Claims

1. A recombinant endolysin comprising or consisting of

(i) a N-terminal catalytic domain,

(ii) a C-terminal cell-wall binding region, wherein the C-terminal cell-wall binding region comprises or consists of one or more cell-wall binding domains, and

(iii) a linker region between the N-terminal catalytic domain and the C-terminal cell-wall binding region,

wherein the N-terminal catalytic domain is from a first natural endolysin, the linker region and the C-terminal cell-wall binding region are from a second natural endolysin, and wherein the first and the second natural endolysins are encoded by different genomes from different prophages,

wherein said recombinant endolysin has a killing activity against *Gardnerella*; and

wherein

(I) the N-terminal catalytic domain is a polypeptide comprising or consisting of the amino acid sequence of any one of SEQ ID NOs: 1 to 5, 7, or 10 to 12, or any variant thereof having at least 80% identity with the amino acid sequence of any one of SEQ ID NOs: 1 to 5, 7, or 10 to 12, whereby said polypeptide or said variant thereof is functional, wherein the function comprises the ability to lyse the cell wall of *Gardnerella*, and

the C-terminal cell-wall binding region comprises or consists of one, two or three cell-wall binding domains, wherein the one, two or three cell-wall binding domains are independently selected from the group consisting of the polypeptides comprising or consisting of the amino acid sequence of SEQ ID NOs: 17 to 24 and 26 to 33, respectively, and any variants thereof having at least 80% identity with the amino acid sequence of SEQ ID NOs: 17 to 24 and 26 to 33, respectively, whereby said polypeptides or said variants thereof are functional, wherein the function comprises the ability to bind to the cell wall of *Gardnerella*; or

(II) the N-terminal catalytic domain is a polypeptide comprising or consisting of the amino acid sequence of any one of SEQ ID NOs: 2 to 5, 7, or 10 to 12, or any variant thereof having at least 80% identity with the amino acid sequence of any one of SEQ ID NOs: 2 to 5, 7, or 10 to 12, whereby said polypeptide or said variant thereof is functional, wherein the function comprises the ability to lyse the cell wall of *Gardnerella*, and

the C-terminal cell-wall binding region comprises or consists of one, two or three cell-wall binding domains, wherein the one, two or three cell-wall binding domains are independently selected from the group consisting of the polypeptides comprising or consisting of the amino acid sequence of SEQ ID NOs: 15 to 24 and 26 to 33, respectively, and any variants thereof having at least 80% identity with the amino acid sequence of SEQ ID NOs: 15 to 24 and 26 to 33, respectively, whereby said polypeptides or said variants thereof are functional, wherein the function comprises the ability to bind to the cell wall of *Gardnerella*.

2. A recombinant endolysin comprising or consisting of

(i) a N-terminal catalytic domain,

(ii) a C-terminal cell-wall binding region, wherein the C-terminal cell-wall binding region comprises or consists of one or more cell-wall binding domains, and

(iii) a linker region between the N-terminal catalytic domain and the C-terminal cell-wall binding region,

wherein the N-terminal catalytic domain is from a first natural endolysin, the linker region and the C-terminal cell-wall binding region are from a second natural endolysin, and wherein the first and the second natural endolysins are encoded by different genomes from different prophages,

wherein said recombinant endolysin has a genus-selective killing activity against *Gardnerella*; and

wherein

(II) the N-terminal catalytic domain is a polypeptide comprising or consisting of the amino acid sequence of any one of SEQ ID NOs: 1 to 5, 7, or 10 to 12, or any variant thereof having at least 80% identity with the amino acid sequence of any one of SEQ ID NOs: 1 to 5, 7, or 10 to 12, whereby said polypeptide or said variant thereof is functional, wherein the function comprises the ability to lyse the cell wall of *Gardnerella*, and

the C-terminal cell-wall binding region comprises or consists of one, two or three cell-wall binding domains, wherein the one, two or three cell-wall binding domains are independently selected from the group consisting of the polypeptides comprising or consisting of the amino acid sequence of SEQ ID NOs: 17 to 24 and 26 to 33, respectively, and any variants thereof having at least 80% identity

with the amino acid sequence of SEQ ID NOs: 17 to 24 and 26 to 33, respectively, whereby said polypeptides or said variants thereof are functional, wherein the function comprises the ability to bind to the cell wall of *Gardnerella*; or

(II) the N-terminal catalytic domain is a polypeptide comprising or consisting of the amino acid sequence of any one of SEQ ID NOs: 2 to 5, 7, or 10 to 12, or any variant thereof having at least 80% identity with the amino acid sequence of any one of SEQ ID NOs: 2 to 5, 7, or 10 to 12, whereby said polypeptide or said variant thereof is functional, wherein the function comprises the ability to lyse the cell wall of *Gardnerella*, and

the C-terminal cell-wall binding region comprises or consists of one, two or three cell-wall binding domains, wherein the one, two or three cell-wall binding domains are independently selected from the group consisting of the polypeptides comprising or consisting of the amino acid sequence of SEQ ID NOs: 15 to 24 and 26 to 33, respectively, and any variants thereof having at least 80% identity with the amino acid sequence of SEQ ID NOs: 15 to 24 and 26 to 33, respectively, whereby said polypeptides or said variants thereof are functional, wherein the function comprises the ability to bind to the cell wall of *Gardnerella*.

3. The recombinant endolysin of claim 1 or claim 2, wherein the C-terminal cell-wall binding region comprises or consists of a first cell-wall binding domain and a second cell-wall binding domain, wherein said first cell-wall binding domain is selected from the group consisting of SEQ ID NOs: 15, 17, 19, 21, 23, 26, 28, 30 and 32 and said second cell-wall binding domain is selected from the group consisting of SEQ ID NOs: 16, 18, 20, 22, 24, 27, 29, 31 and 33.

4. The recombinant endolysin of claim 1 or claim 2, wherein the N-terminal catalytic domain is a polypeptide comprising or consisting of the amino acid sequence of SEQ ID NO: 2 and the C-terminal cell-wall binding region comprises or consists of one, two or three cell-wall binding domains, wherein the one, two or three cell-wall binding domains are independently selected from the group consisting of the polypeptides comprising or consisting of the amino acid sequence of SEQ ID NOs: 28 to 33.

5. The recombinant endolysin of claim 1 or claim 2, wherein the N-terminal catalytic domain is a polypeptide comprising or consisting of the amino acid sequence of SEQ ID

NO: 7 and the C-terminal cell-wall binding region comprises or consists of one, two or three cell-wall binding domains, wherein the one, two or three cell-wall binding domains are independently selected from the group consisting of the polypeptides comprising or consisting of the amino acid sequence of SEQ ID NOs: 19 and 20.

6. The recombinant endolysin of claim 1 or claim 2, wherein the N-terminal catalytic domain is a polypeptide comprising or consisting of the amino acid sequence of SEQ ID NO: 2 and the C-terminal cell-wall binding region comprises or consists of a first cell-wall binding domain and a second cell-wall binding domain, wherein said first cell-wall binding domain is selected from the group consisting of the polypeptides comprising or consisting of an amino acid sequence having at least 90% identity with the amino acid sequence of any one of SEQ ID NOs: 28, 30 and 32, and said second cell-wall binding domain is selected from the group consisting of the polypeptides comprising or consisting of an amino acid sequence having at least 95% identity with the amino acid sequence of any one of SEQ ID Nos: 29, 31 and 33, and wherein said first and second cell-wall binding domains are functional and the function comprises the ability to bind to the cell wall of *Gardnerella.*

7. The recombinant endolysin of claim 1 or claim 2, wherein the N-terminal catalytic domain is a polypeptide comprising or consisting of the amino acid sequence of SEQ ID NO: 2 and the C-terminal cell-wall binding region comprises or consists of a first cell-wall binding domain and a second cell-wall binding domain, wherein said first cell-wall binding domain is selected from the group consisting of SEQ ID NOs: 28, 30 and 32, and said second cell-wall binding domain is selected from the group consisting of SEQ ID NOs: 29, 31 and 33.

8. The recombinant endolysin of claim 1 or claim 2, wherein the N-terminal catalytic domain is a polypeptide comprising or consisting of the amino acid sequence of SEQ ID NO: 2 and the C-terminal cell-wall binding region comprises or consists of a first cell-wall binding domain and a second cell-wall binding domain, wherein said first cell-wall binding domain is defined by SEQ ID NO: 28 and said second cell-wall binding domain is defined by SEQ ID NO: 29.

9. The recombinant endolysin of claim 1 or claim 2, wherein the N-terminal catalytic domain is a polypeptide comprising or consisting of the amino acid sequence of SEQ ID NO: 2 and the C-terminal cell-wall binding region comprises or consists of a first cell-wall binding domain and a second cell-wall binding domain, wherein said first cell-wall binding domain is defined by SEQ ID NO: 28 and said second cell-wall binding domain is defined by SEQ ID NO: 31.

10. The recombinant endolysin of any one of claims 3 and 6 to 9, wherein said first cell-wall binding domain is N-terminally of said second cell-wall binding domain.

11. The recombinant endolysin of any one of the precedent claims wherein the linker region is a polypeptide comprising or consisting of the amino acid sequence:
(i) (XXX)n, wherein each X can be independently G, A or S, preferably wherein the amino acid sequence (XXX)n is (GGS)n, wherein n corresponds to the number of repetitions of the sequence XXX, preferably wherein n is 2, 3, 4, 5 or 6; or
(ii) X_1X_2GLNGX_3X_4NGGS, wherein X_1 is N or K, X_2 is A or V, X_3 is Y or C and X_4 is K or Q.

12. The recombinant endolysin of claim 1, wherein said endolysin has a genus-selective killing activity against *Gardnerella*.

13. The recombinant endolysin of any one of the precedent claims wherein said endolysin has a killing activity against *Gardnerella vaginalis sensu stricto, Gardnerella leopoldii, Gardnerella piotii* and/or *Gardnerella swidsinskii,* or any other species in the genus *Gardnerella*.

14. The recombinant endolysin of any one of the precedent claims wherein said endolysin has no killing activity against *Lactobacilli*.

15. The recombinant endolysin of any one of the precedent claims, wherein said endolysin has no killing activity against *Lactobacilli crispatus*, *Lactobacilli gasseri*, and/or *Lactobacilli jensenii*.

16. A polynucleotide which encodes the recombinant endolysin of any one of claims 1 to 15.

17. A pharmaceutical composition comprising the recombinant endolysin of any one of claims 1 to 15 or the polynucleotide of claim 16 and further comprising a pharmaceutically acceptable carrier and/or diluent.

18. A recombinant endolysin as defined in any one of claims 1 to 15, a polynucleotide as defined in claim 16 or a pharmaceutical composition as defined in claim 17 for use in treating a disease or disorder.

19. Use of a recombinant endolysin as defined in any one of claims 1 to 15, a polynucleotide as defined in claim 16 or a pharmaceutical composition as defined in claim 17 in the manufacture of a medicament for treating a bacterial infection caused by at least one strain of the *Gardnerella* genus.

20. The use according to claim 19 wherein said bacterial infection is bacterial vaginosis.

21. The use according to claim 20 wherein said bacterial vaginosis is caused by *Gardnerella vaginalis sensu stricto, Gardnerella leopoldii, Gardnerella piotii* and/or *Gardnerella swidsinskii*.

22. The use according to any one of claims 19 to 21, wherein said medicament is to be administered locally, preferably wherein said medicament is to be administered locally into the vagina of a female subject and/or into or on the glans penis, prepuce or urethral entry of a male subject.

23. The use according to any one of claims 19 to 22, wherein said medicament is to be administered into the vagina of a female subject and/or into or on the glans penis, prepuce or urethral entry of a male subject.

24. The use according to any one of claims 19 to 23, wherein said medicament is to be co-administered with a compound or composition which adjusts the pH of the vagina to 4.0 – 6.0.

25. A plasmid comprising the polynucleotide of claim 16.

26. A bacterial host cell comprising the plasmid of claim 25, preferably wherein the bacterial host cell is an *E. coli* cell.

27. An *in vitro* method for the diagnosis of a disease or condition which can be treated with the endolysin according to any one of claims 1 to 15, the method comprising the steps of:

(i) contacting a sample obtained from the subject with a polypeptide comprising or consisting of the C-terminal cell-wall binding region of the endolysin according to any one of claims 1 to 15, and optionally the N-terminal catalytic domain of the endolysin according to any one of claims 1 to 15, wherein the sample comprises microbial cells, and wherein the C-terminal cell-wall binding region of said endolysin is optionally labelled;

(ii) testing whether the polypeptide binds to, and/or lyses, the microbial cells of the sample; and

(iii) determining that a disease or condition can be treated with the endolysin according to any one of claims 1 to 15 if the polypeptide binds to, and/or lyses, the microbial cells.