comprising naturally derived rhamnolipids, would satisfy sustainability goals of ensuring sustainable consumption through the use of bio-based antibacterial materials.

[0010] Applicants have determined that particular compositions of rhamnolipid can meet the above objectives while also advancing UN Sustainability Goals ("SDG"). The rhamnolipid compositions of the present technology contribute to better health and well-being by delivering equal or better efficacy in the maintenance of a healthy scalp (e.g., in the prevention and/or treatment of dandruff). The rhamnolipid compositions described herein are advantageously bio-based, renewably sourced actives obtained from a bacterial fermentation process that generates biodegradable waste products that are less impactful on the environment. These benefits further SDG #3 (Good Health and Well-being) and SDG #12 (Responsible Consumption and Production).

## SUMMARY

[0011] One example of the present technology is directed to compositions and methods for facilitating the maintenance of a healthy scalp. More particularly, the technology described herein relates to compositions, and methods of use, for the treatment and/or prevention of the dandruff cycle. In certainexamples, application of the compositions described herein, in accordance with the methods and regimens described herein, inhibit the growth, colonization, and/or reduce the viability of skin condition causing microorganisms such as the lipophilic yeast *Malassezia*.

[0012] One further example of the present technology regards a natural, holistic alternative to the currently available harsh and non-select chemistries for the prevention and treatment of dandruff. More particularly, the technology described herein regards the use of novel Rhamnolipids compositions to facilitate the maintenance of a healthy scalp microbiome, including inhibiting (or otherwise controlling) the growth, colonization, and/or reducing the viability of the lipophilic yeast *Malassezia*, and progression through the dandruff cycle.

[0012a] In one aspect, there is provided the use of a composition in the manufacture of a medicament for treating dandruff comprising:

(a) a mixture of rhamnolipid salts in an amount of about 0.01% to about 30% by weight, based on the total weight of the composition, wherein the mixture of rhamnolipid salts comprises mono-rhamnolipids and di-rhamnolipids in a weight ratio of 10:90 to 90:10 mono-rhamnolipids:di-rhamnolipids based on the total weight of the mixture of rhamnolipid salts, an amount of Rha-C10-C10 mono-rhamnolipid salt of about 5% to about 50% by weight based on the total weight of the mixture of rhamnolipid salts, and an amount of RhaRha-C10-C10 di-rhamnolipid salt of about 30% to about 80% by weight based on the total weight of the mixture of rhamnolipid salts;

(b) at least one surfactant selected from the group consisting of anionic surfactants, amphoteric surfactants, nonionic surfactants, cationic surfactants, and combinations thereof; and

(c) a dermatologically acceptable carrier comprising water in an amount to total 100% by weight,

wherein the composition reduces *Malassezia* species present on mammalian skin in the absence of other anti-fungal actives.

[0012b] In another aspect, there is provided the use of the composition of as defined above in the manufacture of a medicament for the treatment of an excess of *Malassezia* species on mammalian skin.

[0013] In one example of the present technology, there are provided dandruff treatment compositions comprising: (a) a mixture of rhamnolipid salts; (b) at least one surfactant selected from the group consisting of anionic surfactants, amphoteric surfactants, nonionic surfactants, cationic surfactants, and combinations thereof; and (c) a dermatologically acceptable carrier, wherein, when applied to mammalian skin, the composition exhibits an anti-fungal effect (i.e., inhibits, prevents growth and/or otherwise reduces viability) against *Malassezia* species in the absence of other anti-fungal actives.

[0014] In another example, there are provided dandruff treatment compositions comprising: (a) a mixture of Zinc-rhamnolipid salts in an amount of about 0.01% to about 30% by weight, based on the total weight of the composition; and (b) a dermatologically acceptable carrier in an amount to total 100% by weight. When applied to mammalian skin (e.g., to a mammalian scalp), the composition exhibits an anti-fungal effect against *Malassezia* species in the absence of other anti-fungal actives.

[0015] In a still further example of the present technology, there are provided dandruff treatment compositions comprising: (a) a mixture of rhamnolipid salts in an amount of about 0.01% to about 30% by weight, based on the total weight of the composition; (b) about 1% to about 5%, about 1% to about 10%, about 1% to about 15%, about 1% to about 20%, about 1% to about 30%, or about 1% to about 40% by weight of the composition of at least one anionic surfactant; (c) about 1% to about 5%, about 1% to about 10%, about 1% to about 15%, about 1% to about 20%, about 1% to about 30%, or about 1% to about 40% by weight of the composition of at least one amphoteric surfactant; and (d) a dermatologically acceptable carrier in an amount to total 100%. When applied to mammalian skin (e.g., to a mammalian scalp), the composition exhibits an anti-fungal effect against *Malassezia* species in the absence of other anti-fungal actives.

[0016] Furthermore, the mixture of rhamnolipid salts comprises mono-rhamnolipids and di-rhamnolipids, for example, in a weight ratio of 10:90 to 90:10, 40:60 to 60:40, or 40:60 to 48:52 mono-rhamnolipids:di-rhamnolipids. The mixture of rhamnolipid salts further comprises, for example, an amount of Rha-C10-C10 mono-rhamnolipid salt of about 5% to about 50%, or about 5% to about 38% by weight, based on the total weight of the mixture of rhamnolipid salts, and an amount of RhaRha-C10-C10 di-rhamnolipid salt of about 30% to about 80%, or about 34% to about 80% by weight, based on the total weight of the mixture of rhamnolipid salts.

[0017] Still further, the mixture of rhamnolipid salts can be present, in the dandruff treatment compositions described herein, in an amount of about 0.01% to

about 30% by weight, about 0.01% to about 20% by weight, about 0.01% to about 10% by weight, about 0.01% to about 5% by weight, about 0.05% to about 30% by weight, about 0.05% to about 20% by weight, about 0.05% to about 10% by weight, about 0.05% to about 5% by weight, about 0.1% to about 30% by weight, about 0.1% to about 20% by weight, about 0.1% to about 10% by weight, about 0.1% to about 5% by weight, about 0.3% to about 20% by weight, about 0.3% to about 10% by weight, about 0.3% to about 5% by weight, about 0.3% to about 3%, about 0.3% to about 2%, or about 0.3% to about 1%, all based on the total weight of the composition.

[0018] A still further example of the present technology includes one or more methods for controlling, treating, or preventing dandruff in a subject afflicted with or susceptible to dandruff. These methods comprise, for example, applying to the hair of the subject an effective amount of any one of more of the dandruff treatment compositions described herein.

[0019] Another example of the present disclosure includes one or more methods for treating an excess of a *Malassezia* species on mammalian skin, including on a mammalian scalp. These methods include, for example, applying to the mammalian skin an effective amount of any one of more of the dandruff treatment compositions described herein.

[0020] In other examples, the compositions, and methods disclosed herein positively impact fundamental host factors, including microbiome balance. Likewise, the compositions and methods disclosed herein facilitate the

Claims

1. Use of a composition in the manufacture of a medicament for treating dandruff comprising:

    (a) a mixture of rhamnolipid salts in an amount of about 0.01% to about 30% by weight, based on the total weight of the composition, wherein the mixture of rhamnolipid salts comprises mono-rhamnolipids and di-rhamnolipids in a weight ratio of 10:90 to 90:10 mono-rhamnolipids:di-rhamnolipids based on the total weight of the mixture of rhamnolipid salts, an amount of Rha-C10-C10 mono-rhamnolipid salt of about 5% to about 50% by weight based on the total weight of the mixture of rhamnolipid salts, and an amount of RhaRha-C10-C10 di-rhamnolipid salt of about 30% to about 80% by weight based on the total weight of the mixture of rhamnolipid salts;

    (b) at least one surfactant selected from the group consisting of anionic surfactants, amphoteric surfactants, nonionic surfactants, cationic surfactants, and combinations thereof; and

    (c) a dermatologically acceptable carrier comprising water in an amount to total 100% by weight,

    wherein the composition reduces *Malassezia* species present on mammalian skin in the absence of other anti-fungal actives.

2. The use of claim 1, wherein the mixture of rhamnolipid salts comprises a mixture of zinc-rhamnolipid salts.

3. The use of any one of claims 1-2, wherein the at least one surfactant comprises an anionic surfactant in an amount of about 1% to about 40% by weight of the composition.

4. The use of any one of claims 1-3, wherein the at least one surfactant comprises an amphoteric surfactant in an amount of about 1% to about 40% by weight of the composition, about 1% to about 30% by weight of the composition, about 1% to about 20% by weight of the composition, or about 1% to about 10% by weight of the composition.

5. The use of any one of claims 1-4, wherein the mixture of rhamnolipid salts comprises from about 20% to about 60% by weight, from about 30% to about 50% by weight, from about 40% to about 50% by weight, or from about 45% to about 48% by weight, of mono-rhamnolipids based on the total weight of the mixture of rhamnolipid salts.

6. The use of any one of claims 1-5, wherein the mixture of rhamnolipid salts comprises from about 20% to about 70% by weight, from about 30% to about 60% by weight, from about 40% to about 60% by weight, from about 45% to about 55% by weight, or from about 50% to about 55% by weight, of di-rhamnolipids based on the total weight of the mixture of rhamnolipid salts.

7. The use of any one of claims 1-6, wherein the mixture of rhamnolipid salts comprises an amount of Rha-C8-C10 mono-rhamnolipid salt of about 1% to about 10% by weight, about 1% to about 5% by weight, about 2% to about 5% by weight, or about 3% to about 4% by weight, based on the total weight of the mixture of rhamnolipid salts.

8. The use of any one of claims 1-7, wherein the mixture of rhamnolipid salts comprises an amount of RhaRha-C8-C10 di-rhamnolipid salt of about 1% to about 10% by weight, about 1% to about 5% by weight, about 2% to about 5% by weight, or about 3% to about 4% by weight, based on the total weight of the mixture of rhamnolipid salts.

9. The use of any one of claims 1-8, wherein the mixture of rhamnolipid salts comprises an amount of Rha-C10-C12 mono-rhamnolipid salt of about 1% to about 10% by weight, about 1% to about 5% by weight, about 2% to about 5% by

weight, about 3% to about 5% by weight, or about 4% to about 5% by weight, based on the total weight of the mixture of rhamnolipid salts.

10. The use of any one of claims 1-9, wherein the mixture of rhamnolipid salts comprises an amount of RhaRha-C10-C12 di-rhamnolipid salt of about 1% to about 20% by weight, about 5% to about 15% by weight, about 10% to about 15% by weight, or about 10% to about 12% by weight, based on the total weight of the mixture of rhamnolipid salts.

11. The use of any one of claims 1-10, wherein the at least one surfactant is selected from the group consisting of sulfonated alkyl benzenes, sulfonated methyl esters, sulfonated alpha olefins, paraffin sulfonates, alkyl sulfates, alkyl alkoxy sulfates, alkyl alkoxy carbonates, alkyl sulfonates, alkyl alkoxy sulfonates, acyl lactylates, alkyl isethionates, alkyl sarcosinates, alkyl betaines, alkyl amidopropyl betaines, alkyl sultaines, alkyl amine oxides, quaternary ammonium compounds, salts thereof, and combinations thereof.

12. The use of any one of claims 1-11, wherein the dermatologically acceptable carrier further comprises one or more alcohols, glycols, or solvents.

13. The use of any one of claims 1-12, wherein the composition further comprises at least one anti-fungal active selected from the group consisting of zinc pyrithione, sulfur, selenium sulfide, salicylic acid, coal tar, ketoconazole, and piroctone olamine.

14. Use of the composition of claim 1 in the manufacture of a medicament for the treatment of an excess of *Malassezia* species on mammalian skin.

15. The use of claim 14, wherein the *Malassezia* species is *M. furfur, M. dermatis, M. equi, M. globosa, M. japonica, M. obtusa, M. ovalis (also known as Pityrosporum ovale), M. pachydermatis, M. restricta, M. slooffiae, M. sympodialis, or combinations thereof.*