

Claims

1. A peptide comprising an amino acid sequence of alternating hydrophobic amino acids (X) and hydrophilic amino acids (Y), wherein each hydrophobic amino acid is independently selected from isoleucine (I), valine (V) and leucine (L), each
5 hydrophilic amino acid is independently selected from arginine (R), lysine (K), glutamic acid (E), and aspartic acid (D), at least one hydrophilic amino acid is selected from arginine and lysine, at least one hydrophilic amino acid is selected from glutamic acid and aspartic acid, and the amino acid sequence contains at least 8 amino acids.
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2. The peptide according to claim 1, wherein the amino acid sequence is not IRVEIEVK.
3. The peptide according to any one of claims 1 to 2, wherein the amino acid
15 sequence has an even number of amino acids.
4. The peptide according to any one of claims 1 to 3, wherein the amino acid sequence has 8 or 12 amino acids.
- 20 5. The peptide according to any one of claims 1 to 4, wherein there is at least one arginine and at least one lysine in the amino acid sequence.
6. The peptide according to any one of claims 1 to 5, wherein four sequential
25 hydrophilic amino acids (Y₁, Y₂, Y₃ and Y₄) in the amino acid sequence of alternating hydrophobic amino acids (X) and hydrophilic amino acids (Y) are selected such that Y₁ and Y₂ are each independently selected from glutamic acid and aspartic acid, and Y₃ and Y₄ are each independently selected from arginine and lysine.
- 30 7. The peptide according to any one of claims 1 to 5, wherein four sequential hydrophilic amino acids (Y₁, Y₂, Y₃ and Y₄) in the amino acid sequence of alternating hydrophobic amino acids (X) and hydrophilic amino acids (Y) are selected such that Y₁ and Y₃ are each independently selected from arginine and

lysine, and Y₂ and Y₄ are each independently selected from glutamic acid and aspartic acid.

8. The peptide according to any one of claims 1 to 5, wherein six sequential hydrophilic amino acids (Y₁, Y₂, Y₃, Y₄, Y₅, and Y₆) in the amino acid sequence of alternating hydrophobic amino acids (X) and hydrophilic amino acids (Y) are selected such that Y₁, Y₃, and Y₅ are each independently selected from arginine and lysine, and Y₂, Y₄, and Y₆ are each independently selected from glutamic acid and aspartic acid.
9. The peptide according to any one of claims 1 to 5, wherein six sequential hydrophilic amino acids (Y₁, Y₂, Y₃, Y₄, Y₅, and Y₆) in the amino acid sequence of alternating hydrophobic amino acids (X) and hydrophilic amino acids (Y) are selected such that Y₁, Y₂, and Y₃ are each independently selected from glutamic acid and aspartic acid, and Y₄, Y₅, and Y₆ are each independently selected from arginine and lysine.
10. The peptide according to any one of claims 1 to 5, wherein six sequential hydrophilic amino acids (Y₁, Y₂, Y₃, Y₄, Y₅, and Y₆) in the amino acid sequence of alternating hydrophobic amino acids (X) and hydrophilic amino acids (Y) are selected such that Y₁, Y₂, Y₅, and Y₆ are each independently selected from arginine and lysine, and Y₃, and Y₄ are each independently selected from glutamic acid and aspartic acid.
11. The peptide according to any one of claims 1 to 10, wherein the hydrophilic amino acids are selected such that the peptide has a net neutral charge or net positive charge.
12. The peptide according to any one of claims 1 to 11, wherein at least half of the hydrophobic amino acids in the amino acid sequence are isoleucine or leucine.

13. The peptide according to any one of claims 1 to 12, wherein there are 12 amino acids in the amino acid sequence and the hydrophobic amino acid residue is each independently selected from isoleucine and valine.
- 5 14. The peptide according to any one of claims 1 to 13, wherein the amino acid sequence is any one of the following: SEQ ID No. 9, SEQ ID No. 10, SEQ ID No. 11, SEQ ID No. 12, SEQ ID No. 13, SEQ ID No. 14, SEQ ID No. 15, SEQ ID No. 16, SEQ ID No. 19, SEQ ID No. 20, SEQ ID No. 21, SEQ ID No. 22, SEQ ID No. 23, SEQ ID No. 24, SEQ ID No. 25, and SEQ ID No. 26.
- 10 15. The peptide according to any one of claims 1 to 14, wherein the peptide is amidated at a C-terminus of the amino acid sequence and/or acetylated at a N-terminus of the amino acid sequence.
- 15 16. A composition comprising a hydrogel formed of a plurality of peptides according to any one of claims 1 to 15 in a beta-sheet conformation and water or a dried form of the hydrogel.
17. The composition according to claim 16, wherein a concentration of the plurality of peptides is at least 0.6% w/v.
- 20 18. The composition according to claim 17, wherein the concentration is at most 5% w/v.
- 25 19. The composition according to any one of claims 16 to 18, comprising a salt.
20. The composition according to claim 19, wherein the salt is any one selected from PBS, DMEM, MEM, a potassium salt, and a sodium salt.
- 30 21. The composition according to any one of claims 16 to 20, wherein the peptide has the amino sequence of SEQ ID No. 12, SEQ ID No. 15, SEQ ID No. 16, SEQ ID No. 22, SEQ ID No. 25, or SEQ ID No. 26.

22. The composition according to any one of claims 16 to 21, comprising a therapeutic agent.
23. The composition according to any one of claims 16 to 22, comprising a second peptide of SED ID No. 17 or SEQ ID No. 18.
24. The composition according to any one of claims 22 to 23 for use as a medicament.
25. Use of the composition according to claim 23 in the manufacture of a medicament for the treatment of a bacterial infection and/or a fungal infection.
26. A method of treating a bacterial and/or a fungal infection, the method comprising administering a therapeutically effective amount of the hydrogel according to claim 23 to a subject suffering from a bacterial and/or a fungal infection.
27. A method to form a hydrogel, the method comprising mixing a peptide according to any one of claims 1 to 15 in water to form a hydrogel; and isolating the hydrogel.
28. The method according to claim 27, wherein the stirring step is done in the presence of a salt.
29. The method according to any one of claims 27 to 28, wherein the stirring step is done at a temperature of 20 °C to 40 °C.
30. The method according to any one of claims 27 to 29, comprising drying the hydrogel to form a dried hydrogel suitable for reconstitution to the hydrogel.
31. An *in-vitro* method of growing cells, the method comprises providing a mixture of the peptide according to any one of claims 1 to 15, cell culture medium, and a population of cells to form the gel containing the population of cells; and incubating the gel under suitable conditions to grow the population of cells.

32. The method according to claim 31, wherein the cell is any one selected from a healthy cell, stem cell which is used for therapy or to grow tissues, and a cancer cell which is used to grow a tumor for *in vitro* and *in vivo* studies.