

COMPOSITIONS WITH REDUCED BITTER TASTE PERCEPTION

FIELD OF THE INVENTION

The present invention relates to a composition comprising a low molecular weight polyquaternium to modulate bitterness, more particularly a low level of polyquaternium-2, polyquaternium-17, and/or polyquaternium-18 to modulate bitterness.

BACKGROUND OF THE INVENTION

There are five recognized taste sensations, sweet, salty, sour, bitter, and umami. Many people dislike things that are overly bitter and perceive it is as unpleasant, sharp, or otherwise disagreeable. Bitterness is the most sensitive of the tastes and it is thought to be a defense mechanism to protect the body against ingestion of toxic substances, as a large number of natural bitter compounds are known to be toxic.

However some components that are commonly found in foods, beverages, pharmaceuticals, and oral care compositions can have a bitter taste. Sweeteners, salt (including sodium chloride), and flavors are commonly used to mute the bitterness in these compositions. Despite these efforts, many compositions still possess an unpleasant taste and/or after taste. This causes some consumers to avoid and/or dislike taking the composition.

Thus, there is a need for a composition with reduced bitterness.

SUMMARY OF THE INVENTION

A composition with reduced bitterness comprising a polyquaternium selected from the group consisting of polyquaternium-2, polyquaternium-17, polyquaternium-18, and combinations thereof.

A composition with reduced bitterness comprising: (b) a polyquaternium selected from the group consisting of polyquaternium-2, polyquaternium-17, polyquaternium-18, and combinations thereof; and (b) a bitter component selected from the group consisting of Hops, guaifenesin, phenytoin, omeprazole, cetirizine, jambu, acetaminophen, methyl formyl anthranilate, 2-aminoacetophenone, methyl anthranilate, dimethyl anthranilate, beta-terpineol, beta-naphthyl anthranilate, and benzoyl anthranilic acid, 1,10-phenanthroline, saccharin, and propylene glycol, benzamide, brucine, 1,10-phenanthroline, and combinations thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter of the present invention, it is believed that the invention can be more readily understood from the following description taken in connection with the accompanying drawings, in which:

FIG. 1A shows the molecular structure for polyquaternium-2;

FIG. 1B shows the molecular structure for polyquaternium-17;

FIG. 1C shows the molecular structure for polyquaternium-18;

FIG. 2A compares the modulation of bitterness of solutions with different water soluble polymers in an Assay for Taste Receptors;

FIG. 2B compares the modulation of bitterness of solutions with different water soluble polymers in an Assay for Taste Receptors;

FIG. 2C compares the modulation of bitterness of solutions with different water soluble polymers and actives in an Assay for Taste Receptors;

FIG. 3 compares the modulation of bitterness of different strains of hops with polyquaternium-2 in an Assay for Taste Receptors;

FIG. 4A compares the modulation of bitterness of solutions containing a composition and a concentration of polyquaternium-2 in an Assay for Taste Receptors;

FIG. 4B compares the modulation of bitterness of solutions containing a composition and a concentration of polyquaternium-2 in an Assay for Taste Receptors;

FIG. 4C compares the modulation of bitterness of solutions containing a composition and a concentration of polyquaternium-2 in an Assay for Taste Receptors;

FIG. 5A compares the modulation of bitterness of solutions containing a composition and a concentration of polyquaternium-2 in an Assay for Taste Receptors;

FIG. 5B compares the modulation of bitterness of solutions containing a composition and a concentration of polyquaternium-2 in an Assay for Taste Receptors;

FIG. 5C compares the modulation of bitterness of solutions containing a composition and a concentration of polyquaternium-2 in an Assay for Taste Receptors;

FIG. 6 compares the modulation of bitterness of full formulations containing one or more actives and excipients in an Assay for Taste Receptors;

FIG. 7 shows the Descriptive Profile Panel (DPP) bitter intensity of six different compositions containing a high fructose corn syrup (HFCS) base and different concentrations of polyquaternium-2; and

FIG. 8 shows the Descriptive Profile Panel (DPP) bitter intensity of two examples that both contain four actives and one example contains polyquaternium-2.

DETAILED DESCRIPTION OF THE INVENTION

5 Compositions, including many foods, beverages, medicines, and oral care composition, have a bitter taste associated with them. It has been surprisingly found that polyquaternium-2 can significantly modulate the bitterness in these compositions.

Several polymers, including other polyquats, were tested *in vitro* taste bud cell assays to determine whether they may serve as a bitter blocker. Polyquaternium-2 modulated the bitterness
10 of guaifenesin (GG) in the cell assays better than any other polymer, including the polyquats which have a similar chemical structure. Polyquaternium-17 and/or polyquaternium-18 are structurally analogous to polyquaternium-2 and can be used instead of or in combination with polyquaternium-2. GG, a drug used in over-the-counter medication, was selected as a compound for screening bitter blockers because it is known for being exceptionally bitter and difficult to
15 taste mask with sweeteners and flavors.

Surprisingly, it has been found that polyquaternium-2 can modulate the bitterness in many compositions. In some examples, the polyquaternium-2 can be included in the composition at less than about 0.2%.

All percentages and ratios used hereinafter are by weight of total composition, unless
20 otherwise indicated. All percentages, ratios, and levels of ingredients referred to herein are based on the actual amount of the ingredient, and do not include solvents, fillers, or other materials with which the ingredient may be combined as a commercially available product, unless otherwise indicated.

All measurements referred to herein are made at 25°C (i.e. room temperature) unless
25 otherwise specified.

The composition can contain, consist of, or consist essentially of, the essential elements and limitations of the invention described herein, as well as any additional or optional ingredients, components, or limitations described herein or otherwise useful in compositions.

As used herein, the word “include,” and its variants, are intended to be non-limiting, such
30 that recitation of items in a list is not to the exclusion of other like items that may also be useful in the materials, compositions, devices, and methods of this invention.

As used herein, the word "or" when used as a connector of two or more elements is meant to include the elements individually and in combination; for example X or Y, means X or Y or both.

By "oral care composition", as used herein, is meant a product, which in the ordinary course of usage, is not intentionally swallowed for purposes of systemic administration of particular therapeutic agents, but is rather retained in the oral cavity for a time sufficient to contact dental surfaces or oral tissues. Examples of oral care compositions can include dentifrice, mouth rinse, mousse, foam, mouth spray, lozenge, chewable tablet, chewing gum, tooth whitening strips, floss and floss coatings, breath freshening dissolvable strips, or denture care or adhesive product. The oral care composition may also be incorporated onto strips or films for direct application or attachment to oral surfaces.

The term "dentifrice", as used herein, includes tooth or subgingival -paste, gel, or liquid formulations unless otherwise specified. The dentifrice composition may be a single phase composition or may be a combination of two or more separate dentifrice compositions. The dentifrice composition may be in any desired form, such as deep striped, surface striped, multilayered, having a gel surrounding a paste, or any combination thereof. Each dentifrice composition in a dentifrice comprising two or more separate dentifrice compositions may be contained in a physically separated compartment of a dispenser and dispensed side-by-side.

As used herein, "dose" refers to a volume of medication, such as liquid medication, containing an amount of a drug active suitable for administration on a single occasion, according to sound medical practice. A dose can be orally administered. In one example, a dose can be about 30 mL, in another example about 25 mL, in another example about 20 mL, in another example about 15 mL, and in another example about 10 mL. In another example, a dose of liquid medication can be from about 10 mL to about 75 mL, in another example from about 15 mL to about 50 mL, in another example from about 25 mL to about 40 mL, and in another example from about 28 mL to about 35 mL. The concentration of active ingredients can be adjusted to provide the proper doses of actives given the liquid dose size. In one example, the dose is intended to be administered every 4 hours, in another example every 6 hours, in another example every 8 hours, and in another example every 12 hours.

As used herein, "ingestible" refers to a composition that is deliverable to a mammal in need via the oral cavity including the mouth and throat or nasal passage, and combinations thereof. In some examples, the composition can be ingestible and swallowable.

As used herein, “medication” refers to medications, such as pharmaceuticals, including prescription medications, over-the-counter medications, behind-the-counter medications and combinations thereof. In some examples, a medication can be a supplement.

As used herein, the articles “a” and “an” are understood to mean one or more of the material that is claimed or described, for example, "an active" or "a solvent".

The compositions of the present invention can contain, consist of, or consist essentially of, the essential elements and limitations of the invention described herein, as well as any additional or optional ingredients, components, or limitations described herein or otherwise useful in dosage forms intended for use or consumption by humans.

It has been found that polyquaternium-2 can be added to compositions to reduce bitterness. Polyquaternium-2 has the CAS Registry Number 68555-36-2 and the chemical name is Poly[bis(2-chloroethyl) ether-alt-1,3-bis[3-(dimethylamino)propyl]urea] and is commercially available as Mirapol® A 15 (available from Rhodia, Cranbury, New Jersey). The molecular structure for polyquaternium-2 is shown in FIG. 1A. Polyquaternium-17 (CAS Registry Number 148506-50-7) and polyquaternium-18 (CAS Registry Number 113784-58-0) are structurally analogous to polyquaternium-2 and can be used in addition to or instead of polyquaternium-2 to modulate bitter. The molecular structure for polyquaternium-17 is shown in FIG. 1B and the molecular structure for polyquaternium-18 is shown in FIG. 1C.

FIG. 2A compares the modulation of bitterness of a control solution comprising 2 mM guaifenesin (GG) with solutions comprising 2 mM GG and one of seven water soluble polymers at concentrations ranging from 0.33% to 0.01%. The results for FIG. 2 are from an *in vitro* Assay for Taste Receptors, as described hereafter. The cell cultures and assays provide an *in vitro* method to screen for bitterness that can mimic an *in vivo* response.

The water soluble polymers that were tested were as follows at concentrations ranging from 0.01% to 0.33%:

- Polyquaternium-6 commercially available as Mirapol® 100 [CAS# 26062-79-3] (available from Rhodia, Cranbury, New Jersey)
- Polyquaternium-2 commercially available as Mirapol® A 15 [CAS# 68555-36-2] (available from Rhodia, Cranbury, New Jersey)
- Polyquaternium-7 commercially available as Mirapol® 550 [26590-05-6] (available from Rhodia, Cranbury, New Jersey)
- Polyquaternium-7 commercially available as Merquat™ 2200 [CAS# 26590-05-6] (available from Lubrizol, Deer Park, Texas)

- Polyquaternium-16 commercially available as Luviquat® FC550 [CAS# 95144-24-4] (available from BASF, Florham Park, New Jersey)
- Polyquaternium D16 commercially available as Luviquat® FC 905 [CAS# 95144-24-4] (available from Crescent Company, Islandia, New York)
- 5 • Polyquaternium-44 commercially available as Luviquat® care polymer [CAS# 150599-70-5] (available from BOC Sciences, Shirley, New York)

The taste receptors were activated as described in the Assay for Taste Receptors herein. The observed activation is presented as a % of the control value. The control value is activation by a 2 mM GG solution with no added polymers. The results from this assay showed that only
10 Polyquaternium-2 completely blocked the activation of taste cell receptors by GG. This is especially surprising, since GG is one of the most bitter actives used in liquid medications. Other polymers, including polyquaternium-6 and polyquaternium D16 (Luviquat® 905) also showed some reduction, however the modulation was not dose dependent.

FIG. 2B compares the modulation of bitterness of a solution comprising 2 mM GG with
15 one of four water soluble polymers at concentrations ranging from 0.01% to 0.00003%. The four water soluble polymers were polyquaternium-6 (Mirapol® 100), polyquaternium-2 (Mirapol® A15), polyquaternium D16 (Luviquat® FC 550), and polyquaternium D16 (Luviquat® FC 905). The same Assay for Taste Receptor Method described herein and for FIG. 2 was used to generate the results for FIG. 3. The lower concentrations of polymer were selected to help further
20 differentiate the potential ability for the polymers to provide bitter blocking *in vivo*.

Again, polyquaternium-2 provided the greatest reduction in bitterness of the 2mM GG solution. At 0.01%, the bitterness was reduced to less than 20% of the bitterness of the control. Furthermore, polyquaternium-2 was the only composition that showed dose dependent blocking.

FIG. 2C compares the modulation of bitterness of a solutions containing different
25 substances that are known to be bitter with 0.17% polyquaternium-2 (Mirapol® A 15), polyquaternium-7 (Merquat™ 2200), and polyquaternium-44 (Luviquat® Care Polymer). The Assay for Taste Receptor Method described herein and was used to generate the results for FIG. 2C. The substances that were tested were 1 mM clofedanol, 1 mM diphenhydramine, 1 mM GG, 1 mM naproxen, 1 mM ibuprofen, 1 mM quinine, 0.1 mM thymol, 100 µM AITC (Allyl
30 Isothiocyanate), 100 µM APB (2-Aminoethoxydiphenyl borate), 100 µM carvacrol, and 10 µM ionomycin.

Surprisingly, the polyquaternium-2 blocked all but three of the known bitter molecules, whereas the higher molecular weight polyquats, polyquaternium-7, and polyquaternium-44, did

not show bitter blocking. Instead the polyquaternium-7, and polyquaternium-44 caused an increase in the bitter response relative to each bitter molecule, as shown by the higher fluorescence units (FUs).

Since polyquaternium-2 was effective in blocking the bitterness in the Assay for Taste Receptors, it was desirable to understand if polyquaternium-2 was effective against other bitter agents. As shown in FIG. 3, it was found that polyquaternium-2 was also effective at blocking bitterness from hops in the Assay for Taste Receptors.

FIG. 3 compares the modulation of bitterness of solutions containing a strain of hops at different concentrations ranging from 0.000047% to 0.000374%. Each strain of hops was tested with the addition of 0.01% polyquaternium-2. The following strains of hops were tested: B-BL168003, CB-RS5698A-L, CB-RS5722B, and CB-RS5698A-s. All strains of hops used in this example are commercially available from available from Hopsteiner®, Yakima, Washington. 2 mM GG was used as a control to make sure that the bitter cells were registering bitterness. The results for FIG. 3 are from an *in vitro* Assay for Taste Receptors as described hereafter.

Surprisingly, as seen in FIG. 3, 0.01% polyquaternium-2 can significantly reduce the bitterness of all four strains of hops. At many concentrations and strains, the bitterness was not detectable by the bitter cells, which could mimic an *in vivo* response.

In one example, the composition can contain from about 0.0001% to about 5% hops, in another example from about 0.001% to about 2.5%, in another example from about 0.01% to about 1%, in another example from about 0.05% to about 0.5%, and in another example from about 0.1% to about 0.2%. The composition can contain alpha hops and/or beta hops.

In one example polyquaternium-2, polyquaternium-17, and/or polyquaternium-18 can reduce the overall bitterness of a composition by at least about 5% as compared to an identical composition without the polyquaternium-2, polyquaternium-17, and/or polyquaternium-18 as determined by the *in vitro* Assay for Taste Receptors as described hereafter, in another example by at least about 10%, in another example by at least about 20%, in another example by at least about 30%, in another example by at least about 40%, in another example by at least about 50%, in another example by at least about 60%, in another example by at least about 65%, in another example by at least about 70%, in another example by at least about 75%, in another example by at least about 80%, in another example by at least about 85%, in another example by at least about 90%, in another example at least about 93%, in another example at least about 95%, in another example by at least about 97%, in another example by at least about 98%, in another example by at least about 99% and in another example by at least about 100%.

In another example, the composition can have an overall bitterness of less than about 8000 fluorescence units (FUs) as determined by the *in vitro* Assay for Taste Receptors as described hereafter, in another example less than about 7500 FUs, in another example less than about 7000 FUs, in another example less than about 6500 FUs, in another example less than about 6000 FUs, in another example less than about 5500 FUs, in another example less than about 5000 FUs, in another example less than about 4500 FUs, in another example less than about 4000 FUs, in another example less than about 3500 FUs, in another example less than about 3000 FUs, in another example less than about 2500 FUs, in another example less than about 2000 FUs, in another example less than about 1500 FUs, in another example less than about 1000 FUs, in another example less than about 750 FUs, in another example less than about 500 FUs, in another example less than about 350 FUs, in another example less than about 300 FUs, in another example less than about 250 FUs, in another example less than about 200 FUs, in another example less than about 150 FUs, in another example less than about 100 FUs, and in another example less than about 50 FUs.

However, it has been surprisingly discovered that polyquaternium-2 does not modulate the bitterness for all compounds that are known to be bitter. For instance, FIGS. 4A, 4B, and 4C compare the modulation of bitterness, if any, of solutions containing an active and a concentration of polyquaternium-2. The concentration of polyquaternium-2 ranges from 0.00041% to 0.1%. GG at a concentration of 2 mM without polyquaternium-2 is used as a control. The actives were selected because they are frequently used in medications and are known to be bitter. The results for FIGS. 4A, 4B, and 4C are from an *in vitro* Assay for Taste Receptors as described hereafter.

FIG. 4A compares the modulation of bitterness, if any, of solutions comprising 250 μ M active and a concentration of polyquaternium-2. The actives in FIG. 4A are dicyclomine, hydroxyzine, promethazine, doxepin, and 2 mM GG. FIG. 4A shows that polyquaternium-2 has at best a very weak bitter blocking activity on dicyclomine, hydroxyzine, promethazine, and doxepin. However, FIG. 4A does not show a dose dependent effect and thus polyquaternium-2 is probably not a specific blocker of these compositions.

The actives in FIG. 4B are 1 mM diltiazem, 2 mM phenytoin, and 1 mM diphenhydramine. Polyquaternium-2 blocked some of the bitterness of diltiazem, but it doesn't show a dose dependent effect and thus polyquaternium-2 is probably not a specific blocker for diltiazem. Polyquaternium-2 strongly blocked the bitterness from phenytoin and omeprazole and polyquaternium-2 had little or no effect on diphenhydramine.

The actives tested in FIG. 4C included 1 mM cetirizine, 1 mM enalapril, 0.25% jambu (*Acmella oleracea*) extract (commercially available as Jambu SE WS from Naturex™, South Hackensack, New Jersey), and 10 mM acetaminophen (APAP). Polyquaternium-2 blocked some of the bitterness of cetirizine. Polyquaternium-2 did not show a dose dependent bitter blocking of enalapril. However, polyquaternium-2 shows a strong dose dependent effect on blocking jambu and APAP.

Polyquaternium-2, polyquaternium-17, and/or polyquaternium-18 can be added to compositions, in particular oral care compositions, medicines, and/or ingestible compositions. In one example, the composition contains from about 0.01% to about 1% polyquaternium-2, polyquaternium-17, and/or polyquaternium-18, in another example from about 0.03% to about 0.3%, in another example from about 0.05% to about 0.2%, in another example from about 0.07% to about 0.15%, in another example from about 0.08% to about 0.13%, and in another example from about 0.09% to about 0.11. In one example, the composition can contain about 0.1% polyquaternium-2, polyquaternium-17, and/or polyquaternium-18. In another example, the composition can contain less than about 1% polyquaternium-2, polyquaternium-17, and/or polyquaternium-18, in another example less than about 0.5%, in another example less than about 0.3%, in another example less than about 0.2%, in another example less than about 0.15%, and in another example less than about 0.12%.

In one example, polyquaternium-2, polyquaternium-17, and/or polyquaternium-18 can be added to the composition. For instance, the composition can contain polyquaternium-2, polyquaternium-17, and/or polyquaternium-18. In another example, polyquaternium-2, polyquaternium-17, and/or polyquaternium-18 can be administered simultaneously with the composition. In another example, polyquaternium-2, polyquaternium-17, and/or polyquaternium-18 can be administered before the composition. In one example the polyquaternium-2, polyquaternium-17, and/or polyquaternium-18 can be administered immediately before the composition and in one example the polyquaternium-2, polyquaternium-17, and/or polyquaternium-18 can be administered and then a period of time can pass before consuming the composition.

FIG. 5A compares the modulation of bitterness, if any, of solutions comprising 0.2 mM composition and 0.02% polyquaternium-2 in the *in vitro* Assay for Taste Receptors as described hereafter. The compositions tested were methyl formyl anthranilate, 2-aminoacetophenone, methyl anthranilate, dimethyl anthranilate, beta-terpineol, beta-naphthyl anthranilate, benzoyl anthranilic acid, hesperidin, 2-phenoxyethanol, para-vanillyl alcohol, and methyl ethoxypyrazine.

2.5 mM acetaminophen (APAP), 2 mM GG, and 10 μ M Ionomycin, calcium salt (commercially available from Life Technologies, Grand Island, New York, catalog# I-24222) were used as the controls. In FIG. 5A, 0.02% polyquaternium-2 substantially modulated or completely modulated the bitterness from all of the components. This is true for compositions that are particularly bitter, for instance over 6000 FUs, like methyl formyl anthranilate, 2-aminoacetophenone, methyl anthranilate, dimethyl anthranilate, beta-terpineol, beta-naphthyl anthranilate, and benzoyl anthranilic acid where the bitter was completely or substantially modulated in the Assay for Taste Receptors.

FIG. 5B compares the modulation of bitterness, if any, of solutions containing a composition and 0.01% polyquaternium-2 in the *in vitro* Assay for Taste Receptors as described hereafter. The compositions tested were 5 mM pseudoephedrine hydrochloride, 2 mM terpin, 2.5 mM prednisolone, 2.5 mM famotidine, 0.5 mM 1,10-phenanthroline, 0.5 mM erythromycin, 0.5 mM saccharin, 3% propylene glycol, and 2 mM GG was used as the control. 0.01% polyquaternium-2 modulated the bitterness in all of the compositions, including components that were very bitter, like 1,10-phenanthroline, saccharin, and propylene glycol. Surprisingly, polyquaternium-2 completely blocked the bitterness from saccharin and substantially reduced the bitterness of both propylene glycol and 1,10-phenanthroline.

FIG. 5C compares the modulation of bitterness, if any, of solutions comprising 2 mM of a composition and 0.01% polyquaternium-2 in the *in vitro* Assay for Taste Receptors as described hereafter. The compositions tested were amygdalin, benzamide, brucine, ϵ -Caprolactam, N-methylthiourea, orphenadrine hydrochloride, 1,10-phenanthroline, procainamide hydrochloride, and chlorhesidice. Polyquaternium-2 significantly reduced the bitterness of benzamide and brucine and moderately reduced the bitterness of 1,10-phenanthroline. However, polyquaternium-2 did not significantly reduce the bitterness of orphenadrine hydrochloride, which is the most bitter component in FIG. 5C. Polyquaternium-2 may also modulate the bitterness of compositions that are only slightly bitter such as amygdalin, ϵ -Caprolactam, N-methylthiourea, procainamide hydrochloride, and chlorhesidice.

FIG. 6 compares ten full formulations diluted to 0.617% with the same ten formulations diluted to 0.617% with 0.02% polyquaternium-2 the *in vitro* Assay for Taste Receptors as described hereafter. The formulations are described in Table 1 below. FIG. 6 also includes a formulation with 2 mM GG and 10 μ M Ionomycin, calcium salt, which were both used as controls.

Table 1

Formulation	Dose Size	Active Ingredients per Dose	Excipients
Hyland's® DEFEND Cold & Cough (Lot # 114220)	15 mL	<i>Allium cepa</i> 6X, Hepar sulfuris calcareum 12X, <i>Hydrastis canadensis</i> 6X, Natrum Muriaticum 6X, Phosphorus 12X, <i>Pulsatilla</i> 6X, Sulphur 12X	Citric acid, glycyrrhiza extract, purified water, sodium benzoate N.F., vegetable glycerine.
PediaCare® Decongestant (Lot # 18263)	5 mL	Phenylephrine HCl (2.5 mg)	Carboxymethylcellulose sodium, citric acid, edetate disodium, FD&C red #40, flavors, glycerin, sodium benzoate, sodium citrate, sorbitol, sucralose, water
Chestal® Honey (Lot # M0092897)	2 US tsp (9.9 mL)	Antimonium tartaricum 6C, Bryonia 3C, Coccus cacti 3C, <i>Drosera</i> 3C, <i>Ipecacuanha</i> 3C, <i>Pulsatilla</i> 6C, <i>Rumex crispus</i> 6C, Spongia tosta 3C, Sticta pulmonaria 3C	Citric acid, honey, purified water, sodium benzoate, sucrose
Nature's Way®, Umcka® ColdCare, Mint- Menthol Flavor (Lot # 125637)	7.5 mL	Pelargonium sidoides 1X	Alcohol (8.2%), fructose, natural menthol, natural spearmint flavor, purified water, vegetable-source glycerin
Nighttime Cold & Flu Relief similar to Nyquil® without Doxylamine	30 mL	Acetaminophen (650 mg), and Dextromethorphan HBr (30 mg)	Citric Acid, sodium citrate dihydrate, FD&C Blue #1, Red#40, purified water, saccharin, ace sulfame potassium, sodium, propylene glycol, alcohol, PEG-8, high fructose corn syrup, flavor
Nighttime Cold & Flu Relief similar to NyQuil® cherry flavor without Doxylamine	30 mL	Acetaminophen (650 mg), and Dextromethorphan HBr (30 mg)	Citric Acid, sodium citrate dihydrate, FD&C Blue #1, Red#40, purified water, saccharin, ace sulfame potassium, sodium, propylene glycol, alcohol, PEG-8, high fructose corn syrup, flavor

Nighttime Cold & Flu Relief similar to Alcohol-Free NyQuil® without Chlorpheniramine	30 mL	Acetaminophen (650 mg), and Dextromethorphan HBr (30 mg)	Citric Acid, sodium citrate dihydrate, Red#40, flavor, purified water, saccharin, ace sulfame potassium, sodium, propylene glycol, sodium benzoate, Carboxymethylcellulose sodium, PEG-8, high fructose corn syrup
DayQuil® Cold & Flu Relief (Lot # 124917193U)	30 mL	Acetaminophen (325 mg), Dextromethorphan HBr (10 mg), and Phenylephrine HCl (5 mg)	Citric Acid, FD&C Yellow No. 6, flavor, glycerin, propylene glycol, purified water, saccharin sodium, sodium benzoate, sodium chloride, sodium citrate, sorbitol, sucralose, xantham gum
DayQuil® Severe	30 mL	Acetaminophen (650 mg), Guaifenesin(400 mg), Dextromethorphan HBr (20 mg), and Phenylephrine HCl (10 mg)	Citric Acid, FD&C Yellow No. 6, flavor, glycerin, propylene glycol, purified water, saccharin sodium, sodium benzoate, sodium chloride, sodium citrate, sorbitol, sucralose, xantham gum
Mucinex® Fast-Max® DM Max (Lot # 1002471)	20 mL	Dextromethorphan HBr (20 mg) Guaifenesin (400 mg)	Anhydrous citric acid, dextrose, D&C Red #33, FD&C Red #40, flavors, glycerin, methylparaben, potassium sorbate, propylene glycol, propylparaben, purified water, saccharin sodium, sodium hydroxide, sucralose, xanthan gum

In the assays of FIG. 6, 0.02% polyquaternium-2 was effective in substantially reducing or completely reducing the bitterness in all of the full formulations. Polyquaternium-2 completely or almost completely reduced the bitter from Nature's Way® Umcka™ ColdCare, the Nighttime Cold & Flu Relief similar to Nyquil® without doxylamine, the Nighttime Cold & Flu Relief similar to Nyquil® cherry flavor without doxylamine, the Nighttime Cold & Flu Relief similar to Alcohol-Free NyQuil® without chlorpheniramine, and DayQuil®. The 0.02% polyquaternium-2 significantly reduced the bitterness of DayQuil® Severe and Mucinex® Fast-Max® DM Max.

FIG. 7 compares the bitterness, as determined by the DPP panel, of the examples described in Table 2 below. The high fructose corn syrup (HFCS) base contains 46.7% HFCS stock, 5.9% PEG-400 (polyethylene glycol 400), 8.6% propylene glycol, 7.4% ethanol, and 30.07% water. Excipients, including propylene glycol, can be bitter and the polyquaternium-2 can block the bitterness of the excipients in the HFCS base.

Table 2

Example	High Fructose Corn Syrup Base	Polyquaternium-2
1	q.s.	0%
2	q.s.	1%
3	q.s.	0.3%
4	q.s.	0.1%
5	q.s.	0.03%
6	q.s.	0.01%

Each panelist sampled 10 mL of each example using a “swish-and-spit” approach and rated the formulation for perceived bitter intensity. The DPP panel includes panelists that are trained and validated in Spectrum™ Descriptive Analysis methodology and evaluate bitterness on a 60 point scale.

It was surprisingly found that the Example 4, which contained 0.1% polyquaternium-2 was less bitter than Examples 2 and 3, which had higher levels of Polyquaternium-2. Examples 5 and 6 were also less bitter than Examples 2 and 3 and may still be acceptable to consumers.

FIG. 8 compares the bitterness, as determined by the DPP panel, of the following examples:

- Example 7 was commercially available DayQuil® Severe (Lot # 3308171931, expiration date October 2015) which contains four actives: APAP (216.67 mg per 10 mL), GG (133.33 mg per 10 mL), phenylephrine HCl (PE) (3.33 mg per 10 mL), and dextromethorphan (DXM) (6.67 mg per 10 mL). DayQuil® Severe also contains the following excipients: citric acid, FD&C Yellow No. 6, flavor, glycerin, propylene glycol, purified water, saccharin sodium, sodium benzoate, sodium chloride, sodium citrate, sorbitol, sucralose, xanthan gum
- Example 8 was the DayQuil® Severe of Example 7 with the addition of 0.1% polyquaternium-2.

The DPP panel for FIG. 8 was conducted according to the procedure described herein for FIG. 7. Polyquaternium-2 reduced the overall bitterness in mouth, after expectoration, and at three minutes. The in mouth bitter was reduced by about 50% and the after expectoration bitter was reduced by over 10%. The three minute bitter was only reduced slightly and there was not a noticeable difference in bitterness after ten minutes. However, it can be most important to reduce the bitterness when the composition is in the mouth and immediately after it has been expectorated because this is the time when the composition is most bitter and unpleasant to the consumer.

In one example, the DPP in mouth bitter is reduced by at least about 5% as compared to the in mouth bitterness of an identical composition without polyquaternium-2, polyquaternium-17, and/or polyquaternium-18, in another example by at least about 10%, in another example by at least about 15%, in another example by at least about 20%, in another example by at least about 25%, in another example by at least about 35%, in another example by at least about 40%, in another example by at least about 45%, and in another example by at least about 50%. In one example, the DPP after expectoration bitter is reduced by at least about 4% as compared to the in mouth bitterness of an identical composition without polyquaternium-2, polyquaternium-17, and/or polyquaternium-18, in another example by at least about 4%, in another example by at least about 10%, in another example the DPP after expectoration bitterness by at least about 15%, in another example by at least about 18%, in another example by at least about 20%, and in another example by at least about 22%.

Polyquaternium-2, polyquaternium-17, and/or polyquaternium-18 can be added to compositions, in particular liquid pharmaceutical compositions. In one example, the composition contains from about 0.01% to about 1% polyquaternium-2, polyquaternium-17, and/or polyquaternium-18, in another example from about 0.03% to about 0.3%, in another example from about 0.05% to about 0.2%, in another example from about 0.07% to about 0.15%, in another example from about 0.08% to about 0.13%, and in another example from about 0.09% to about 0.11. In one example, the composition can contain about 0.1% polyquaternium-2, polyquaternium-17, and/or polyquaternium-18. In another example, the composition can contain less than about 1% polyquaternium-2, polyquaternium-17, and/or polyquaternium-18, in another example less than about 0.5%, in another example less than about 0.3%, in another example less than about 0.2%, in another example less than about 0.15%, and in another example less than about 0.12%.

In one example, the polyquaternium-2, polyquaternium-17, and/or polyquaternium-18 can be used in combination with a bitter food or beverage. Non-limiting examples of bitter foods can include artichokes, arugula (*Eruca sativa*), asparagus, basil including, but not limited to, holy basil, bitter melon, broccoli, Brazil nuts, Brussels sprouts, burdock root, cabbage, castor oil, chard, cauliflower, chayotes, chicory, chocolate including, but not limited to, dark chocolate and unsweetened cocoa, citrus fruits and juices from citrus fruits including, but not limited to lemons, limes and grapefruit, citrus peels, cloves, collard greens, cress, cucumbers, cumin, dandelion greens, dill, eggplant, endive, fenugreek, ginger, guarana, Jerusalem artichoke, hazelnut, kale, lemon balm, lettuce, maca, melons, milk thistle including the leaves, mushrooms, mustard, neem leaves, nettles, olives including, but not limited to, uncured olives, oregano, pak choi, pumpkin, radicchio, radishes, rapini, rhubarb including the leaves, rosemary, rose root (*Rhodiola rosea*), rutabaga, saffron, sauerkraut, sesame seeds, sesame oil, squash including but not limited to zucchini and other summer squash, thistles, tomatoes, turmeric, and combinations thereof.

Non-limiting examples of beverages can include coffee, teas including, but not limited to, green tea, white tea, and black tea, tonic water, South American mate, and alcoholic beverages including, but not limited to beer, wine, and spirits, and combinations thereof.

There are many compounds that can make foods and beverages bitter. For instance, two components that can make beer bitter can be hops and ethanol. Polyquaternium-2, polyquaternium-17, and/or polyquaternium-18 can modulate the bitterness of one or more bitter compounds. In one example, polyquaternium-2 can block specific bitter compounds.

In one example, the food and/or beverage compositions can be consumed as whole foods and beverages. In another example, the food and/or beverage compositions can be partially consumed and can be extracted or condensed or otherwise changed before consumption. In another example, the food and/or beverage compositions can be made into dosage forms, for instance to provide a supplement.

In one example, polyquaternium-2, polyquaternium-17, and/or polyquaternium-18 can be added to a composition intended for use by children. Children can be especially sensitive to bitter tastes and adding polyquaternium-2, polyquaternium-17, and/or polyquaternium-18 can make bitter compositions, for instance foods, beverages, supplements and medicines more palatable to children.

In one example, the composition can include a variety of orally administered dosage forms, which can contain drug actives. Non-limiting examples of dosage forms can include a liquid medication, particles suspended in a liquid formulation, a solid in a gelatin or foam, or a

solid dose in the form of a tablet, powder, granules, pellets, microspheres, nanospheres, beads, or nonpareils, and combinations thereof. In one example, the dosage form is a liquid medication. Dosage forms can be orally administered and can be swallowed immediately, slowly dissolved in the mouth, or chewed.

5 Non-limiting examples of additional solvents can include water, ethanol, glycerol, propylene glycol, polyethylene glycol 400, polyethylene glycol 200, and mixtures thereof. In one example the medication comprises from about 40% to about 95% solvent, in another example from about 50% to about 80% solvent, and in another example from about 55% to about 60% solvent, and in another example from about 68% solvent to about 72% solvent.

10 In one example, the medication can contain water and propylene glycol. In one example, the medication comprises from about 15% to about 80% water, in another example from about 25% to about 75% water, in another example from about 40% to about 70% water, in another example from about 35% to about 45% water, and in another example from about 57% to about 66% water. In another example, the medication can comprise from about 1% to about 10%
15 propylene glycol, in another example from about 2% to about 8% propylene glycol, and in another example from about 3% to about 6% propylene glycol. In another example, the medication can contain from about 5% to about 40% propylene glycol, in another example from about 15% to about 35% propylene glycol, and in another example from about 20% to about 30% propylene glycol. In another example, the medication can comprise from about 1% to about 15%
20 ethanol, in another example from about 3% to about 12% ethanol, and in another example from about 6% to about 10% ethanol.

The compositions can comprise a sweetener to provide sweetness and taste masking of the actives and excipients that provide a bitter character. In one example, the composition comprises from about 2% to 25% sweetener, in another example from about 5% to 20%
25 sweetener, in another example from about 7% to 15% sweetener, and in another example from about 8% to 12% sweetener. Non-limiting examples of sweeteners can include nutritive sweeteners, sugar alcohols, synthetic sugars, high intensity natural sweeteners, and combinations thereof. Non-limiting examples of nutritive sweeteners can include fructose, galactose, and combinations thereof. In one example, the sweetener can be high fructose corn syrup.

30 Non-limiting examples of sugar alcohols can include xylitol, sorbitol, mannitol, maltitol, lactitol, isomalt, erythritol, glycerin, and combinations thereof. In one example the composition can comprise from about 1% to about 30% sugar alcohol, in another example from about 5% to about 28% sugar alcohol, in another example about 10% to about 25% sugar alcohol, and in

another example about 15% to about 23% sugar alcohol. In one example the composition comprises from about 5% to about 20% sorbitol, in another example from about 7% to about 18% sorbitol, and in another example from about 10% to about 15% sorbitol. In another example, the composition comprises from about 3% to about 15% glycerin, in another example from about 5% to about 10% glycerin, and in another example from about 7% to about 9% glycerin.

Non-limiting examples of synthetic sweeteners can include sodium saccharin, acesulfame potassium, sucralose, aspartame, monoammonium glycyrrhizinate, neohesperidin dihydrochalcone, thaumatin, neotame, cyclamates, and mixtures thereof. In one example the composition can comprise from about 0.01% to about 0.5% artificial sweetener, in another example from about 0.1% to about 0.3% artificial sweetener, and in another example about 0.15% to about 0.25% artificial sweetener.

Non-limiting examples of high intensity natural sweeteners can include neohesperidin dihydrochalcone, stevioside, rebaudioside A, rebaudioside C, dulcoside, monoammonium glycyrrhizinate, thaumatin, and combinations thereof.

The liquid composition can optionally include one or more sensates. Non-limiting examples of sensates can include cooling sensates, warming sensates, tingling sensates, and combinations thereof. Sensates can be useful to deliver signals to the user.

In one example the sweetener can be Rebiana®, a steviolglycoside, commercially available from Cargill® Corp., Minneapolis, Minnesota, which is an extract from the leaves of the Stevia rebaudiana plant (hereinafter referred to as "Rebiana"). This is a crystalline diterpene glycoside, about 300x sweeter than sucrose. Examples of suitable steviolglycosides which may be combined include rebaudioside A, rebaudioside B, rebaudioside C, rebaudioside D, rebaudioside E, rebaudioside F, dulcoside A, dulcoside B, rubusoside, stevioside, or steviolbioside. According to particularly desirable examples of the present invention, the combination of high-potency sweeteners comprises rebaudioside A in combination with rebaudioside B, rebaudioside C, rebaudioside F, rebaudioside F, stevioside, steviolbioside, dulcoside A.

Non-limiting examples of cooling sensates can include WS-23 (2-Isopropyl-N,2,3-trimethylbutyramide), WS-3 (N-Ethyl-p-menthane-3-carboxamide), WS-30 (1-glycerol-p-menthane-3-carboxylate), WS-4 (ethyleneglycol-p-menthane-3-carboxylate), WS-14 (N-t-butyl-p-menthane-3-carboxamide), WS-12 (N-(4-ethoxyphenyl)-p-menthane-3-carboxamide), WS-5 (Ethyl-3-(p-menthane-3-carboxamido)acetate, Menthone glycerol ketal (sold as Frescolat® MGA by Haarmann & Reimer), (-)-Menthyl lactate (sold as Frescolat® ML by Haarmann & Reimer), (-)-Menthoxyp propane-1,2-diol (sold as Coolant Agent 10 by Takasago International), 3-(1-

menthoxy)propane-1,2-diol, 3-(1-Menthoxy)-2-methylpropane-1,2-diol, (-)-Isopulegol is sold under the name "Coolact P[®]" by Takasago International., cis & trans p-Menthane-3,8-diols(PMD38) – Takasago International, Questice[®] (menthyl pyrrolidone carboxylate), (1R,3R,4S)-3-menthyl-3,6-dioxaheptanoate – Firmenich, (1R,2S,5R)-3-menthyl methoxyacetate – Firmenich, (1R,2S,5R)-3-menthyl 3,6,9-trioxadecanoate – Firmenich, (1R,2S,5R)-menthyl 11-hydroxy-3,6,9-trioxaundecanoate – Firmenich, (1R,2S,5R)-3-menthyl (2-hydroxyethoxy)acetate – Firmenich, Cubebol – Firmenich, Icilin also known as AG-3-5, chemical name 1-[2-hydroxyphenyl]-4-[2-nitrophenyl]-1,2,3,6-tetrahydropyrimidine-2-one), 4-methyl-3-(1-pyrrolidinyl)-2[5H]-furanone, Frescolat ML – menthyl lactate, Frescolat MGA – menthone glycerin acetal, Peppermint oil, L-Monomenthyl succinate, L-monomenthyl glutarate, 3-1-menthoxypropane-1,2-diol – (Coolact 10), 2-1-menthoxyethanol (Coolact 5), TK10 Coolact (3-1-Menthoxy propane-1,2-diol), Evercool[™] 180 (N-(4-cyanomethylphenyl)-p-menthanecarboxamide)), and combinations thereof. In one example, the composition can comprise from about 0.005% to about 1% cooling sensate, in another example from about 0.05% to about 0.5% cooling sensate, and in another example from about 0.01% to about 0.25% cooling sensate.

In one example, the cooling sensate can be EverCool[™] 180 available from Givaudan of Cincinnati, Ohio, as a 5% solution of N-(4-cyanomethylphenyl)-p-menthanecarboxamide in a flavoring ingredient cool white grape, or as a 7.5% solution of N-(4-cyanomethylphenyl)-p-menthanecarboxamide in a flavor ingredient such as spearmint or peppermint.

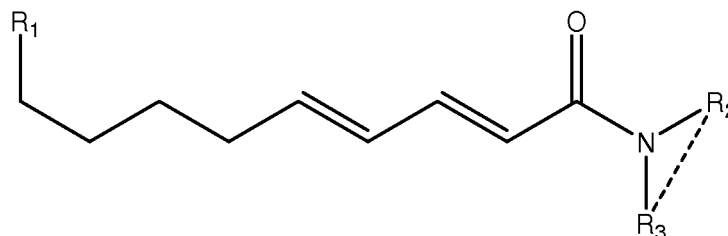
Non-limiting examples of warming sensates can include TK 1000, TK 1 MM, Heatenol – Sensient Flavors, Optaheat – Symrise Flavors, Cinnamon, Capsicum, Capsaicin, Curry, FSI Flavors, Isobutavan, Nonivamide 60162807, Hotact VEE, Hotact 1MM, piperine, optaheat 295 832, optaheat 204 656, optaheat 200 349, and combinations thereof. Warming sensates can be present from about 0.005% to about 2%, in another example from about 0.01% to about 1%, and in another example from about 0.1% to about 0.5%.

Non-limiting examples of tingling sensates can include sichuan pepper, hydroxy alpha sanshool, jambu extracts, spilanthol, and combinations thereof. In one example, tingling sensates can be present from about 0.005% to about 1%, in another example from about 0.01% to about 0.5%, and another example from about 0.015% to about 0.3%.

The composition can comprise a flavoring ingredient. When present, flavoring ingredients are generally used in the compositions at levels of from about 0.001% to about 8%, by weight of the composition.

Additional non-limiting examples of flavoring ingredients can include peppermint oil, corn mint oil, spearmint oil, oil of wintergreen, clove bud oil, cassia, sage, parsley oil, marjoram, lemon, lime, orange, mango, cis-jasmone, 2,5-dimethyl-4-hydroxy-3(2H)-furanone, 5-ethyl-3-hydroxy-4-methyl-2(5H)-furanone, vanillin, ethyl vanillin, propenyl guaethol, heliotropine, 4-*cis*-heptenal, diacetyl, methyl-*p*-tert-butyl phenyl acetate, menthol, methyl salicylate, ethyl salicylate, 1-menthyl acetate, oxanone, alpha-irisone, methyl cinnamate, ethyl cinnamate, butyl cinnamate, ethyl butyrate, ethyl acetate, methyl anthranilate, *iso*-amyl acetate, *iso*-amyl butyrate, allyl caproate, eugenol, eucalyptol, thymol, cinnamic alcohol, octanol, octanal, decanol, decanal, phenylethyl alcohol, benzyl alcohol, alpha-terpineol, linalool, limonene, citral, maltol, ethyl maltol, carvone, menthone, β -damascenone, ionone, gamma decalactone, gamma nonalactone, gamma undecalactone and mixtures thereof. Generally suitable flavoring ingredients are those containing structural features and functional groups that are less prone to redox reactions. These include derivatives of flavouring ingredients that are saturated or contain stable aromatic rings or ester groups. In one example, the composition comprises from about 0.01% to about 1% flavoring ingredients, in another example from about 0.05% to about 0.5% flavoring ingredients, and in another example from about 0.1% to about 0.3% flavoring ingredients.

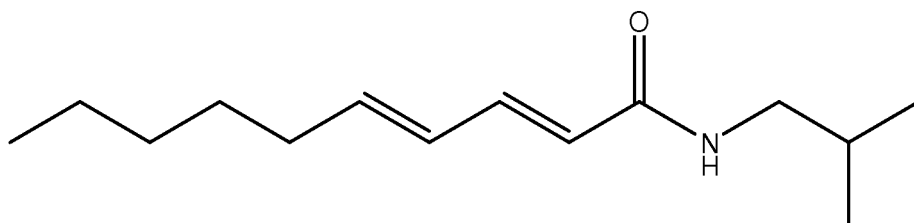
The composition can optionally include one or more salivation agents. Non-limiting examples of salivation agents include formula (I):



(I)

wherein R₁ represents C1-C2 n-alkyl; R₂ is 2-methyl-1-propyl and R₃ is hydrogen, or R₂ and R₃ taken together is a moiety (designated by the dashed lines) having the formula $-(CH_2)_n-$ wherein n is 4 or 5, and combinations thereof.

In an embodiment, the salivating agent comprises a material wherein R₂ is 2-methyl-1-propyl and R₃ is hydrogen, in another embodiment the salivating agent comprises a material wherein R₁ is C1 n-alkyl, R₂ is 2-methyl-1-propyl and R₃ is hydrogen. In another embodiment, the salivating agent comprises trans-pellitorin, a chemical having a structure according to formula (II):



(II)

In another embodiment, the salivation agent can include sodium bicarbonate, sodium chloride, trans-pellitorin, and combinations thereof. In one example, salivation agents can be present from about 0.05% to about 2%, in another embodiment from about 0.1% to about 1%, and in another example from about 0.25% to about 0.75%.

The liquid composition can be any color. Non-limiting examples of colors can include red, green, amber, orange, yellow, blue, pink, violet, turquoise, and combinations thereof. In one example, the composition is green. In another example, the liquid composition is clear.

The composition can also comprise a dye that provides the color. Non-limiting examples dyes that may be used in the present invention include FD&C blue #1, FD&C blue #2, D&C blue #4, D&C blue #9, FD&C green #3, D&C green #5, D&C green #6, D&C green #8, D&C orange #4, D&C orange #5, D&C orange #10, D&C orange #11, FD&C red #3, FD&C red #4, D&C red #6, D&C red #7, D&C red #17, D&C red #21, D&C red #22, D&C red #27, D&C red #28, D&C red #30, D&C red #31, D&C red #33, D&C red #34, D&C red #36, D&C red #39, FD&C red #40, D&C violet #2, FD&C yellow #5, FD&C yellow #6, D&C yellow #7, Ext. D&C yellow #7, D&C yellow #8, D&C yellow #10, D&C yellow #11, and combinations thereof. In one example, the composition comprises from about 0.001% to about 0.1% dye, in another example from about 0.002% to about 0.05% dye, and in another example from about 0.003% to about 0.01% dye.

In one example, the composition comprises a buffer. The buffer can help maintain a constant pH within the liquid composition. In one example the liquid composition comprises from about 0.05% to about 2% buffer, in another example from about 0.1% to about 1% buffer, in another example from about 0.15% to about 0.5% buffer, and in another example from about 0.18% to about 0.25% buffer. Buffers can include acetate buffers, citrate buffers, and phosphate buffers. Non-limiting examples of buffers can include acetic acid, sodium acetate, citric acid, sodium citrate, monobasic sodium phosphate, dibasic sodium phosphate, sodium carbonate, sodium bicarbonate, succinic acid, sodium succinate, potassium dihydrogen phosphate, and phosphoric acid.

In one example, the composition comprises a preservative. In one example the liquid composition comprises from about 0.01% to about 1% preservative, in another example from

about 0.05% to about 0.5% preservative, in another example from about 0.07% to about 0.3% preservative, and in another example from about 0.08% to about 0.15% preservative. Non-limiting examples of preservatives can include benzalkonium chloride, ethylenediaminetetraacetic acid (EDTA), benzyl alcohol, potassium sorbate, parabens, benzoic acid, sodium benzoate, and mixtures thereof.

In one example, the composition comprises a thickener. In one example the liquid composition comprises from 0.01% to 3% thickener, in another example 0.05% to 1.5% thickener, in another example 0.1% to 0.75% thickener, and in another example 0.12% to 0.3% thickener. Non-limiting examples of thickeners can include xanthan gum, carrageenan, polyacrylic acid, polyvinylpyrrolidone, cellulosic polymers including carboxymethylcellulose, hydroxethylcellulose, hydroxymethylcellulose, and hydroxypropylmethylcellulose, and combinations thereof.

In certain examples, the compositions can contain one or more drug actives. In one example, the composition a liquid composition containing one or more drug actives. In one example, the drug actives can be immediate release drug actives, extended release drug actives, or delayed release drug actives. In one example, the drug active can be formulated as particles and in another example the active can be formulated as coated beads.

In one example, the drug active is a multi-symptom relief (MSR) cold/flu active which can be used to treat one or more cold/flu symptoms. MSR cold/flu actives can be used to treat a variety of cold/flu symptoms including nasal congestion, runny nose, sneezing, headache, dry cough, sore throat, sinus pressure or pain, chest congestion, muscle aches/pains, wet/chesty cough, fever, and combinations thereof. MSR cold/flu actives can include decongestants, expectorants, antihistamines, antitussives, pain relievers, and combinations thereof.

In one example, MSR cold/flu actives can be formulated for daytime use or nighttime use. In one example, the liquid medication comprises instructions that direct a user to ingest the medication at night before bedtime.

Non-limiting examples of expectorants can include guaifenesin, ambroxol, bromhexine, and combinations thereof. In one example, the expectorant can be guaifenesin. In one example a dose can comprise 200 mg of guaifenesin and in another example 400 mg of guaifenesin.

Non-limiting examples of antihistamines can include chlorpheniramine, desloratadine, levocetirizine, diphenhydramine, doxylamine succinate, triprolidine, clemastine, pheniramine, brompheniramine, dexbrompheniramine, loratadine, cetirizine and fexofenadine, amlexanox, alkylamine derivatives, cromolyn, acrivastine, ibudilast, bamipine, ketotifen, nedocromil,

omalizumab, dimethindene, oxatomide, pemirolast, pyrrobutamine, pentigetide, thenaldine, picumast, tolpropamine, ramatroban, repirinast, suplatast tosylate aminoalkylethers, tazanolast, bromodiphenhydramine, tranilast, carbinoxamine, traxanox, chlorphenoxamine, diphenylpyaline, embramine, p-methyldiphenhydramine, moxastine, orphenadrine, 5 phenyltoloxamine, setastine, ethylenediamine derivatives, chloropyramine, chlorothen, methapyrilene, pyrilamine, talastine, thenyldiamine, thonzylamine hydrochloride, tripelennamine, piperazines, chlorcyclizine, clocinazine, homochlorcyclizine, hydroxyzine, tricyclics, phenothiazines, mequitazine, promethazine, thiazinamium methylsulfate, azatadine, cyproheptadine, dectropine, desloratadine, isothipendyl, olopatadine, rupatadine, antazoline, 10 astemizole, azelastine, bepotastine, clemizole, ebastine, emedastine, epinastine, levocabastine, mebhydroline, mizolastine, phenindamine, terfenadine, tritoqualine, phenylephrine (PE), pseudophedrine (PSE) and combinations thereof.

In one example the liquid composition can comprise from about 0.01% to about 0.1% antihistamine, in another example from about 0.02% to about 0.07% antihistamine, and in 15 another example from about 0.03% to about 0.05% antihistamine. In one example, the antihistamine can be doxylamine succinate and a dose of liquid medication can contain 12.5 mg doxylamine succinate. In another example, the antihistamine can be chlorpheniramine. In one example a dose can contain 2 mg of chlorpheniramine and in another example a dose can contain 4 mg of chlorpheniramine. In another example, the antihistamine can be PE. In one example a 20 dose can contain 5 mg PE, in another example 10 mg PE, and in another example 20 mg PE. In another example, the antihistamine can be PSE. In one example a dose can contain 120 mg PSE and in another example 30 mg PSE.

Non-limiting examples of antitussives can include DXM, codeine, chlrophedianol, levodropropizine, and combinations thereof. In one example the liquid medication can comprise 25 from about 0.01% to about 0.2% antitussive, in another example from about 0.025% to about 0.1%, and in another example from about 0.04% to about 0.075% antitussive. In one example the antitussive can be selected from the group consisting of DXM, chlrophedianol, and combinations thereof. In one example a dose can comprise 15 mg DXM, in another example 20 mg DXM, and in another example 30 mg DXM. In another example a dose can comprise 12.5 mg 30 chlrophedianol.

Non-limiting examples of pain relievers can include APAP, ibuprofen, ketoprofen, diclofenac, naproxen, aspirin, and combinations thereof. In one example the liquid medication can comprise from about 0.5% to about 3.5% pain reliever, in another example from about 1% to

about 3% pain reliever, and in another example from about 1.5% to about 2% pain reliever. In one example the pain relievers can include APAP, ibuprofen, naproxen, or combinations thereof. In one example a dose can comprise 325 mg to 500 mg APAP, in another example 200 mg ibuprofen, and in another example, 200 mg naproxen.

5 In one example, the liquid medication can further comprise a stimulant such as caffeine.

In one example, the liquid medication can comprise one or more MSR cold/flu actives, in another example two or more MSR cold/flu actives, in another example three or more MSR cold/flu actives, and in another example four or more MSR cold/flu actives. In one example, the liquid medication can comprise exactly one MSR cold/flu active, in another example exactly two
10 MSR cold/flu actives, in another example exactly three MSR cold/flu actives, and in another example exactly four MSR cold/flu actives. In one example the liquid medication can comprise APAP, doxylamine succinate, DXM, and PE.

In one example, the active can be a plant-derived materials. As used herein, non-limiting examples of plant-derived materials can include those used in traditional native American,
15 Chinese, Aryurvedic and Japanese medicine, including flowers, leaves, stems and roots of plants as well as extracts and isolated active components from the flower, leaves, stems, and roots of plants. Plant and Animal based oils and esters such as Omega-3-fatty acids and alkyl esters thereof; Vitamins (including but not limited to provitamin and all forms of Vitamins C, D, A, B, E, and combinations thereof); Fibers: Non-limiting examples of fibers and analogous
20 carbohydrate polymers can include pectins, psyllium, guar gum, xanthan gum, alginates, gum arabic, fructo-oligosaccharides, inulin, agar, beta-glucans, chitins, dextrans, lignin, celluloses, non-starch polysaccharides, carrageenan, reduced starch, and mixtures and/or combinations thereof; Prebiotics: Non-limiting examples of prebiotics suitable for use in the compositions and methods can include psyllium, fructo-oligosaccharides, inulin, oligofructose, galacto-
25 oligosaccharides, isomalto-oligosaccharides, xylo-oligosaccharides, soy-oligosaccharides, gluco-oligosaccharides, mannan-oligosaccharides, arabinogalactan, arabinxylan, lactosucrose, gluconan, lactulose, polydextrose, oligodextran, gentiologosaccharide, pectic oligosaccharide, xanthan gum, gum arabic, hemicellulose, resistant starch and its derivatives, reduced starch, and mixtures and/or combinations thereof. Probiotics: Non-limiting examples of probiotic bacteria
30 suitable for use herein can include strains of *Streptococcus lactis*, *Streptococcus cremoris*, *Streptococcus diacetylactis*, *Streptococcus thermophilus*, *Lactobacillus bulgaricus*, *Lactobacillus acidophilus*, *Lactobacillus helveticus*, *Lactobacillus bifidus*, *Lactobacillus casei*, *Lactobacillus lactis*, *Lactobacillus plantarum*, *Lactobacillus rhamnosus*, *Lactobacillus delbruekii*,

Lactobacillus thermophilus, *Lactobacillus fermentii*, *Lactobacillus salivarius*, *Lactobacillus reuteri*, *Lactobacillus brevis*, *Lactobacillus paracasei*, *Lactobacillus gasseri*, *Pediococcus cerevisiae*, *Bifidobacterium longum*, *Bifidobacterium infantis*, *Bifidobacterium adolescentis*, *Bifidobacterium bifidum*, *Bifidobacterium animalis*, *Bifidobacterium pseudolongum*,
5 *Bifidobacterium thermophilum*, *Bifidobacterium lactis*, *Bifidobacterium bulgaricus*, *Bifidobacterium breve*, *Bifidobacterium subtilis*, *Escherichia coli* and strains of the genera including *Bacillus*, *Bacteroides*, *Enterococcus* (e.g., *Enterococcus faecium*) and *Leuconostoc*, and mixtures and/or combinations thereof.

Minerals, metals and/or elements: Non-limiting examples of minerals, metals, and
10 elements useful in the systems of the present invention include: zinc, iron, calcium, iodine, copper and selenium. When present, the minerals, metals and/or elements can be on or in a suitable carrier, and comprise from about 1% to about 50% by weight and alternatively from about 2% to about 30%, by weight of the composition comprising the mineral, metal or element and the carrier.

15 In another example, the active can be a gastrointestinal active. Non-limiting examples of gastrointestinal actives can include anti-diarrheal actives, laxatives, anti-nausea and anti-emetic actives, anti-flattulents, proton pump inhibitors, anti-inflammatory gastrointestinal actives, rafting agents, and combinations thereof.

Non-limiting examples of anti-diarrheal actives can include loperamide, bismuth-
20 containing compositions, bismuth subsalicylate, colloidal bismuth subcitrate, bismuth subcitrate, kaolin, pectin, clays such as attapulgite, activated charcoal, and combinations thereof.

Non-limiting examples of laxatives can include fiber, resistant starch, resistant
maltodextrin, pectin, cellulose, modified cellulose, polycarophil, senna, sennosides, bisacodyl,
sodium phosphate, docusate, magnesium citrate, mineral oil, glycerin, aloe, castor oil,
25 magnesium hydroxide, and combinations thereof

Non-limiting examples of anti-nausea and anti-emetic actives can bismuth containing
compositions including bismuth subsalicylate, phosphated carbohydrates, diphenhydramine,
cyclizine, meclizine, and combinations thereof; non-limiting examples of antacids can include
sodium bicarbonate, sodium carbonate, calcium carbonate, magnesium carbonate, magnesium
30 hydroxide, aluminum hydroxide, magnesium silicates, alginic acids, sodium alginate, magaldrate, and combinations thereof.

Non-limiting examples of anti-flattulents can include simethicone, activated charcoal,
lactase, alpha-galactosidase enzymes, and combinations thereof; non-limiting examples of H₂

receptor antagonists can include famotidine, ranitidine, cimetidine, nitazidine, and combinations thereof.

Non-limiting examples of proton pump inhibitors can include omeprazole, lansoprazole, esomeprazole, pantoprazole, rabeprazole, and combinations thereof.

5 A non-limiting example of an anti-inflammatory gastrointestinal active can include mesalamine.

Non-limiting examples of rafting agents can include alginates, pectins and polysaccharides.

10 A metal salt includes zinc salts, stannous salts, potassium salts, copper salts, alkali metal bicarbonate salts, and combinations thereof. Metal salts have a wide range of functions from antimicrobial agents to sensitivity agents or buffers. The compositions of the present invention may contain metal salt in an amount from about 0.05% to about 11%, from about 0.5% to about 7%, or from about 1% to about 5%, by total weight of the oral care composition.

15 It is common to have a fluoride compound present in dentifrices and other oral care compositions in an amount sufficient to give a fluoride ion concentration in the composition of from about 0.0025% to about 5.0% or from about 0.005% to about 2.0%, by weight of the oral care composition to provide anticaries effectiveness. A wide variety of fluoride ion-yielding materials can be employed as sources of soluble fluoride in the present invention. Representative fluoride ion sources include: stannous fluoride, sodium fluoride, potassium fluoride, amine
20 fluoride, sodium monofluorophosphate, indium fluoride, amine fluorides such as Olaflur, and many others. Examples of suitable fluoride ion-yielding materials are found in U.S. Pat. No. 3,535,421 to Briner et al. and U.S. Pat. No. 3,678,154 to Widder et al.

25 Stannous salts include stannous fluoride, stannous chloride, stannous iodide, stannous chlorofluoride, stannous acetate, stannous hexafluorozirconate, stannous sulfate, stannous lactate, stannous tartrate, stannous gluconate, stannous citrate, stannous malate, stannous glycinate, stannous pyrophosphate, stannous metaphosphate, stannous oxalate, stannous phosphate, stannous carbonate, and combinations thereof. Dentifrices containing stannous salts, particularly stannous fluoride and stannous chloride, are described in U.S. Pat. No. 5,004,597 to Majeti et al. Other descriptions of stannous salts are found in U.S. Pat. No. 5,578,293 issued to
30 Prencipe et al. and in U.S. Pat. No. 5,281,410 issued to Lukacovic et al. In addition to the stannous ion source, other ingredients used to stabilize the stannous may be included, such as the ingredients described in Majeti et al. and Prencipe et al.

Zinc salts include zinc fluoride, zinc chloride, zinc iodide, zinc chlorofluoride, zinc acetate, zinc hexafluorozirconate, zinc sulfate, zinc lactate, zinc tartrate, zinc gluconate, zinc citrate, zinc malate, zinc glycinate, zinc pyrophosphate, zinc metaphosphate, zinc oxalate, zinc phosphate, zinc carbonate, and combinations thereof.

5 Potassium salts include potassium nitrate, potassium citrate, potassium oxalate, potassium bicarbonate, potassium acetate, potassium chloride, and combinations thereof.

In one example, the copper salt can be selected from copper fluoride, copper chloride, copper iodide, copper chlorofluoride, copper acetate, copper hexafluorozirconate, copper sulfate, copper lactate, copper tartrate, copper gluconate, copper citrate, copper malate, copper glycinate,
10 copper pyrophosphate, copper metaphosphate, copper oxalate, copper phosphate, copper carbonate, and combinations thereof. In a further example, the copper salt can be selected from copper gluconate, copper acetate, copper glycinate, and combinations thereof.

Alkali metal bicarbonate salts are soluble in water and unless stabilized, tend to release carbon dioxide in an aqueous system. Sodium bicarbonate, also known as baking soda, can be the
15 preferred alkali metal bicarbonate salt. The alkali metal bicarbonate salt also functions as a buffering agent. Because of the pH at which alkali metal bicarbonate salts buffer, the bicarbonate salt may be in a phase separate from the stannous ion source. In certain examples, the composition of the present invention may contain from about 0.5% to about 50%, from about 0.5% to about 30%, from about 2% to about 20%, or from about 5% to about 18% of an alkali
20 metal bicarbonate salt, by weight of the composition.

Some metal salts which may be used in the present invention, such as zinc chloride, zinc citrate, copper gluconate, and zinc gluconate, are also associated with an off taste described as dirty, dry, earthy, metallic, sour, bitter, and astringent.

Carrier materials include water, glycerin, sorbitol, polyethylene glycols having a
25 molecular weight of less than about 50,000, propylene glycol and other edible polyhydric alcohols, ethanol, or combinations thereof. The compositions of the present invention include from about 5% to about 80%, by weight of the composition, of a carrier material. In certain examples, the compositions contain carrier materials in an amount of from about 10% to about 40%, by total weight of the composition.

30 Antimicrobial agents include quaternary ammonium compounds. Those useful in the present invention include, for example, those in which one or two of the substitutes on the quaternary nitrogen has a carbon chain length (typically alkyl group) from about 8 to about 20, typically from about 10 to about 18 carbon atoms while the remaining substitutes (typically alkyl

or benzyl group) have a lower number of carbon atoms, such as from about 1 to about 7 carbon atoms, typically methyl or ethyl groups. Dodecyl trimethyl ammonium bromide, tetradecylpyridinium chloride, domiphen bromide, N-tetradecyl-4-ethyl pyridinium chloride, dodecyl dimethyl (2-phenoxyethyl) ammonium bromide, benzyl dimethoystearyl ammonium chloride, quaternized 5-amino-1,3-bis(2-ethyl-hexyl)-5-methyl hexahydropyrimidine, benzalkonium chloride, benzethonium chloride and methyl benzethonium chloride are exemplary of typical quaternary ammonium antibacterial agents.

Other quaternary ammonium compounds include the pyridinium compounds. Examples of pyridinium quaternary ammonium compounds include bis[4-(R-amino)-1-pyridinium] alkanes as disclosed in U.S. Pat. No. 4,206,215, Jun. 3, 1980, to Bailey and cetylpyridinium and tetradecylpyridinium halide salts (i.e., chloride, bromide, fluoride and iodide).

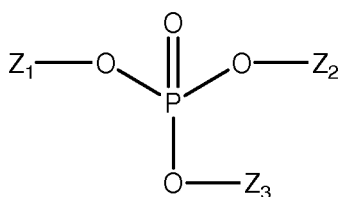
The compositions of the present invention may also include other antimicrobial agents including non-cationic antimicrobial agents such as halogenated diphenyl ethers, phenolic compounds including phenol and its homologs, mono and poly-alkyl and aromatic halophenols, resorcinol and its derivatives, xylitol, bisphenolic compounds and halogenated salicylanilides, benzoic esters, and halogenated carbanilides. Also useful antimicrobials are enzymes, including endoglycosidase, papain, dextranase, mutanase, and combinations thereof. Such agents are disclosed in U.S. Pat. No. 2,946,725, Jul. 26, 1960, to Norris et al. and in U.S. Pat. No. 4,051,234 to Gieske et al. Examples of other antimicrobial agents include chlorhexidine, and flavor oils such as thymol. In another example, the antimicrobial agent can include triclosan.

The compositions of the present invention may contain antimicrobial agents in an amount of from about 0.035% or more, from about 0.1% to about 1.5%, from about 0.045% to about 1.0%, or from about 0.05% to about 0.10%, by total weight of the composition.

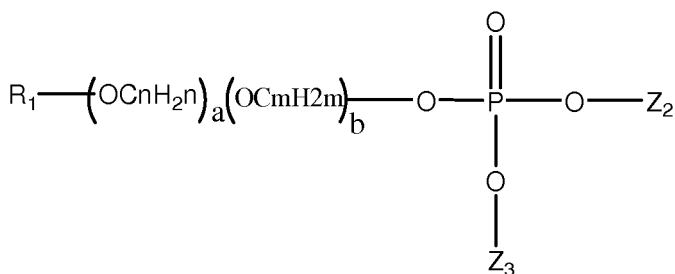
Bleaching agents can include peroxides, perborates, percarbonates, peroxyacids, persulfates, and combinations thereof. Suitable peroxide compounds include hydrogen peroxide, urea peroxide, calcium peroxide, sodium peroxide, zinc peroxide, or combinations thereof. One example of a percarbonate is sodium percarbonate. An example of a persulfate includes oxones. Some bleaching agents provide a burn sensation within a composition, for example peroxides and percarbonates.

The compositions of the present invention may contain bleaching agents in an amount of from about 0.01% to about 30%, from about 0.1% to about 10%, or from about 0.5% to about 5%, by total weight of the composition.

Surfactants may include anionic surfactants such as organophosphate, which include alkyl phosphates. These surface active organophosphate agents have a strong affinity for enamel surface and have sufficient surface binding propensity to desorb pellicle proteins and remain affixed to enamel surfaces. Suitable examples of organophosphate compounds include mono-, di- or triesters represented by the general structure below wherein Z1, Z2, or Z3 may be identical or different, at least one being an organic moiety, in one example selected from linear or branched, alkyl or alkenyl group of from 1 to 22 carbon atoms, optionally substituted by one or more phosphate groups; alkoxyated alkyl or alkenyl, (poly)saccharide, polyol or polyether group.



Some other organophosphate agents include alkyl or alkenyl phosphate esters represented by the following structure:



wherein R1 represents a linear or branched, alkyl or alkenyl group of from 6 to 22 carbon atoms, optionally substituted by one or more phosphate groups; n and m, are individually and separately, 2 to 4, and a and b, individually and separately, are 0 to 20; Z2 and Z3 may be identical or different, each represents hydrogen, alkali metal, ammonium, protonated alkyl amine or protonated functional alkyl amine such as an alkanolamine, or a R1-(OCnH2n)a(OCmH2m)b-group. Examples of suitable agents include alkyl and alkyl (poly)alkoxy phosphates such as lauryl phosphate; PPG5 cetareth-10 phosphate; Laureth-1 phosphate; Laureth-3 phosphate; Laureth-9 phosphate; Trilaureth-4 phosphate; C12-18 PEG 9 phosphate; Sodium dilaureth-10 phosphate. In one example, the alkyl phosphate is polymeric. Examples of polymeric alkyl phosphates include those containing repeating alkoxy groups as the polymeric portion, in particular 3 or more ethoxy, propoxy isopropoxy or butoxy groups.

Zwitterionic or amphoteric surfactants useful in the present invention can include derivatives of aliphatic quaternary ammonium, phosphonium, and sulfonium compounds, in which the aliphatic radicals can be straight chain or branched, and wherein one of the aliphatic

substituents contains from about 8 to 18 carbon atoms and one contains an anionic water-solubilizing group, such as carboxy, sulfonate, sulfate, phosphate or phosphonate. Suitable amphoteric surfactants include betaine surfactants such as disclosed in U.S. Pat. No. 5,180,577 to Polefka et al. Typical alkyl dimethyl betaines include decyl betaine or 2-(N-decyl-N,N-dimethylammonio) acetate, coco betaine or 2-(N-coco-N, N-dimethyl ammonio) acetate, myristyl betaine, palmityl betaine, lauryl betaine, cetyl betaine, stearyl betaine, etc. Amphoteric surfactants useful herein further include amine oxide surfactants. The amidobetaines are exemplified by cocoamidoethyl betaine, cocamidopropyl betaine (CAPB), and lauramidopropyl betaine. The unwanted tastes often associated with these surfactants are soapy, bitter, chemical, or artificial.

Additional suitable polymeric organophosphate agents can include dextran phosphate, polyglucoside phosphate, alkyl polyglucoside phosphate, polyglyceryl phosphate, alkyl polyglyceryl phosphate, polyether phosphates and alkoxylated polyol phosphates. Some specific examples are PEG phosphate, PPG phosphate, alkyl PPG phosphate, PEG/PPG phosphate, alkyl PEG/PPG phosphate, PEG/PPG/PEG phosphate, dipropylene glycol phosphate, PEG glyceryl phosphate, PBG (polybutylene glycol) phosphate, PEG cyclodextrin phosphate, PEG sorbitan phosphate, PEG alkyl sorbitan phosphate, and PEG methyl glucoside phosphate. Suitable non-polymeric phosphates include alkyl mono glyceride phosphate, alkyl sorbitan phosphate, alkyl methyl glucoside phosphate, alkyl sucrose phosphates. The impurities in these phosphates may induce a burning sensation. Impurities may include dodecanol, dodecanal, benzaldehyde, and other TRPA1 or TRPV1 agonists.

Cationic surfactants useful in the present invention can include derivatives of quaternary ammonium compounds having one long alkyl chain containing from about 8 to 18 carbon atoms such as lauryl trimethylammonium chloride, cetyl trimethylammonium bromide, coconut alkyltrimethylammonium nitrite, cetyl pyridinium fluoride, etc. Quaternary ammonium halides having detergent properties can be used, such as those described in U.S. Pat. No. 3,535,421 to Briner et al. Certain cationic surfactants can also act as germicides in the compositions disclosed herein.

Anti-tartar agents include pyrophosphate salts as a source of pyrophosphate ion. The pyrophosphate salts useful in the present compositions include, for example, the mono-, di- and tetraalkali metal pyrophosphate salts and combinations thereof. Disodium dihydrogen pyrophosphate ($\text{Na}_2\text{H}_2\text{P}_2\text{O}_7$), sodium acid pyrophosphate, tetrasodium pyrophosphate ($\text{Na}_4\text{P}_2\text{O}_7$), and tetrapotassium pyrophosphate ($\text{K}_4\text{P}_2\text{O}_7$) in their unhydrated as well as hydrated

forms are further species. In compositions of the present invention, the pyrophosphate salt may be present in one of three ways: predominately dissolved, predominately undissolved, or a combination of dissolved and undissolved pyrophosphate. The amount of pyrophosphate salt useful in making these compositions is any tartar control effective amount. In varying examples, the amount of pyrophosphate salt may be from about 1.5% to about 15%, from about 2% to about 10%, or about 3% to about 8%, by total weight of the oral care composition.

Abrasive polishing material can be any material that does not excessively abrade dentin. The oral care compositions can contain abrasive polishing material in an amount of from about 6% to about 70% or from about 10% to about 50%, by weight of the oral care composition. Typical abrasive polishing materials include silicas including gels and precipitates; aluminas; phosphates including orthophosphates, polymetaphosphates, and pyrophosphates; and mixtures thereof. Specific examples include dicalcium orthophosphate dihydrate, calcium pyrophosphate, tricalcium phosphate, calcium polymetaphosphate, insoluble sodium polymetaphosphate, rice hull silica, hydrated alumina, beta calcium pyrophosphate, calcium carbonate, and resinous abrasive materials such as particulate condensation products of urea and formaldehyde, and others such as disclosed by Cooley et al in U.S. Pat. No. 3,070,510. In certain examples, if the oral composition or particular phase comprises a polyphosphate having an average chain length of about 4 or more, calcium containing abrasives and alumina are not preferred abrasives.

Silica dental abrasives of various types are often used in oral care compositions due to their exceptional dental cleaning and polishing performance without unduly abrading tooth enamel or dentine. Silica abrasive polishing materials that may be used in the present invention, as well as other abrasives, generally have an average particle size ranging between about 0.1 to about 30 μm or from about 5 to about 15 μm . The abrasive can be precipitated silica or silica gels such as the silica xerogels described in Pader et al., U.S. Pat. No. 3,538,230 and DiGiulio, U.S. Pat. No. 3,862,307. Silica xerogels marketed under the trade name "Syloid" by the W.R. Grace & Company, Davison Chemical Division, Augusta, GA may be used. Also precipitated silica materials such as those marketed by the J. M. Huber Corporation, Edison, NJ under the trade name, "Zeodent", particularly the silica carrying the designation "Zeodent 119", may be used. The types of silica dental abrasives useful in the oral care compositions of the present invention are described in more detail in Wason, U.S. Pat. No. 4,340,583; and Rice U.S. Pat. No's 5,589,160; 5,603,920; 5,651,958; 5,658,553; and 5,716,601.

Thickening material or binders may be used to provide a desirable consistency to the oral care compositions of the present invention. For example when the oral care compositions are in

the form of dentifrices, topical oral gels, mouthrinse, denture product, mouthsprays, lozenges, oral tablets or chewing gums, the amount and type of the thickening material will depend upon the form of the product. Thickening materials include carboxyvinyl polymers, carrageenan, hydroxyethyl cellulose, and water soluble salts of cellulose ethers such as sodium carboxymethylcellulose and sodium hydroxyethyl cellulose. Natural gums such as gum karaya, xanthan gum, gum arabic, and gum tragacanth can also be used. Colloidal magnesium aluminum silicate or finely divided silica can be used as part of the thickening material to further improve texture. Thickening materials can be used in an amount from about 0.1% to about 15%, by weight of the oral care composition.

Humectants keep oral care compositions from hardening upon exposure to air and certain humectants can also impart desirable sweetness of flavor to dentifrice compositions. Suitable humectants for use in the present invention include glycerin, sorbitol, polyethylene glycol, propylene glycol, xylitol, and other edible polyhydric alcohols. The oral care compositions of the present invention may comprise humectants in an amount of from about 0% to about 70% or from about 15% to about 55%, by weight of the oral care composition.

Assay for Taste Receptors

Human fungiform taste bud cells were isolated from tongues of humans as described in Ozdener, Mehmet, and Nancy Rawson. "Primary Culture of Mammalian Taste Epithelium." *Methods in Molecular Biology*; 2013; 945: 95-107.

Then the cells were further cultured according to the following procedure. The cells were grown in a Corning® cell culture flask, with a surface area of 75 cm², a canted neck, and a 0.2 µm Vent cap (Catalog# 430641, available from VWR International, Bridgeport, NJ, USA) at 37°C using a growth medium containing 500 mL of Iscove's Modified Dulbecco's Media (IMDM), 100 mL of Ham's F12 Nutrient Mixture, 60 mL Fetal Bovine Serum (FBS), and 150 µg/mL Penicillin-Streptomycin cocktail (all growth media components available from Life Technologies, Grand Island, New York, USA).

After the cells reach 80-90% confluence, which generally takes about seven days of cultivation, the cells were released by adding 3 mL of Gibco® Trypsin-EDTA (0.05%) solution (available from Life Technologies) at 37°C in couple of minutes, followed by adding 12 mL of cell growth medium to deactivate trypsin. Then the cells were diluted in the growth medium at approximately 250,000 cells/mL. Next, 100 µl volume of cell suspension containing 20,000 to 30,000 cells were seeded into each well of a Falcon® 96 Well Black with Clear Flat Bottom TC-

Treated Imaging Plate (REF # 353219, available from VWR International, Bridgeport, NJ, USA) and the cells are grown overnight.

After the overnight cultivation, the cell culture media was removed by aspiration. Then, 100 μ L of Calcium-6QF solution was added to each well. The Calcium-6QF solution was made by dissolving the contents of one vial of Calcium-6QF (available from Molecular Devices, Sunnyvale, California, USA) in 20 mL of assay buffer, which contains Hank's Balanced Salt Solution (HBSS) with 20 mM HEPES (4-(2-hydroxyethyl)-1-piperazineethanesulfonic acid) (both components are available from Life Technologies). The plate was then incubated at 37°C for 105 min and at room temperature for 15 min. Then the 96-well plate is placed in a FLIPR® Tetra High Throughput Cellular Screening System (available from Molecular Devices) and 20 μ L of working solution, as described below, are added to each well. The fluorescence signal was read continuously for 5 min, where the excitation and emission wave lengths used were 488 nM and 510 nM respectively. The peak value and/or area under the curve after five minutes was calculated and recorded.

In order to form the working solution, the test material was diluted with the assay buffer. Examples of test materials can include, but are not limited to GG solutions, PG solutions, 1,3-PPD solutions, full formulations such as those in Example 4 and 5, and combinations thereof. The amount of assay buffer varies depending on the desired final concentration, which occurs when the test material is in the wells. For example, if the test material is GG, it can be desirable to have a final concentration of 2 mM. Thus, a 12 mM working solution is made and when it is added to the wells, the concentration is further reduced to a final concentration of 2 mM. In another example, in order to make a working solution for Examples 4 and 5, and other full formulations, 1 mL of the example is added to 27 mL of assay buffer to form the working solution and then it is added to the wells for an overall reduction of 162 fold.

While the specification concludes with the claims particularly pointing and distinctly claiming the invention, it is believed that embodiments of the present invention will be better understood from this description. In all embodiments of the present invention, all weight percentages are by weight of the total composition, unless specifically stated otherwise. All ratios are weight ratios, unless specifically stated otherwise. All ranges are inclusive and combinable. The number of significant digits conveys neither limitation on the indicated amounts nor on the accuracy of the measurements. All measurements are understood to be made at 25°C and at ambient conditions, where "ambient conditions" means conditions under about one atmosphere of pressure and at about 50% relative humidity. All such weights as they pertain to listed

ingredients are based on the active level and do not include carriers or by-products that may be included in commercially available materials, unless otherwise specified.

The dimensions and values disclosed herein are not to be understood as being strictly limited to the exact numerical values recited. Instead, unless otherwise specified, each such dimension is intended to mean both the recited value and a functionally equivalent range surrounding that value. For example, a dimension disclosed as “40 mm” is intended to mean “about 40 mm.”

Every document cited herein, including any cross referenced or related patent or application and any patent application or patent to which this application claims priority or benefit thereof, is hereby incorporated herein by reference in its entirety unless expressly excluded or otherwise limited. The citation of any document is not an admission that it is prior art with respect to any invention disclosed or claimed herein or that it alone, or in any combination with any other reference or references, teaches, suggests or discloses any such invention. Further, to the extent that any meaning or definition of a term in this document conflicts with any meaning or definition of the same term in a document incorporated by reference, the meaning or definition assigned to that term in this document shall govern.

While particular embodiments of the present invention have been illustrated and described, it would be obvious to those skilled in the art that various other changes and modifications can be made without departing from the spirit and scope of the invention. It is therefore intended to cover in the appended claims all such changes and modifications that are within the scope of this invention.

CLAIMS

What is claimed is:

1. A composition with reduced bitterness comprising a polyquaternium selected from the group consisting of polyquaternium-2, polyquaternium-17, polyquaternium-18, and combinations thereof.
2. The composition according to claim 1, wherein the composition is selected from the group consisting of bitter foods, bitter beverages, oral care compositions, and combinations thereof.
3. The composition according to claims 1 or 2, wherein the composition further comprises a bitter component selected from the group consisting of Hops, guaifenesin, phenytoin, omeprazole, cetirizine, jambu, acetaminophen, methyl formyl anthranilate, 2-aminoacetophenone, methyl anthranilate, dimethyl anthranilate, beta-terpineol, beta-naphthyl anthranilate, and benzoyl anthranilic acid, 1,10-phenanthroline, saccharin, and propylene glycol, benzamide, brucine, 1,10-phenanthroline, and combinations thereof.
4. The composition according to claims 1 to 3, wherein an overall bitterness is reduced by at least 25% as compared to an identical composition without the polyquaternium as determined by the *in vitro* Assay for Taste Receptors.
5. The composition according to claims 1 to 4, wherein an overall bitterness is reduced by at least 40% as compared to an identical composition without the polyquaternium as determined by the *in vitro* Assay for Taste Receptors.
6. The composition of claims 1 to 5580, wherein an overall bitterness is less than 7000 fluorescence units, preferably less than 6000 fluorescence units, more preferred less than 5000 fluorescence units, more preferred less than 4000 fluorescence units, more preferred less than 3000 fluorescence units, more preferred less than 1000 fluorescence units, and most preferred less than 500 fluorescence units as determined by the *in vitro* Assay for Taste Receptors.

7. The composition according to claims 1 to 6 wherein an overall bitterness is reduced by at least 30%, preferably at least 40%, more preferred at least 50%, more preferred at least 60%, more preferred at least 75%, and most preferred at least 85% as compared to an identical composition without the polyquaternium as determined by the *in vitro* Assay for Taste Receptors.