composition obtained according to EXAMPLE 5 possessed the best organoleptic characteristics.

EXAMPLE 9 Diet cookies

Flour (50.0%), margarine (30.0%) fructose (10.0%), maltitol (8.0%), whole milk (1.0%), salt (0.2%), baking powder (0.15%), vanillin (0.1%) and different stevia compositions (0.03%) were kneaded well in dough-mixing machine. The obtained dough was molded and baked in oven at 200°C for 15 minutes. The stevia compositions were selected from a commercial stevia extract (containing stevioside 26%, rebaudioside A 55%, and 16% of other glycosides), a commercial rebaudioside A (containing 98.2% reb A) and material obtained according to EXAMPLE 5.

The sensory properties were evaluated by 20 panelists. The best results were obtained in samples containing the composition obtained according to EXAMPLE 5. The panelists noted a rounded and complete flavor profile and mouthfeel.

EXAMPLE 10 Yoghurt

Different stevia compositions (0.03%) and sucrose (4%) were dissolved in low fat milk. The stevia compositions were selected from a commercial stevia extract (containing stevioside 26%, rebaudioside A 55%, and 16% of other glycosides), a commercial rebaudioside A (containing 98.2% reb A) and the material obtained according to EXAMPLE 5. After pasteurizing at 82°C for 20 minutes, the milk was cooled to 37°C. A starter culture (3%) was added and the mixture was incubated at 37°C for 6 hours then at 5°C for 12 hours.

The sensory properties were evaluated by 20 panelists. The best results were obtained in samples containing the composition obtained according to EXAMPLE 5. The panelists noted a rounded and complete flavor profile and mouthfeel.

It is to be understood that the foregoing descriptions and specific embodiments shown herein are merely illustrative of the best mode of the invention and the principles thereof, and that modifications and additions may be easily made by those skilled in the art without departing for the spirit and scope of the invention, which is therefore understood to be limited only by the scope of the appended claims.

CLAIMS

What is claimed is:

1. A process for producing a stevia composition comprising rebaudioside *B*, comprising the steps of:

providing a stevia sweetener;

providing a biocatalyst capable of hydrolyzing β -glucosyl ester bonds in the stevia sweetener;

dissolving the stevia sweetener and adding the biocatalyst to make a reaction mixture;

incubating the reaction mixture for about 12 to 48 hours to at least partially hydrolyze β -glucosyl ester bonds in the stevia sweetener;

cooling the mixture to about 10-30°C and adjusting the pH with acid to about pH 3.0-4.0;

incubating the mixture at low temperature to obtain a precipitate;

separating the precipitate and washing the precipitate with water; and

drying the washed precipitate to obtain the stevia composition.

2. The process of claim 1 further comprising the steps of:

suspending the stevia composition in water and incubating at an elevated temperature for about 1-3 hours; and

separating the stevia composition from the water and drying the stevia composition to obtain a purified stevia composition comprising rebaudioside *B* having a purity of greater than about 99%.

3. The process of claim 1 further comprising the steps of:

suspending the stevia composition in water to form a suspension;

increasing the temperature of the suspension by a gradient heating method;

holding the suspension at an elevated temperature;

decreasing the temperature of the suspension by a gradient cooling method to obtain a high stability and high concentration stevia composition solution; and

spray drying the high stability and high concentration stevia composition solution to provide a highly soluble stevia composition.

4. The process of claim 1, further comprising the steps of:

dispersing the stevia composition in water to form a mixture;

adding a base into the mixture;

incubating the mixture to facilitate at least partial conversion of a carboxyl group of the rebaudioside *B* into a carboxylate salt to make a rebaudioside *B* carboxylate salt; and

separating and drying the stevia composition comprising the rebaudioside *B* carboxylate salt.

5. The process of claim 1 wherein the stevia sweetener comprises rebaudioside *A*.

6. The process of claim 1 wherein the biocatalyst is selected from the group consisting of free cells, immobilized cells, an enzyme, and an enzyme preparation.

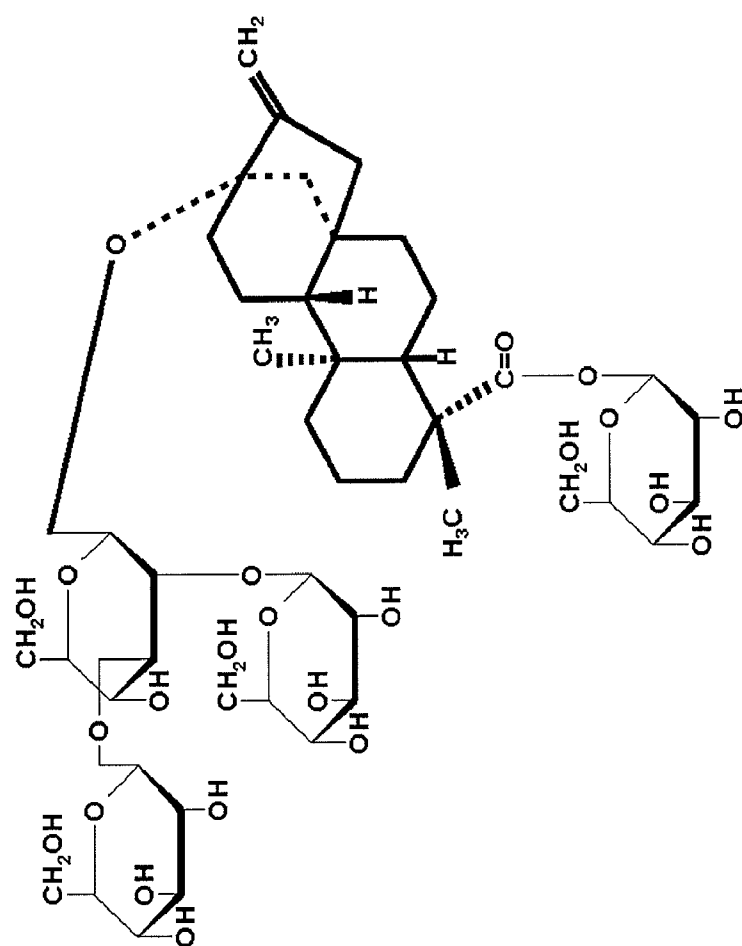
7. The process of claim 1 wherein the biocatalyst comprises an enzyme or an enzyme preparation having an enzyme selected from the group consisting of esterases, lipases, cellulases, hemicellulases, hesperidinases and β -glucosidases.

8. A stevia composition made by the process of claim 1 comprising a mixture of rebaudioside *A* and rebaudioside *B* at a ratio ranging from about 5%:95% to about 95%:5% (w/w).

9. A stevia composition made by the process of claim 1 comprising a mixture of rebaudioside *D* and rebaudioside *B* at a ratio ranging from about 5%:95% to about 95%:5% (w/w).

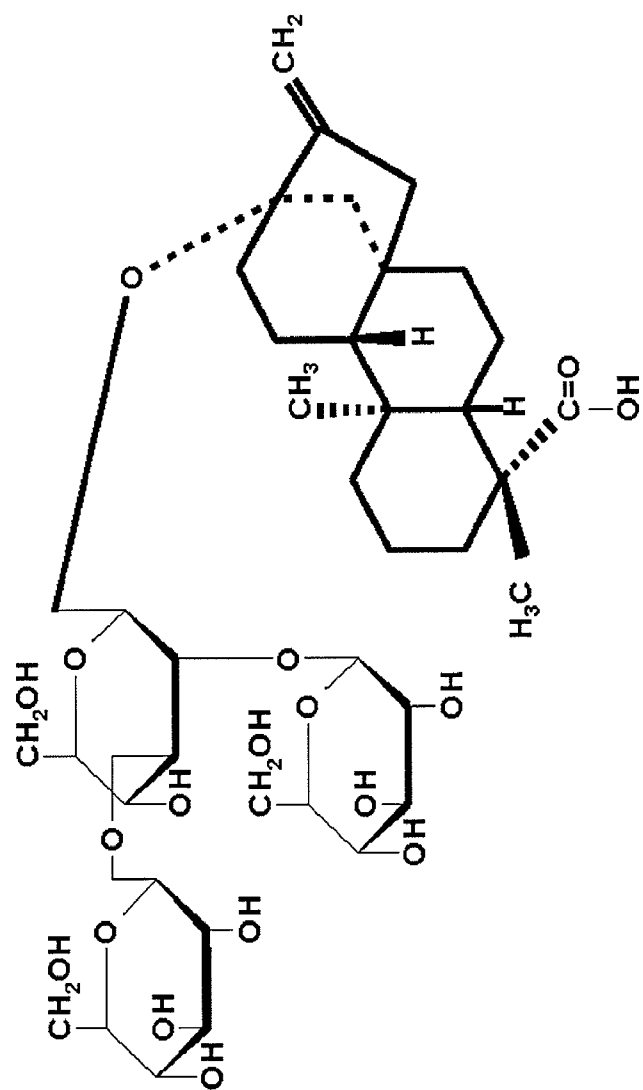
10. A stevia composition comprising rebaudioside *A* and rebaudioside *B* at a ratio ranging from about 5%:95% to about 95%:5% (w/w).
11. The composition of claim 10 further comprising an additional sweetening agent selected from the group consisting of: stevia extract, steviol glycosides, stevioside, rebaudioside *C*, rebaudioside *D*, rebaudioside *E*, rebaudioside *F*, dulcoside *A*, steviolbioside, rubusoside, other steviol glycosides found in *Stevia rebaudiana* Bertoni plant and mixtures thereof, Luo Han Guo extract, mogrosides, high-fructose corn syrup, corn syrup, invert sugar, fructooligosaccharides, inulin, inulooligosaccharides, coupling sugar, maltooligosaccharides, maltodextrins, corn syrup solids, glucose, maltose, sucrose, lactose, aspartame, saccharin, sucralose, sugar alcohols, and a combination thereof.
12. The composition of claim 10 further comprising a flavoring agent selected from the group consisting of: lemon, orange, fruit, banana, grape, pear, pineapple, mango, bitter almond, cola, cinnamon, sugar, cotton candy, vanilla, and a combination thereof.
13. The composition of claim 10 further comprising a food ingredient selected from the group consisting of: acidulants, organic and amino acids, coloring agents, bulking agents, modified starches, gums, texturizers, preservatives, antioxidants, emulsifiers, stabilisers, thickeners, gelling agents, and a combination thereof.
14. A food, beverage, pharmaceutical or cosmetic composition comprising the stevia composition of claim 10.

FIG. 1



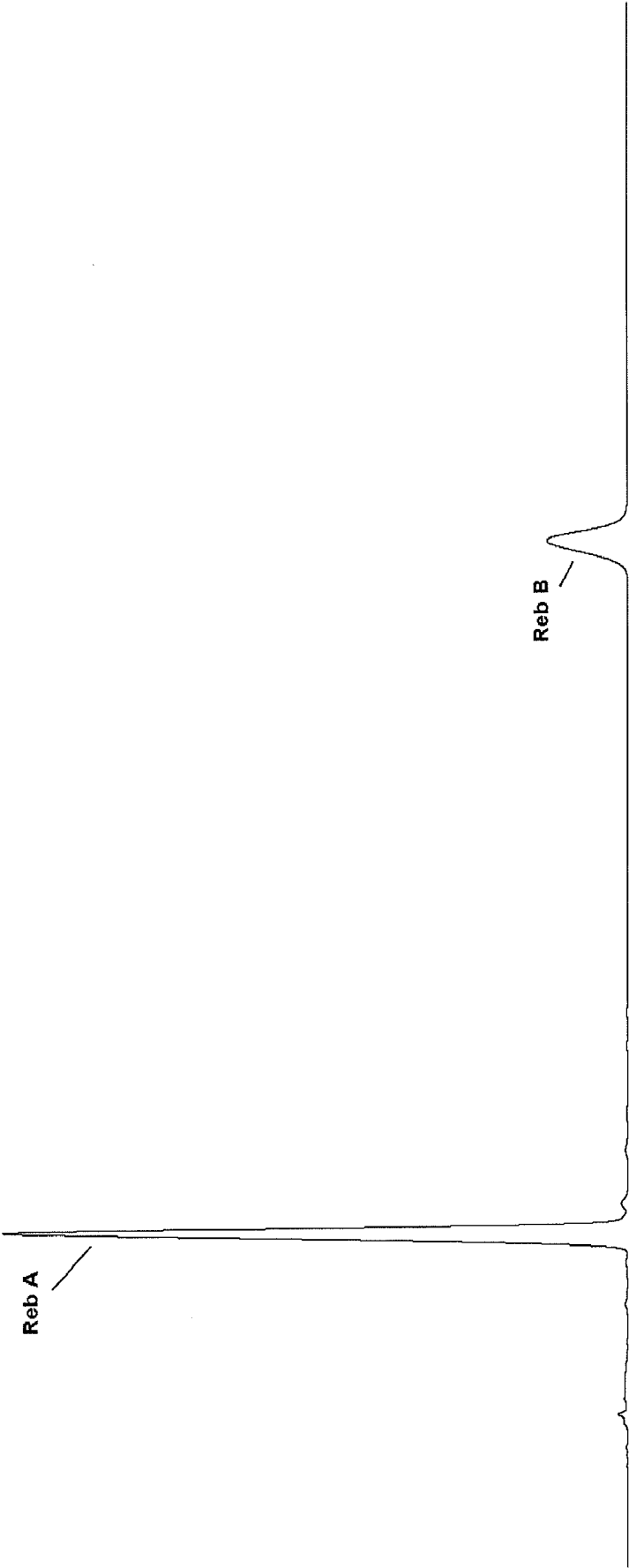
Rebaudioside A

FIG. 2



Rebaudioside B

FIG. 3



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 11/47499

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A23G 3/00 (2011.01)

USPC - 426/658

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8)- A23G 3/00 (2011.01);

USPC- 426/658

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

USPC- 426/536, 548; 424/737, 756, 43, 464; 514/777;

Patents and NPL (classification, keyword; search terms below)

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

PubWest (US Pat, PgPub, EPO, JPO), GoogleScholar (PL, NPL), FreePatentsOnline (US Pat, PgPub, EPO, JPO, WIPO, NPL);
search terms: stevia, stevioside, rebaudioside, reb, B, solution, dispersion, aqueous, incubate, precipitate, dry, wash, acid, purity,
carboxylate, salt, glycosyl, beta, hydrolysis, hydrolyze, enzyme, biocatalyst

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2010/0278993 A1 (PRAKASH et al.) 04 November 2010 (04.11.2010), para [0030], [0033], [0034], [0037], [0073], [0075], [0079]-[0083]	1-14
Y	US 4,590,160 A (NISHIHASHI et al.) 20 May 1986 (20.05.1986), col 2, ln 25-38; col 3, ln 27-31; col 17, ln 56 to col 18, ln 19; col 22, ln 51 to col 23, ln 19	1-14
Y	US 4,454,290 A (DUBOIS) 12 June 1984 (12.06.1984), col 2, ln 39-62; col 4, ln 16-23	4, 8-10
Y	US 4,599,403 A (KUMAR) 08 July 1986 (08.07.1986), col 2, ln 64 to col 3, ln 28; col 5, ln 18-50	4, 8-10
Y	US 2011/0092684 A1 (ABELYAN et al.) 21 April 2011 (21.04.2011), para [0108], [0123]; Table 6	8-10
Y	US 2009/0074935 A1 (LEE) 19 March 2009 (19.03.2009), para [0005]-[0062]	1-14
Y	US 6,204,377 B1 (NISHIMOTO et al.) 20 March 2001 (20.03.2001), col 2-30	1-14
Y	US 4,219,571 A (MIYAKE) 26 August 1980 (26.08.1980), col 2-16	1-14

☐ Further documents are listed in the continuation of Box C.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

13 December 2011 (13.12.2011)

Date of mailing of the international search report

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