CLAIMS:

1. An isolated, genetically modified *Helicobacter pylori* comprising a functional urease, wherein the contiguous amino acid sequence between amino acid 529 and amino acid 555 of SEQ ID NO:1 is altered to produce said modified *Helicobacter pylori* which is unable to establish or maintain a persistent infection.

2. A genetically modified *Helicobacter pylori* cell according to claim 1, wherein the amino acid sequence between amino acid 529 to amino acid 555 of SEQ ID NO:1 is altered by deletion, mutation or insertion.

3. A genetically modified *Helicobacter pylori* cell according to claim 1 or claim 2, wherein the amino acids that are altered are selected from the group consisting of 547, 548 and 549 of SEQ ID NO:1.

4. A genetically modified *Helicobacter pylori* according to claim 2, wherein the mutation comprises a conservative or non-conservative amino acid change.

5. A genetically modified *Helicobacter pylori* according to any one of claims 1 to 3, wherein the alteration comprises an insertion of one or more amino acids.

6. A genetically modified *Helicobacter pylori* according to claim 5, wherein the insertion comprises between 10 and 100 amino acids.

7. A genetically modified *Helicobacter pylori* according to any one of claims 1 to 6, further comprising

a nucleic acid molecule encoding at least one heterologous antigen, or a functional fragment thereof.

8. A genetically modified *Helicobacter pylori* according to claim 7, wherein the heterologous antigen, or a functional fragment thereof is from a pathogenic microorganism.

9. A genetically modified *Helicobacter pylori* according to claim 6, wherein the pathogenic microorganism from which the nucleic acid encoding the heterologous antigen is obtained is selected from the group consisting of a virus, a bacterium, a protozoan and a fungus.

10. A genetically modified *Helicobacter pylori* according to claim 7 or claim 8, wherein the heterologous antigen is selected from the group consisting of a human immunodeficiency virus (HIV) antigen, an HTLV antigen, an SIV antigen, an RSV antigen, a PIV antigen, an HSV antigen, a CMV antigen, an Epstein-Barr virus antigen, a Varicella-Zoster virus antigen, a mumps virus antigen, a measles virus antigen, an influenza virus antigen, a poliovirus antigen, a rhinovirus antigen, a hepatitis A virus antigen, a hepatitis B virus antigen, a hepatitis C virus antigen, a Norwalk virus antigen, a togavirus antigen, an alphavirus antigen, a rubella virus antigen, a rabies virus antigen, a Marburg virus antigen, an Ebola virus antigen, a papilloma virus antigen, a polyoma virus antigen, a metapneumovirus antigen, a coronavirus antigen, a *Vibrio cholerae* antigen, a *Plasmodium falciparum* antigen, a *Plasmodium vivax* antigen, a *Plasmodium ovate* antigen, a *Plasmodium malariae* antigen, a *Plasmodium knowlesi* antigen, a *Streptococcus pneumoniae* antigen, *Streptococcus pyogenes* antigen, a *Helicobacter pylori* antigen, a *Streptococcus agalactiae* antigen, a *Neisseria*

meningitidis antigen, a *Neisseria gonorrhoeae* antigen, a *Corynebacterium diphtheriae* antigen, a *Clostridium tetani* antigen, a *Bordetella pertussis* antigen, a *Haemophilus* antigen, a *Chlamydia* antigen and an *Escherichia coli* antigen.

11. A genetically modified *Helicobacter pylori* according to claim 5 or claim 6, wherein the amino acid insertion encodes a heterologous antigen or a functional fragment thereof.

12. A genetically modified *Helicobacter pylori* according to claim 11, wherein the heterologous antigen is selected from the group consisting of a human immunodeficiency virus (HIV) antigen, an HTLV antigen, an SIV antigen, an RSV antigen, a PIV antigen, an HSV antigen, a CMV antigen, an Epstein-Barr virus antigen, a Varicella-Zoster virus antigen, a mumps virus antigen, a measles virus antigen, an influenza virus antigen, a poliovirus antigen, a rhinovirus antigen, a hepatitis A virus antigen, a hepatitis B virus antigen, a hepatitis C virus antigen, a Norwalk virus antigen, a togavirus antigen, an alphavirus antigen, a rubella virus antigen, a rabies virus antigen, a Marburg virus antigen, an Ebola virus antigen, a papilloma virus antigen, a polyoma virus antigen, a metapneumovirus antigen, a coronavirus antigen, a *Vibrio cholerae* antigen, a *Plasmodium falciparum* antigen, a *Plasmodium vivax* antigen, a *Plasmodium ovate* antigen, a *Plasmodium malariae* antigen, a *Plasmodium knowlesi* antigen, a *Streptococcus pneumoniae* antigen, *Streptococcus pyogenes* antigen, a *Helicobacter pylori* antigen, a *Streptococcus agalactiae* antigen, a *Neisseria meningitidis* antigen, a *Neisseria gonorrhoeae* antigen, a *Corynebacterium diphtheriae* antigen, a *Clostridium tetani* antigen, a *Bordetella pertussis* antigen, a *Haemophilus*

antigen, a *Chlamydia* antigen and an *Escherichia coli* antigen.

13. An immunogenic composition comprising a genetically modified *Helicobacter pylori* according to any one of claims 1 to 12, and a pharmaceutically acceptable carrier.

14. An immunogenic composition according to claim 13, further comprising an adjuvant.

15. A method for protecting a mammal against infection with a pathogenic microorganism comprising the step of administering an immunologically effective amount of an immunogenic composition according to claim 13 or claim 14.

16. A method of controlling the ability of *Helicobacter pylori* to establish a persistent infection comprising the step of altering the contiguous amino acid sequence between amino acid 529 and amino acid 555 of SEQ ID NO:1 to produce a modified UreB subunit of urease, wherein said urease retains de-acidification function, but said *Helicobacter pylori* is unable to establish or maintain a persistent infection.

17. A method of vaccinating an mammal against *Helicobacter pylori* infection comprising the step of administering to said mammal an isolated, genetically modified Helicobacter pylori comprising a functional urease, wherein the contiguous amino acid sequence between amino acid 529 and amino acid 555 of SEQ ID NO:1 is altered to produce said modified Helicobacter pylori which is unable to establish or maintain a persistent infection.

18. An immunogenic composition for use in vaccinating a mammal said composition comprising an isolated,

genetically modified *Helicobacter pylori* comprising a functional urease, wherein the contiguous amino acid sequence between amino acid 529 and amino acid 555 of SEQ ID NO:1 is altered to produce said modified *Helicobacter pylori* which is unable to establish or maintain a persistent infection and a pharmaceutically acceptable carrier.

19. A peptide vaccine consisting essentially of amino acid 529 to amino acid 555 of SEQ ID NO:1 and a pharmaceutical carrier.

20. A peptide vaccine according to claim 19, further comprising an adjuvant.

21. A method of vaccinating a subject against *Helicobacter pylori* infection comprising the step of administering to said subject a peptide vaccine according to claim 19 or claim 20.

CLAIMS

1. An isolated, genetically modified *Helicobacter pylori* comprising a functional urease, wherein the contiguous amino acid sequence between amino acid 529 and amino acid 555 of SEQ ID NO: 1 is altered to produce said modified *Helicobacter pylori* which is unable to establish or maintain a persistent infection.

2. The isolated, genetically modified *Helicobacter pylori* according to claim 1, wherein the amino acid sequence between amino acid 529 to amino acid 555 of SEQ ID NO:1 is altered by insertion of one or more than one additional contiguous amino acid(s).

3. An isolated, genetically modified *Helicobacter pylori* comprising a functional urease comprising a modified UreB subunit, wherein said modified UreB subunit comprises the amino acid sequence set forth in SEQ ID NO: 1 wherein one or more than one additional contiguous amino acid residue(s) have been inserted in a region between amino acid 529 and amino acid 555 of SEQ ID NO: 1, and wherein said modified *Helicobacter pylori* has reduced ability to establish or maintain a persistent infection relative to a *Helicobacter pylori* expressing an unmodified urease.

4. The isolated, genetically modified *Helicobacter pylori* according to claim 3, wherein said modified UreB subunit comprises an amino acid sequence set forth in SEQ ID NO: 1 wherein at least 10 additional contiguous amino acids residues have been inserted in a region between amino acid 529 and amino acid 555 of SEQ ID NO: 1.

5. The isolated genetically modified *Helicobacter pylori* according to claim 3 or 4, wherein between 10 to 100

additional contiguous amino acid residues have been inserted in a region between amino acid 529 and amino acid 555 of SEQ ID NO: 1.

6. The isolated genetically modified *Helicobacter pylori* according to any one of claims 3 to 5, wherein between 20 to 50 additional contiguous amino acid residues have been inserted in a region between amino acid 529 and amino acid 555 of SEQ ID NO: 1.

7. The isolated genetically modified *Helicobacter pylori* according to any one of claims 3 to 6, wherein 49 additional contiguous amino acid residues have been inserted in a region between amino acid 529 and amino acid 555 of SEQ ID NO: 1.

8. The isolated, genetically modified *Helicobacter pylori* according to any one of claims 3 to 7, wherein the insertion is between amino acid residues 549 and 550 of SEQ ID NO: 1.

9. The isolated genetically modified *Helicobacter pylori* according to any one of claims 2 to 8, wherein the amino acid insertion is a heterologous antigen or a functional fragment thereof.

10. The isolated genetically modified *Helicobacter pylori* according to claim 9, wherein the heterologous antigen or functional fragment thereof is from a pathogenic microorganism.

11. The isolated genetically modified *Helicobacter pylori* according to claim 10, wherein the pathogenic microorganism is selected from the group consisting of a virus, a bacterium, a protozoan and a fungus.

12. The isolated genetically modified *Helicobacter pylori* according to claim 10 or claim 11, wherein the heterologous antigen is selected from the group consisting of a human immunodeficiency virus (HIV) antigen, an HTLV antigen, an SIV antigen, an RSV antigen, a PIV antigen, an HSV antigen, a CMV antigen, an Epstein-Barr virus antigen, a Varicella-Zoster virus antigen, a mumps virus antigen, a measles virus antigen, an influenza virus antigen, a poliovirus antigen, a rhinovirus antigen, a hepatitis A virus antigen, a hepatitis B virus antigen, a hepatitis C virus antigen, a Norwalk virus antigen, a togavirus antigen, an alphavirus antigen, a rubella virus antigen, rabies virus antigen, a Marburg virus antigen, an Ebola virus antigen, a papilloma virus antigen, a polyoma virus antigen, a metapneumovirus antigen, a coronavirus antigen a *Vibrio cholerae* antigen, a *Plasmodium falciparum* antigen, a *Plasmodium vivax* antigen, a *Plasmodium ovate* antigen, a *Plasmodium malariae* antigen, a *Plasmodium knowlesi* antigen, a *Streptococcus pneumoniae* antigen, *Streptococcus pyogenes* antigen, a *Helicobacter pylori* antigen, a *Streptococcus agalactiae* antigen, a *Neisseria meningitidis* antigen, a *Neisseria gonorrhoeae* antigen, a *Corynebacterium diphtheriae* antigen, a *Clostridium tetani* antigen, a *Bordetella pertussis* antigen, a *Haemophilus* antigen, a *Chlamydia* antigen and an *Escherichia coli* antigen.

13. An immunogenic composition comprising the isolated genetically modified *Helicobacter pylori* according to any one of claims 1 to 12 and a pharmaceutically acceptable carrier.

14. The immunogenic composition according to claim 13, further comprising an adjuvant.

15. A method of controlling the ability of *Helicobacter pylori* to establish a persistent infection comprising the step of inserting one or more than one additional contiguous amino acid(s) between amino acid residues 529 and amino acid 555 of SEQ ID NO : 1 to produce a modified UreB subunit of urease in said *Helicobacter pylori*, wherein said urease retains de-acidification function, but said *Helicobacter pylori* has a reduced ability to establish or maintain a persistent infection relative to a *Helicobacter pylori* expressing an unmodified urease.

16. A method of producing a genetically modified Helicobacter pylori having reduced ability to establish or maintain persistent infection, said method comprising:

inserting a nucleic acid encoding one or more than one contiguous amino acid residue(s) in-frame into a nucleic acid encoding a UreB subunit of *H. pylori* urease to thereby produce a recombinant UreB gene encoding a modified UreB subunit comprising one or more than one contiguous amino acid residue(s) in a region of SEQ ID NO: 1 between amino acid 529 and amino acid 555, and

introducing the recombinant UreB gene into *H. pylori* to produce a modified *H. pylori* expressing a functional urease protein comprising the a modified UreB subunit, wherein said functional urease has de-acidification function, and wherein said modified *H. pylori* has a reduced persistence relative to a *H. pylori* expressing an unmodified urease.

17. The method of claim 16, wherein the nucleic acid is inserted in-frame between nucleotide residues 1588 and 1662 of SEQ ID NO: 2.

18. The method according to claim 16 or claim 17, comprising inserting nucleic acid encoding between 10 and 100 contiguous amino acid residues in-frame into nucleic acid encoding a UreB subunit of *H. pylori* urease to thereby produce a recombinant UreB gene encoding a modified UreB subunit comprising the between 10 and 100 contiguous amino acid residues in a region of SEQ ID NO: 1 between amino acid 529 and amino acid 555.

19. The method according to any one of claims 16 to 18, wherein the nucleic acid encoding one or more than one contiguous amino acid residue(s) is inserted in-frame into nucleic acid encoding a UreB subunit of *H. pylori* urease to thereby produce a recombinant UreB gene encoding a modified UreB subunit comprising the one or more than one contiguous amino acid residue(s) in a region of SEQ ID NO: 1 between amino acid 549 and amino acid 550.

20. The method according to claim 23, wherein the nucleic acid is inserted in-frame between nucleotide residues 1647 and 1648 of SEQ ID NO: 2.

21. A method of vaccinating a mammal against *Helicobacter pylori* infection comprising administering to said mammal the isolated, genetically modified *Helicobacter pylori* according to any one of claims 1 to 12 or the immunogenic composition according claim 13 or 14.

22. Use of the isolated, genetically modified *Helicobacter pylori* according to any one of claims 1 to 12 in the preparation of a medicament for vaccinating a mammal against *Helicobacter pylori* infection.

23. The isolated, genetically modified Helicobacter pylori according to any one of claims 1 to 12 or the

immunogenic composition according to claim 13 or 14 or the method according to any one of claims 15 to 21 or the use according to claim 22 substantially as herein before described with reference to the Examples and/or Drawings.