and specific oral diseases, and additional improvements, as well as methods of administration or uses thereof.

Summary

In one aspect of the disclosure~~invention~~ there is provided a composition for use in oral hygiene, comprising an oral hygiene effective amount of a probiotic, the probiotic comprising a *Lactobacillus helveticus* strain.

In one~~a second~~ embodiment~~aspect~~ of the present ~~–~~disclosure~~invention~~, there is provided a composition for use in oral hygiene, comprising an oral hygiene effective amount of a probiotic, the probiotic comprising a *Lactobacillus helveticus* strain and a *Lactobacillus plantarum* strain.

In another~~third~~ embodiment~~aspect~~ of the present disclosure~~invention~~, there is provided a composition for use in oral hygiene, comprising an oral hygiene effective amount of a probiotic, the probiotic comprising a *Lactobacillus helveticus* strain and *Bifidobacterium longum* SD5846.

In another~~fourth~~ aspect of the present disclosure~~invention~~, there is provided a composition for use in preventing dental caries, comprising a dental caries preventing effective amount of a probiotic, the probiotic comprising *Lactobacillus plantarum* SD5870.

In another~~fifth~~ aspect of the present disclosure~~invention~~, there is provided a composition for use in preventing dental caries, comprising a dental caries preventing effective amount of a probiotic, the probiotic comprising *Bifidobacterium longum* SD5846.

In another~~sixth~~ embodiment~~aspect~~ of the present disclosure~~invention~~, there are provided uses of the aforementioned probiotics for oral hygiene.

In another aspect of the present disclosure, there is provided use of a *Lactobacillus helveticus* strain for oral hygiene in a subject.

In another aspect of the present disclosure, there is provided use of a composition as defined above for oral hygiene in a subject

In another~~seventh~~ embodiment~~aspect~~ of the present disclosure~~invention~~, there are provided uses of the aforementioned probiotics for the preparation of a medicament for oral hygiene.

In another aspect of the present disclosure, there is provided use of a composition as defined above for preparation of a medicament for oral hygiene in a subject.

In another ~~eighth~~ embodiment~~aspect~~ of the present disclosure~~invention~~, there is provided a method of treating or preventing an oral condition or disease in a subject, comprising orally administering an aforementioned probiotic to the subject.

In another ~~ninth~~ embodiment~~aspect~~ of the present disclosure~~invention~~, there is provided a commercial package comprising an aforementioned probiotic and instructions for its use in oral hygiene.

In another aspect of the present disclosure, there is provided a commercial package comprising a *Lactobacillus helveticus* strain and instructions for its use in oral hygiene in a subject.

In another aspect of the present disclosure, there is provided a commercial package comprising a composition as defined above and instructions for its use in oral hygiene in a subject.

The probiotic comprises or consists essentially of a *Lactobacillus helveticus* strain. The probiotic may comprise or consist essentially of a *Lactobacillus helveticus* strain and one or more other probiotic bacteria, preferably from the lactobacilli, bifidobacteria and/or streptococci genii, more preferably one or more other lactobacilli, yet more preferably one other lactobacillus. The probiotic may comprise or consist essentially of both a *Lactobacillus helveticus* strain and a *Lactobacillus plantarum* strain, especially *Lactobacillus plantarum* SD5870 (known commercially as *Lactobacillus plantarum* Lp-2001). The phrase "consists essentially of" indicates that other probiotic bacteria are not present, or are present in inconsequential amounts. The *Lactobacillus helveticus* strain preferably comprises *Lactobacillus helveticus* LAFTI L10, *Lactobacillus helveticus* R0052 or a mixture thereof. The *Lactobacillus helveticus* strain more preferably comprises *Lactobacillus helveticus* LAFTI L10.

For treating or preventing dental caries specifically, the probiotic may alternatively comprise *Lactobacillus plantarum* SD5870 or *Bifidobacterium longum* SD5846. The probiotic preferably comprises *Lactobacillus plantarum* SD5870 in combination with one or both of *Streptococcus salivarius* M18 and *Streptococcus salivarius* K12. Preferably, the probiotic consists essentially of *Lactobacillus plantarum* SD5870, or consists essentially of *Lactobacillus plantarum* SD5870 and one or both of *Streptococcus salivarius* M18 and *Streptococcus salivarius* K12 such that other probiotic bacteria are not present, or are present in inconsequential amounts.

Oral hygiene comprises the prevention or treatment of conditions or diseases of an oral cavity. Such conditions or diseases include, for example, dental caries (cavities), halitosis, gingivitis, mouth ulcers including aphthous stomatitis (canker sores), candidiasis and periodontal diseases. In one aspect of the disclosure~~invention~~, *Streptococcus mutans* population in the oral cavity is suppressed leading to better oral health. In a particularly preferred embodiment, dental caries is prevented. Subjects for which this disclosure~~invention~~ is useful include, for example, mammals. Subjects may include primates, humans or domesticated animals. Some examples of domesticated animals are dogs, cats and horses.

The composition may comprise from about 0.0001% to about 100% by weight of the probiotic, based on total weight of the composition. Optionally, the probiotic may be from about 0.001% to about 50% by weight, or from about 0.001% to about 10% by weight, or from about 0.001% to about 5% by weight of the composition. Oral hygiene effective amounts of the probiotic in the composition depend to some extent on the age of the subject, the type of probiotic bacteria, dosing frequency, dosage form, administration

Inclusion of prebiotics in the composition enhances probiotic effectiveness in certain circumstances. A prebiotic mainly functions to feed microbial flora. The term "synbiotic" describes a composition that contains both prebiotics and probiotics. Some examples of prebiotics that may be useful in the present disclosure~~invention~~ include, for example, mono-, di- and oligo-saccharides such as manose fructans, fructooligosaccharides (FOS), xylooligosaccharides (XOS), polydextrose and galactooligosaccharides (GOS), lactulose, tagatose, inulin, maltodextrin, lactitol and mixtures thereof. In general, the amount of prebiotic used is much greater than the amount of probiotic, for example gram amounts of prebiotic may be used for milligram amounts of probiotic.

Carriers, diluents and excipients for oral compositions are generally known the art and include, for example, absorbents, acidifying agents, alkalizing agents, binders, buffers, coatings, colors, controlled-release agents, controlled-release carriers, diluents, disintegrants, effervescent agents, flavors, glidants, lubricants, plasticizers, solubility enhancers, wetting agents, surfactants, preserving agents, sweetening agents, flavouring agents, etc. Some specific examples include lactose, dextrose, fructose, sucrose, sorbitol, mannitol, starches, gum acacia, calcium phosphate, alginates, tragacant, gelatine, calcium silicate, polyvinylpyrrolidone, cellulose (e.g. microcrystalline cellulose), water syrup, water, water/ethanol, water/glycol, water/polyethylene glycol, propylene glycol, methyl cellulose, methylhydroxybenzoates, propyl hydroxybenzoates, talc, magnesium stearate, mineral oil or fatty substances such as hard fat or suitable mixtures thereof.

A particularly preferred class of excipients is sugar substitutes, which act as sweeteners with a reduced or negligible effect on blood glucose levels. Preferably, the sugar substitutes are non-cariogenic. Such sugar substitutes include, for example, sugar alcohols (e.g. isomalt), stevia, aspartame, sucralose, neotame, acesulfame potassium and saccharin. Stevia and isomalt are of particular note. Stevia is based on steviol glycosides and comprises an extract of the plant *Stevia rebaudiana*. Isomalt is an equimolar mixture of two disaccharides, each composed of two sugars glucose and mannitol (α-D-glucopyranosido-1,6-mannitol) and also glucose and sorbitol (α-D-glucopyranosido-1,6-sorbitol). Isomalt in particular improves stability of the compositions of the present disclosure~~invention~~. Certain sugar substitutes (e.g. isomalt) may also be considered to be prebiotics.

Compositions of the present disclosure~~invention~~ may be administered to the subject orally in oral or topical dosage forms. Suitable dosage forms include, for example, tablets (e.g. effervescent tablets and/or multi-layered tablets), pills, powders, lozenges (including

multi-layered lozenges), sachets, cachets, elixirs, suspensions, emulsions, solutions, syrups, aerosols, capsules, pastes (e.g. toothpaste), food and confectionary (e.g. chewing gum). Formulation of such dosage forms is well known in the art. *Compositions of the present disclosure~~invention~~ have good stability maintaining effective CFU count of the probiotic strains over a period of at least 24 months, even over a period of at least 30 months, at room temperature (20-25°C). Shelf life can be extended beyond 36 months in certain storage conditions (e.g., refrigerated conditions at 2-8°C) and/or various delivery systems such as sachets/powder sticks.*

The composition may be provided in the market place in the form of a commercial package together with instructions for use of the composition for oral hygiene. Commercial packages include, for example, bottles, jars, blister packs, boxes, etc. Instructions may be provided, for example, in visual or audio forms, for example, in writing, in pictures, on sound and/or video recording media, or combinations thereof.

Further features of the disclosure~~invention~~ will be described or will become apparent in the course of the following detailed description.

Brief Description of the Drawings

In order that the invention may be more clearly understood, embodiments thereof will now be described in detail by way of example, with reference to the accompanying drawings, in which:

Fig. 1 depicts a schematic diagram of culture plates showing bacterial swabbing zones and how zones of inhibition (ZOIs) are determined.

Fig. 2 depicts a 1.5% agarose gel of PCR amplicons of a species specific DNA segment of the *S. mutans* chromosome. Type strain *S. mutans* 25175 was used as a positive control.

Fig. 3 depicts a graph showing quantification of deferred antagonism experiments of probiotics individually and in all possible combinations of two against *S. mutans* 25175. Experiments were repeated at least 4 times using BHI agar pH balanced with 0.1% $CaCO_3$.

Fig. 4 depicts a graph showing quantification of deferred antagonism experiments of probiotics individually and in all possible combinations of two against freshly isolated *S. mutans* 13. Experiments were repeated at least 4 times using BHI agar pH balanced with 0.1% $CaCO_3$.

13. The composition according to claim 1, wherein the probiotic consists essentially of *Lactobacillus helveticus* LAFTI L10 and *Bifidobacterium longum* SD5846.

14. A composition for use in treating or preventing dental caries, comprising a dental caries preventing effective amount of a probiotic, the probiotic comprising *Lactobacillus plantarum* SD5870.

15. The composition according to claim 14, wherein the probiotic further comprises *Streptococcus salivarius*.

16. The composition according to claims 14 or 15, wherein the probiotic further comprises *Streptococcus salivarius* M18.

17. The composition according to any one of claims 14 to 16, wherein the probiotic further comprises *Streptococcus salivarius* K12.

18. The composition according to claim 14, wherein the probiotic consists essentially of *Lactobacillus plantarum* SD5870 and *Streptococcus salivarius* M18.

19. A composition for use in treating or preventing dental caries, comprising a dental caries preventing effective amount of a probiotic, the probiotic comprising *Bifidobacterium longum* SD5846.

20. The composition according to any one of claims 1 to 19, further comprising a remineralization agent.

21. The composition according to claim 20, wherein the remineralization agent comprises casein phosphate peptide-amorphous calcium phosphate.

22. The composition according to any one of claims 1 to 21, further comprising a prebiotic.

23. The composition according to any one of claims 1 to 22, further comprising a carrier, diluent, excipient or any mixture thereof.

~~24. A method of treating or preventing an oral condition or disease in a subject, comprising orally administering a composition as defined in any one of claims 1 to 23 to the subject.~~

~~25. The method according to claim 24, wherein the subject is a human, dog, cat or horse.~~

~~26. The method according to claims 24 or 25, wherein the composition is formulated as a tablet, pill, powder, lozenge, sachet, cachet, elixir, suspension, emulsion, solution, syrup, aerosol, capsule, paste, food or confectionary.~~

~~27. The method according to claims 24 or 25, wherein the composition is formulated as a toothpaste, chewing gum or effervescent tablet.~~

~~28. The method according to any one of claims 24 to 27, wherein the oral condition or disease comprises dental caries, halitosis, gingivitis, mouth ulcers, aphthous stomatitis, candidiasis and/or a periodontal disease.~~

~~29. The method according to any one of claims 24 to 28 for treating or preventing dental caries.~~

24~~30~~. Use of a *Lactobacillus helveticus* strain for oral hygiene in a subject.

25~~31~~. Use of a composition as defined in any one of claims 1 to 23 for oral hygiene in a subject.

26~~32~~. Use of a composition as defined in any one of claims 1 to 23 for preparation of a medicament for oral hygiene in a subject.

27~~33~~. The use according to any one of claims 25~~31~~ to 26~~32~~, wherein the composition is formulated as a tablet, pill, powder, lozenge, sachet, cachet, elixir, suspension, emulsion, solution, syrup, aerosol, capsule, paste, food or confectionary.

28~~34~~. The use according to any one of claims 25~~31~~ to 26~~32~~, wherein the composition is formulated as a toothpaste, chewing gum or effervescent tablet.

29~~35~~. The use according to any one of claims 24~~30~~ to 28~~34~~, wherein the subject is a human, dog, cat or horse.

30~~36~~. The use according to any one of claims 24~~30~~ to 29~~35~~, wherein oral hygiene comprises preventing or treating dental caries, halitosis, gingivitis, mouth ulcers, aphthous stomatitis, candidiasis and/or a periodontal disease.

31~~37~~. The use according to any one of claims 24~~30~~ to 30~~36~~ for treating or preventing dental caries.

3238. A commercial package comprising a *Lactobacillus helveticus* strain and instructions for its use in oral hygiene in a subject.

3339. A commercial package comprising a composition as defined in any one of claims 1 to 23 and instructions for its use in oral hygiene in a subject.

3440. The commercial package according to claim 3339, wherein the composition is formulated as a tablet, pill, powder, lozenge, sachet, cachet, elixir, suspension, emulsion, solution, syrup, aerosol, capsule, paste, food or confectionary.

3541. The commercial package according to claim 3339, wherein the composition is formulated as a toothpaste, chewing gum or effervescent tablet.

3642. The commercial package according to any one of claims 3238 to 3541, wherein the subject is a human, dog, cat or horse.

3743. The commercial package according to any one of claims 3238 to 3642, wherein oral hygiene comprises preventing or treating dental caries, halitosis, gingivitis, mouth ulcers, aphthous stomatitis, candidiasis and/or a periodontal disease.

3844. The commercial package according to any one of claims 2935 to 3440, wherein oral hygiene comprises preventing dental caries.