CLAIMS:

1. A modified single chain Monellin (MNEI) protein, comprising an amino acid sequence that has two or more amino acids deletions, insertions, replacements, or any combination thereof, from a reference MNEI protein, wherein the modified MNEI protein has at least one improved food-related property compared to the reference MNEI protein, and wherein the reference MNEI protein comprises the amino acid sequence set forth in SEQ ID NO:45.

2. The modified MNEI protein, according to claim 1, wherein the at least two or more amino acid ~~deletions,~~ replacements~~, or any combination thereof,~~ are located on the surface of the reference MNEI protein or in the core of the reference MNEI protein.

3. The modified MNEI protein, according to claim 1, wherein the at least two or more amino acid deletions~~, insertions, replacements, or any combination thereof,~~ are located within ~~the modified MNEI protein loop and beta strand edges spanning~~ residues 46-56.

~~**4.** A modified MNEI protein comprising an amino acid sequence having between 40% to 98% identity with a reference MNEI protein, wherein the modified MNEI protein has at least one improved food-related property compared to the reference MNEI protein.~~

~~**5.** The modified MNEI protein, according to any one of claims 1 to 4, having an energy that is lower than -182 given in Rosetta Energy Unit (REU).~~

~~6.~~4. The modified MNEI protein, according to ~~any one of~~ claim~~s~~ 1~~ to 5~~, wherein the at least one food-related property is at least one of sweetness potency, sweetness kinetics, masking effect, enhancing taste and off-taste, optionally having at least 1.5-fold increased sweetness potency compared with the reference MNEI protein.

~~**7.** The modified MNEI protein, according to any one of claims 1 to 6, having at least 1.5-fold increased sweetness potency compared with the reference MNEI protein.~~

~~8.~~5. The modified MNEI protein, according to ~~any one of~~ claim~~s~~ 1~~ to 7~~, characterized by at least one of the following compared with the reference MNEI protein: (1) increased thermal stability, (2) increased pH stability, (3) increased solubility, (4) decreased binding to hydrophobic regions, (5) high pressure stability, and (6) increased shelf-life stability.

~~9.~~6. The modified MNEI protein, according to ~~any one of~~ claim~~s~~ 1 ~~to 8~~, wherein the modified MNEI protein comprises an amino acid sequence selected from the group consisting of SEQ ID NO:1, SEQ ID NO:2, SEQ ID NO:3, SEQ ID NO:4, SEQ ID NO:5, SEQ ID NO:6, SEQ ID NO:7, SEQ ID NO:8, SEQ ID NO:9, SEQ ID NO:10, SEQ ID NO:11, SEQ ID NO:12, SEQ ID NO:13, SEQ ID NO:14, SEQ ID NO:15, SEQ ID NO:16, SEQ ID NO:17, SEQ ID NO:18, SEQ ID NO:19, SEQ ID NO:20 and SEQ ID NO:21, or of a fragment or variant thereof.

~~10. The modified MNEI protein, according to any one of claims 1 to 9, wherein the reference MNEI protein comprises the amino acid sequence set forth in SEQ ID NO:45.~~

~~11.~~7. The modified MNEI protein, according to ~~any one of~~ claim~~s~~ 1 ~~to 10~~, ~~or any combination of two or more modified MNEI proteins according to any one of claims 1 to 10,~~ for use (i) in the preparation of a product for oral delivery, optionally wherein the product is a food product, a food supplementary product, or a medicament, (ii) for use as a flavor modifying agent. a flavor enhancing agent or a flavor masking agent or (iii) for use as a sweetener.

~~12. The modified MNEI protein, or combination of MNEI proteins according to claim 11, wherein the product is a food product, a food supplementary product, or a medicament.~~

~~13. The modified MNEI protein according to any one of claims 1 to 10, or any combination of two or more modified MNEI proteins according to any one of claims 1 to 10, for use as a flavor modifying agent. a flavor enhancing agent or a flavor masking agent.~~

~~14. The modified MNEI protein, according to any one of claims 1 to 10, or any combination of two or more modified MNEI proteins according to any one of claims 1 to 10, for use as a sweetener.~~

~~15.~~8. A food product comprising the modified MNEI protein according to ~~any one of~~ claim~~s~~ 1 ~~to 10, or any combination of two or more modified MNEI proteins according to any one of claims 1 to 10~~.

~~16.~~9. The food product, according to claim ~~15~~8, comprising at least one food ingredient, optionally wherein the food ingredient is (i) at least one of artificial flavor, food additive, food coloring, preservative, or a sweetness enhancer, (ii) at least one of artificial flavor, food additive, food coloring, preservative, or a sweetness enhancer or (iii) selected from the group consisting of stevia, sucrose, agave nectar, brown rice syrup, date sugar, honey, maple syrup, molasses, monk fruit, sugar alcohols, rare sugars, aspartame, sucralose, acesulfame potassium, saccharin, neotame, advantame, and dietary fibers.

~~17. The food product, according to claim 16, wherein the food ingredient is at least one of artificial flavor, food additive, food coloring, preservative, or a sweetness enhancer.~~

~~18. The food product, according to claim 17, wherein the food ingredient is selected from the group consisting of stevia, sucrose, agave nectar, brown rice syrup, date sugar, honey, maple syrup, molasses, monk fruit, sugar alcohols, rare sugars, aspartame, sucralose, acesulfame potassium, saccharin, neotame, advantame, and dietary fibers.~~

~~19.~~10. A sweetening composition comprising the modified MNEI protein according to ~~any one of~~ claims ~~1~~ 1 ~~to 10, or any combination of two or more modified MNEI proteins, according to any one of claims 1 to 10~~.

~~20.~~11. An ingestible composition comprising the sweetening composition, according to claim ~~19~~10, optionally wherein the ingestible composition has low glycemic effects and is in the form of liquid or solid foodstuffs.

~~21. The ingestible composition, according to claim 20, wherein the ingestible composition has low glycemic effects and is in the form of liquid or solid foodstuffs.~~

~~22.~~12. A food or beverage formulation comprising one or more modified single chain Monellin (MNEI) proteins according to claim 1, wherein said one or more modified MNEI proteins is in a range of between about 0.2 mg and about 30 mg per 100 gr or 100 ml, optionally wherein the formulation has a pH in the range of between about 2 and about 8.5.

~~23. The food or beverage formulation according to claim 22, wherein the formulation has a pH in the range of between about 2 and about 8.5.~~

~~24. The food or beverage formulation according to claim 22, wherein said modified MNEI protein comprises an amino acid sequence having 40% to 99% identity with a reference MNEI protein comprising the sequence set forth in SEQ ID NO:45.~~

~~25. The food or beverage formulation, according to claim 22, wherein the modified MNEI protein comprises an amino acid sequence selected from the group consisting of SEQ ID NOs:1-27, or a fragment or variant thereof.~~

~~26.~~13. A food or beverage composition formulated for consumption by a human subject, said composition comprising the formulation of ~~any one of~~ claim~~s~~ ~~22~~ 12~~to 25~~.

~~27.~~14. The beverage composition of claim ~~26~~13, wherein (i) the beverage is selected from the group consisting of a carbonated soft drink, a non-carbonated soft drink, a fountain beverage, a frozen ready-to-drink beverage, a coffee beverage, a tea beverage, a dairy beverage, a fruit beverage, a flavored water, an enhanced water, a sports drink, an energy drink, an isotonic drink, low-calorie drink, and an alcoholic beverage, (ii) the foods are selected from the group consisting of bakery products, cookies, biscuits, baking mixes, cereals, confectioneries, candies, toffees, chewing gum, bubble gum, dairy products, yogurts, flavored yogurts, peanut butter, soy sauce and other soy base products, nondairy products, salad dressings, ketchup, mayonnaise, vinegar, frozen-desserts, meat products, fish-meat products, bottled and canned foods, tabletop sweeteners, chocolate, fruits, dry fruits, and vegetables, or (iii) aid composition has at least one improved food or beverage-related property compared with food or beverage composition with the reference MNEI protein, optionally wherein the at least one improved food or beverage-related property is selected from the group consisting of better sweetness profile, shortened sweet taste lingering, better sweetness potency, better sweetness kinetics, increased thermal stability, high pressure stability, increased pH stability, decreased binding to hydrophobic regions, improved freeze-thaw stability, improved reconstitutability after drying, increased solubility, a sensory profile that is closer to that of sugar and increased shelf-life stability, optionally comprising at least one additional food ingredient, optionally the food ingredient is selected from the group consisting of (i) a flavor, food additive, food coloring, preservative, and sweetness enhancer or (ii) stevia, sucrose, agave nectar, brown rice syrup, date sugar, honey, maple syrup, molasses,

steviol glycosides, monk fruit, sugar alcohols, rare sugars, aspartame, sucralose, acesulfame potassium, saccharin, neotame, advantame, and dietary fibers.

~~**28.** The food composition of claim 26, wherein the foods are selected from the group consisting of bakery products, cookies, biscuits, baking mixes, cereals, confectioneries, candies, toffees, chewing gum, bubble gum, dairy products, yogurts, flavored yogurts, peanut butter, soy sauce and other soy base products, nondairy products, salad dressings, ketchup, mayonnaise, vinegar, frozen desserts, meat products, fish meat products, bottled and canned foods, tabletop sweeteners, chocolate, fruits, dry fruits, and vegetables.~~

~~**29.** The food or beverage composition according to claims 26, wherein said composition has at least one improved food or beverage related property compared with food or beverage composition with the reference MNEI protein.~~

~~**30.** The food or beverage composition, according to claim 29, wherein the at least one improved food or beverage related property is selected from the group consisting of better sweetness profile, shortened sweet taste lingering, better sweetness potency, better sweetness kinetics, increased thermal stability, high pressure stability, increased pH stability, decreased binding to hydrophobic regions, improved freeze thaw stability, improved reconstitutability after drying, increased solubility, a sensory profile that is closer to that of sugar and increased shelf life stability.~~

~~**31.** The food or beverage composition, according to claim 26, comprising at least one additional food ingredient.~~

~~**32.** The food or beverage composition, according to claim 31, wherein the food ingredient is selected from the group consisting of a flavor, food additive, food coloring, preservative, and sweetness enhancer.~~

~~**33.** The food or beverage composition, according to claim 31, wherein the food ingredient is selected from the group consisting of stevia, sucrose, agave nectar, brown rice syrup, date sugar, honey, maple syrup, molasses, steviol glycosides, monk fruit, sugar alcohols, rare sugars, aspartame, sucralose, acesulfame potassium, saccharin, neotame, advantame, and dietary fibers.~~

~~34.~~**15.** The food or beverage composition, according to claim ~~26~~13, wherein the food or beverage composition has low glycemic effects.

~~35.~~**16.** The beverage composition of claim ~~27~~14, wherein (i) the carbonated soft drink is selected from the group consisting of cola, lemon-lime flavored sparkline beverage, orange-flavored sparkling beverage, grapefruit-flavored sparkling beverage, grape-flavored sparkling beverage, raspberry-flavored sparkling beverage, strawberry-flavored sparkling beverage, pineapple-flavored sparkling beverage, ginger-ale, root beer, and malt beverage, (ii) the non-carbonated soft drink is selected from the group consisting of fruit juice, fruit-flavored juice, juice drink, nectar, vegetable juice, vegetable-flavored juice, sports drink, energy drink, protein drink, enhanced water with vitamins, near water drink, coconut water, tea, coffee, cocoa drink, a beverage containing milk components, a beverage containing cereals extract, and smoothie.

~~36. The beverage composition of claim 27, wherein the non-carbonated soft drink is selected from the group consisting of fruit juice, fruit-flavored juice, juice drink, nectar, vegetable juice, vegetable-flavored juice, sports drink, energy drink, protein drink, enhanced water with vitamins, near water drink, coconut water, tea, coffee, cocoa drink, a beverage containing milk components, a beverage containing cereals extract, and smoothies.~~

~~37.~~**17.** A (i) reduced sugar or no-sugar added soft drink beverage, (ii) reduced sugar or no-sugar added dairy product, (iii) reduced sugar or no-sugar added sauce product, (iv) reduced sugar or no-sugar added dried fruits, (v) reduced sugar or no-sugar added gum product, (vi) reduced sugar or no-sugar added spread product, or (vii) reduced sugar or no-sugar added syrup product, comprising the formulation of claim ~~22~~12.

~~38. A reduced sugar or no-sugar added dairy product comprising the formulation of claim 22.~~

~~39. A reduced sugar or no-sugar added sauce product comprising the formulation of claim 22.~~

~~40. A reduced sugar or no-sugar added dried fruits product comprising the formulation of claim 22.~~

~~41. A reduced sugar or no-sugar added gum product comprising the formulation of claim 22.~~

~~42. A reduced sugar or no-sugar added spread product comprising the formulation of claim 22.~~

~~43. A reduced sugar or no-sugar added syrup product comprising the formulation of claim 22.~~

~~44.~~18. The modified single chain Monellin (MNEI) protein of claim 1, wherein said amino acid deletions, substitutions, replacement, grafting, or any combinations thereof, is capable of stabilizing a loop region of the modified protein by at least one of (i) adding at least one hydrogen bond, (ii) extending the beta strands holding the loop region (iii) decreasing the relative Debye-Waller factors at the loop region, or (iv) any combination thereof.

~~45.~~19. The modified single chain Monellin (MNEI) protein of claim 4418, wherein said stabilizing is capable of at least one of (i) decreases aggregation, (ii) increases melting temperature (iii) increases shelf-life stability, or (iv) any combination thereof.