therapeutically effective amount of a purified viable gram negative bacteria and a pharmaceutically acceptable carrier, wherein a) a lysate and/or component of the gram negative bacteria inhibits growth of *S. aureus* in an *in vitro* assay; b) the gram negative bacteria stimulates human keratinocytes; c) the gram negative bacteria induces cytokine expression from human cells; and d) the gram negative bacteria is non-pathogenic when administered to the skin of the subject. The pharmaceutical compositions are formulated for topical administration.

Methods of treating a topical dermatitis using these pharmaceutical compositions are also disclosed.

In one aspect, there is provided a use of a pharmaceutical composition comprising:

a therapeutically effective amount of at least one species of gram-negative bacteria isolated from skin of a subject that does not have atopic dermatitis; and

a pharmaceutically acceptable carrier in the manufacture of a medicament for treating atopic dermatitis in a subject in need thereof.

In one aspect, there is provided a use of a pharmaceutical composition comprising:

a therapeutically effective amount of at least one strain of *Roseomonas mucosa* isolated from skin of a subject that does not have atopic dermatitis; and

a pharmaceutically acceptable carrier in the manufacture of a medicament for treating atopic dermatitis in a subject in need thereof.

In one aspect, there is provided a bandage comprising the medicament as described herein.

In one aspect, there is provided a spray bottle comprising medicament as described herein.

In one aspect, there is provided a kit for treating atopic dermatitis, comprising:

a) a container comprising a medicament as described herein;

b) a container comprising a the pharmaceutically acceptable carrier; and

c) instructions for applying the therapeutically effective amount of the purified viable gram-negative bacteria in the pharmaceutically acceptable carrier topically to the skin.

The foregoing and other features and advantages of the invention will become more apparent from the following detailed description of several embodiments which proceeds with reference to the accompanying figures.

BRIEF DESCRIPTION OF THE FIGURES

FIGs. 1A-1D: CGN isolates differ in presence and *S. aureus* inhibition between healthy volunteers and patients with AD. (A) Percentage of individuals with CGN isolate yield from HV (n=26) and AD (n=17) subjects. Individuals with multiple CGN isolates were counted per isolate for >100% total in HV; see Table 1 for details. (B) Eight strains of *S. aureus* isolated

from HV and AD patients were grown in the presence of either CGN supernatant or control media. Each data point represents the effect on *S. aureus* growth of supernatant from one CGN isolate compared to media control (HV isolates = 9, AD isolates = 7); shapes represent sourcing of *S. aureus* as either the participant's autologous *S. aureus*, or one *S. aureus* isolate from HV or AD patients. Data points with a * symbol represent one HV- and one AD-derived CGN isolate selected for subsequent human challenge and mouse model experiments. Data is alternatively presented by CGN species, see FIG. 4. (C) Healthy mouse ears were co-inoculated with *S. aureus* (strain SAAS9) and *R. mucosa* (*Rm*) from HV or AD patients, or *P. aeruginosa* from a HV for 10 days. Day 12 ears were homogenized and plated by serial dilution for CFU. Percent change in growth versus diluent (no CGN added) control is shown. (D) CGN CFU yield taken from same mice as panel C. Data shown are a combination of three or more independent experiments (B) or representative of two independent experiments (C-D) and displayed as mean + sem. SA = *S. aureus*, HV = Healthy Volunteer, AD = Atopic Dermatitis, CGN = Culturable gram negative, Rm = *Roseomonas mucosa*, Pa = *Pseudomonas aeruginosa*. Significance determined by Student's t test (B) or ANOVA with Bonferroni's correction (C-D).

FIGs. 2A-2D: CGN from HV enhances innate immunity and barrier function. (A) Cytokine analysis for in vivo human blister challenge on healthy controls showing cytokine

We claim:

1. Use of a pharmaceutical composition comprising:
   a therapeutically effective amount of at least one species of gram-negative bacteria isolated from skin of a subject that does not have atopic dermatitis; and
   a pharmaceutically acceptable carrier in the manufacture of a medicament for treating atopic dermatitis in a subject in need thereof.
2. The use of claim 1, wherein the medicament is formulated in a topical dosage form selected from a cream, gel, salve, foam, ointment, and a lotion.
3. The use of claim 1, wherein the at least one species of gram-negative bacteria comprises a species of *Pseudomonas*.
4. The use of claim 3, wherein the species of *Pseudomonas* is *Pseudomonas aeruginosa*, *Pseudomonas luteola*, or *Pseudomonas oryzihabitans*.
5. The use of claim 1, wherein the at least one species of gram-negative bacteria comprises a species of *Pantoea*.
6. The use of claim 5, wherein the species of *Pantoea* is *Pantoea septica*.
7. The use of claim 1, wherein the at least one species of gram-negative bacteria comprises a species of *Moraxella*.
8. The use of claim 7, wherein the species of *Moraxella* is *Moraxella osloensis*.
9. The use of claim 1, wherein the at least one species of gram-negative bacteria comprises a species of Methylobacterium.
10. The use of claim 1, wherein the at least one species of gram-negative bacteria comprises *Acinetobacter radioresistens*, *Moraxella osloensis*, *Pantoea septica*, *Pseudomonas luteola*, *Pseudomonas aeruginosa*, or *Pseudomonas oryzihabitans*.
11. The use of claim 1, wherein the at least one species of gram-negative bacteria is present in an amount of 10^4 to 10^{12} colony forming units.
12. The use of claim 1, wherein the at least one species of gram-negative bacteria is viable.
13. The use of claim 1, wherein the at least one species of gram-negative bacteria is purified.
14. The use of claim 1, wherein the at least one species of gram-negative bacteria comprises up to three strains of gram-negative bacteria.

15. The use of claim 1, wherein the at least one species of gram-negative bacteria comprises up to five strains of gram-negative bacteria.
16. The use of claim 1, wherein the pharmaceutically acceptable carrier comprises sucrose.
17. Use of a pharmaceutical composition comprising:
    a therapeutically effective amount of at least one strain of *Roseomonas mucosa* isolated from skin of a subject that does not have atopic dermatitis; and
    a pharmaceutically acceptable carrier in the manufacture of a medicament for treating atopic dermatitis in a subject in need thereof.
18. The use of claim 17, wherein the medicament is formulated in a topical dosage form selected from the group consisting of a cream, gel, salve, foam, ointment, and a lotion.
19. The use of claim 17, wherein the at least one strain of *Roseomonas mucosa* is present in an amount of 10^4 to 10^{12} colony forming units.
20. The use of claim 17, wherein the at least one strain of *Roseomonas mucosa* is viable.
21. The use of claim 17, wherein the at least one strain of *Roseomonas mucosa* is purified.
22. The use of claim 17, wherein the at least one strain of *Roseomonas mucosa* is present in an amount sufficient for a reduction in *Staphylococcus aureus* in the subject.
23. The use of claim 17, wherein the at least one strain of *Roseomonas mucosa* comprises up to three strains of *Roseomonas mucosa.*
24. The use of claim 17, wherein the at least one strain of *Roseomonas mucosa* comprises up to five strains of *Roseomonas mucosa.*
25. The use of claim 17, wherein the pharmaceutically acceptable carrier comprises sucrose.
26. A bandage comprising the medicament of any one of claims 1-25.
27. A spray bottle comprising medicament of any one of claims 1-25.
28. A kit for treating atopic dermatitis, comprising:
    a) a container comprising a medicament as described in any one of claims 1-25;
    b) a container comprising a the pharmaceutically acceptable carrier; and
    c) instructions for applying the therapeutically effective amount of the purified viable gram-negative bacteria in the pharmaceutically acceptable carrier topically to the skin.