resolution of the condition. Such microbe specific medications are disadvantages as it requires specific diagnosis of the cause of keratitis before treatment can be provided. Furthermore, commercially available anti-fungal medication does not address the fact that fungal keratitis infection often exists as a biofilm, which is particularly difficult to remove because fungal cells are encapsulated in a protective and impermeable extracellular matrix (ECM). Therefore, typically, treatment requires significantly higher doses of antifungal agents in an attempt to clear biofilm.

[0010] Furthermore, current commercial drugs include azole compounds (such as funconazole) and polyenes (such as amphopterin B, nystatin and natamycin). The azoles are fungistatic, which function by enzyme inhibition and are prone to drug resistance development. However, azoles available in the art are extremely unstable; their topical solution must be kept refrigerated for no more than 48 hours and protected from light. Another antifungal drugs known in the art are the polyenes, which function via disrupting the permeability of ions through the cell membrane, are rather expensive, poorly water soluble and quite unstable in aqueous, acid or alkaline media, or when exposed to light and excessive heat. All these limit their clinical applications.

[0011] In view of the above, there is a need to provide alternative agents useful for treating keratitis caused by various microbes. There is also a need to provide alternative agents useful for treating keratitis that is stable and safe to use.

SUMMARY OF THE INVENTION

[0012] In one aspect, there is provided the use of an amphiphilic peptide comprising $(X_1Y_1X_2Y_2)_n$ (Formula I), wherein the C-terminal end of the peptide is amidated; X_1 and X_2 is independently of each other a hydrophobic amino acid; Y_1 and Y_2 is independently of each other a cationic amino acid and wherein n is at least 1.5, wherein the peptide is capable of self-assembly into b-sheet structure in the manufacture of a medicament for treating keratitis in a subject.

[0013] Also disclosed is the peptide as described herein for treating keratitis in a subject.

[0014] Also disclosed is a method of treating keratitis in a subject. The method comprises the administration of a pharmaceutically effective amount of a peptide as described herein.

[0015] In another aspect, there is provided use of an effective amount of an amphiphilic peptide in the manufacture of a medicament for removing a biofilm from a cornea of a subject, wherein the peptide comprises: (X1Y1X2Y2)n (Formula I), wherein the C-terminal end of the peptide is amidated; X1 and X2 is independently of each other a hydrophobic amino acid Y1 and Y2 is independently of each other a cationic amino acid; and n is at least 1.5, wherein the peptide is capable of self-assembly into β-sheet structure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The invention will be better understood with reference to the detailed description when considered in conjunction with the non-limiting examples and the accompanying drawings, in which:

[0017] **Figure 1** shows design features of synthetic β-sheet forming peptides. A) shows exemplary peptide of the present disclosure. B) shows an example of the peptide of the present disclosure presented as a linear molecule. C) shows a schematic diagram of possible membrane disruption caused by the peptide of the present disclosure. In brief, in aqueous solutions, the peptides exist as monomeric random coils due to electrostatic repulsion between the protonated Arg and/or Lys residues. However, in the presence of microbial cell membranes, the peptides readily assemble into β-sheet secondary structures stabilized by electrostatic interactions between the positively charged residues and the negatively charged phospholipids, followed by the insertion of their hydrophobic residues into the lipid bilayer to mediate membrane disruption.

[0018] **Figure 2** shows circular dichroism spectra of (a) $(VRVK)_2$-NH_2 (SEQ ID NO: 11), (b) $(IRIR)_2$-NH_2 (SEQ ID NO: 12), (c) $(IKIK)_2$-NH_2 (SEQ ID NO: 13), (d) $(IRIK)_2$-NH_2 (SEQ ID NO: 17), (e) $(IRVK)_2$-NH_2 (SEQ ID NO: 14), (f) $(FRFK)_2$-NH_2 (SEQ ID NO: 15), (g) $(VRVK)_3$-NH_2 (SEQ ID NO: 20), (h) $(IRIK)_3$-NH_2 (SEQ ID NO: 21), (i) $(IRVK)_3$-NH_2 (SEQ ID NO: 22) in deionized water and 25 mM SDS micelles solution. Figure 2 demonstrates how the peptides of the present disclosure readily self-assembled into β-sheet secondary structures in a microbial membrane mimicking condition (25 mM SDS solution).

[0019] **Figure 3** shows haemolytic activities of the synthetic antimicrobial peptides. Figure 3 shows that the peptides of the present disclosure induced minimal or no haemolysis against rat red blood cells at various minimum inhibitory concentration (MIC) values.

[0020] **Figure 4** shows plot of viable microbe colony-forming units (CFU) after treatment with representative peptide $(IRIK)_2$-NH_2 (SEQ ID NO: 17) at various concentrations (i.e. 0, 0.5 × minimum inhibitory concentration (MIC), MIC and 2 × MIC). Figure 4 shows that the peptides of the present disclosure are bactericidal at MIC values and above.

[0021] **Figure 5** shows FE-SEM images of (a) *Escherichia coli* and (b) *Staphylococcus aureus* treated with broth containing 10% (by volume) of water as control and representative

Claims

1. Use of an amphiphilic peptide, wherein the peptide comprises: $(X_1Y_1X_2Y_2)_n$ (Formula I), wherein

the C-terminal end of the peptide is amidated;

X_1 and X_2 is independently of each other a hydrophobic amino acid

Y_1 and Y_2 is independently of each other a cationic amino acid; and

n is at least 1.5,

wherein the peptide is capable of self-assembly into β-sheet structure,

in the manufacture of a medicament for treating keratitis in a subject.

2. The use of claim 1, wherein n is 2 or 2.5 or 3 or 3.5 or 4 or 4.5 or 5.

3. The use of any one of claims 1 to 2, wherein $(X_1Y_1X_2Y_2)_n$ is $(X_1Y_1X_2Y_2)_n$-NH_2.

4. The use of any one of claims 1 to 3, wherein the hydrophobic amino acid is selected from the group consisting of alanine (A), valine (V), isoleucine (I), leucine (L), methionine (M), phenylalanine (F), tryptophan (W) and cysteine (C).

5. The use of claim 4, wherein the hydrophobic amino acid is isoleucine (I), or valine (V).

6. The use of any one of claims 1 to 5, wherein the cationic amino acid is selected from the group consisting of lysine (K), arginine (R) and histidine (H).

7. The use of any one of claims 1 to 6, wherein each repeating unit n of Formula I comprises independently of each other 1 or 2 or 3 or 4 or 6 or 8 D-amino acids with the remaining amino acids being L-amino acids.

8. The use of any one of claims 1 to 6, wherein each repeating unit n of Formula I comprises independently of each other 2 or 4 or 6 or 8 D-amino acids with the remaining amino acids being L-amino acids.

9. The use of claim 7 or 8, wherein the distribution of D-amino acids in each repeating unit n of Formula I is identical or different from each other.

10. The use of any one of claims 7 to 9, wherein n is 2 and amino acids in position 4 and 6 are D-amino acids while the remaining amino acids are L-amino acids.

11. The use of any one of claims 1 to 10 comprising the sequence $(IY_1IY_2)_n$-NH_2.

12. The use of any one of claims 1 to 10 comprising the sequence $(IRX_2K)_n$-NH_2.

13. The use of any one of claims 1 to 12, wherein the peptide is selected from the group consisting of VRVKVRVK-NH_2 (SEQ ID NO: 11), VRVKVRVKVRVK-NH_2 (SEQ ID NO: 20), IRIRIRIR-NH_2 (SEQ ID NO: 12), IKIKIKIK-NH_2 (SEQ ID NO: 13), IRVKIRVK-NH_2 (SEQ ID NO: 14), FRFKFRFK-NH_2 (SEQ ID NO: 15), WRWKWRWK-NH_2 (SEQ ID NO: 16), IRIKIRIK-NH_2 (SEQ ID NO: 17), IRIKIRIKIRIK-NH_2 (SEQ ID NO: 21), <u>irikir</u>-NH_2 (SEQ ID NO: 10), <u>irikirik</u>-NH_2 (SEQ ID NO: 18), IR<u>I</u><u>k</u><u>I</u><u>r</u>IK-NH_2 (SEQ ID NO: 19), IRVKIRVKIRVK-NH_2 (SEQ ID NO: 22) and <u>irvkirvkirvk</u>-NH_2 (SEQ ID NO: 23), wherein small underlined residues represent D-amino acids while capital non-underlined represent L-amino acid.

14. The use of any one of claims 1 to 13, wherein the keratitis is a fungal keratitis, a viral keratitis or a bacterial keratitis.

15. The use of claim 14, wherein the bacterial keratitis is caused by *Pseudomonas aeruginosa, Streptococcus pneumonia, Staphylococcus aureus or Staphylococcus epidermidis*.

16. The use of claim 14, wherein the viral keratitis is caused by varicella zoster, adenoviruses or HSV-1.

17. The use of claim 14, wherein the fungal keratitis is caused by filamentous fungi and/or yeast-like fungi.

18. The use of claim 17, wherein the yeast-like fungi is *Candida albicans*.

19. The use of claim 17, wherein the filamentous fungi is selected from the group consisting of *Aspergillus flavus, Aspergillus fumigatus, Fusarium spp., Alternaria spp.*, and *Paecilomyces lilacinus.*

20. Use of an effective amount of an amphiphilic peptide in the manufacture of a medicament for removing a biofilm from a cornea of a subject, wherein the peptide comprises: $(X_1Y_1X_2Y_2)_n$ (Formula I), wherein

the C-terminal end of the peptide is amidated;

X_1 and X_2 is independently of each other a hydrophobic amino acid

Y_1 and Y_2 is independently of each other a cationic amino acid; and

n is at least 1.5,

wherein the peptide is capable of self-assembly into β-sheet structure.

21. The use of claim 20, wherein the biofilm is caused by fungal keratitis.

22. The use of claim 21, wherein the fungal infestation is caused by filamentous fungi and/or yeast-like fungi.

23. The use of claim 22, wherein the yeast-like fungi is *Candida albicans*.

24. The use of claim 22, wherein the filamentous fungi is selected from the group consisting of *Aspergillus flavus, Aspergillus fumigatus, Fusarium spp., Alternaria spp.*, and *Paecilomyces lilacinus.*