detected in pigs. These include porcine parvovirus 2 (PPV2) (2) and related viruses (3). A new group of porcine and bovine parvoviruses, namely the hokoviruses (PHoV, BHoV), were identified in Hong Kong (4), and these viruses were found to be genetically similar to human PARV4 and 5. Although they were originally named hokoviruses after Hong Kong, a new classification of PHoV as PPV3 was proposed (5). PPV4 shows the highest similarity to bovine parvovirus 2, but the coding capacity and genome organization are similar to those of bocaviruses, as PPV4 encodes an additional ORF3 like bocaviruses, located between ORF1 and ORF2. The PPV4-encoded putative ORF3 protein, however, is quite different from that of bocaviruses (5).

[0006] There is an ongoing need to monitor swine for the emergence of new viruses, and to develop vaccines, treatments and methods of detection for new viruses.

SUMMARY ~~OF THE INVENTION~~

[0007] The present ~~invention~~ disclosure provides novel nucleotides sequences, protein sequences, immunogenic compositions, vaccines, and methods that relate to making and using new parvovirus strains that infect, inter alia, domestic swine. These strains are related to the novel porcine parvovirus identified in tissue samples from clinically diseased domestic swine; based on sequence homology with known porcine parvovirus species and strains, the novel virus was denominated porcine parvovirus 5A or PPV5A.

[0008] The compositions and methods of the ~~invention~~ disclosure provide for the detection of infections by said new virus, monitoring genetic changes in the viral sequences in wild and domestic animals and herds, and making and using novel vaccines for protecting animals from infection by the virus.

[0009] Immunogenic compositions and vaccines of the ~~invention~~ disclosure comprise polypeptide sequences encoded by the nucleic acid sequence of SEQ ID NO:1, or immunogenic fragments thereof, optionally including adjuvants for inducing a more robust immunogenic response.

[0010] Exemplary compositions of the ~~invention~~ disclosure comprise any one of the polypeptide sequences of SEQ ID NO:2, SEQ ID NO:3, SEQ NO:4, or fragments thereof that are

immunoreactive to antibodies specific for PPV5A. Preferred polypeptides of the ~~invention~~ disclosure include the sequences of SEQ ID NO:2 or SEQ ID NO:4, in particular SEQ ID NO:4. Preferably those polypeptides, or fragments thereof, are immunoreactive to antibodies specific for PPV5A.

[0011] ~~In another aspect the invention~~The disclosure provides nucleic acid sequences that encode one or more polypeptides, antibody constructs, or antibody conjugates. The gene sequences coding for the polypeptides comprise a nucleic acid sequence that is at least 95%, 90%, 85%, or even 80% homologous to and/or identical with the sequence of SEQ ID NO: 1, in particular, nucleotide sequences 2845-5547 of SEQ ID NO:1 (the capsid protein), or fragments of SEQ ID NO:1 coding for a polypeptide that is immunoreactive to antibodies specific for PPV5A. Exemplary nucleic acid sequences of the ~~invention~~ disclosure include any one of the sequences of nucleotides 1975-2844 of SEQ ID NO:1, and nucleotides 2845-5547 of SEQ ID NO:1, and fragments thereof, that encode a polypeptide that is immunoreactive to an antibody specific for PPV5A. Preferably, the nucleic acid sequences, or genes, are those coding for a polypeptide or peptide that is immunoreactive to an antibody specific for PPV5A.

[0011a] In one aspect, there is provided an isolated antibody that specifically binds to a PPV5A polypeptide encoded by a PPV5A polynucleotide having a sequence of SEQ ID NO:1, said polypeptide having an amino acid sequence of SEQ ID NO:2 or SEQ ID NO:3 or of a polypeptide that is encoded by a polynucleotide comprising the sequence of nucleotides 2845-5547 of SEQ ID NO: 1, and wherein said antibody does not bind to a polypeptide encoded by a different parvovirus. In another aspect, there is provided a hybridoma that expresses an antibody as defined herein.

[0012] Moreover a polypeptide of the ~~invention~~ disclosure as used herein includes but is not limited to a polypeptide that comprises:

i) a polypeptide comprising the amino acid sequence of SEQ ID NO: 2 or SEQ ID NO:4;

ii) a polypeptide that is at least 80% homologous to and/or identical with a polypeptide of i);

iii) a fragment of the polypeptides of i) and/or ii);

iv) a fragment of iii) or iv) comprising at least 5, preferably 8, more preferably 10, even more preferably 15 contiguous amino acids included in the sequences of SEQ ID NO: 2 or SEQ ID NO:4;

v) a polypeptide that is encoded by a polynucleotide comprising the sequence of nucleotides 1975-2844 of SEQ ID NO:1, or nucleotides 2845-5547 of SEQ ID NO:1;

vi) a polypeptide that is encoded by a polynucleotide that is at least 80% homologous to or identical with polynucleotide of vi);

vii) a protein fragment that is encoded by a polynucleotide that comprises at least 15, preferably 24, more preferably 30, even more preferably 45 contiguous nucleotides

included in the sequences of nucleotides 1975-2844 of SEQ ID NO:1, or nucleotides 2845-5547 of SEQ ID NO:1.

[0012a] In another aspect, there is provided an isolated polynucleotide, comprising a polynucleotide

a) having the nucleic acid sequence of SEQ ID NO:1;

b) having a nucleic acid sequence that encodes

- a polypeptide of SEQ ID NO:2,
- a polypeptide SEQ ID NO:3, or
- a polypeptide that is encoded by a polynucleotide comprising the sequence of nucleotides 2845-5547 of SEQ ID NO. 1; or

c) having a nucleic acid sequence at least 80% identical to SEQ ID NO:1, which encodes a polypeptide having a biological or immunologically-effective activity of a polypeptide of SEQ ID NO:2, or SEQ ID NO:3 or of a polypeptide that is encoded by a polynucleotide comprising the sequence of nucleotides 2845-5547 of SEQ ID NO:1.

[0012b] In another aspect, there is provided an isolated polypeptide, comprising a polypeptide

a) having the amino acid sequence of SEQ ID NO:2, or SEQ ID NO:3, or that is encoded by a polynucleotide comprising the sequence of nucleotides 2845-5547 of SEQ ID NO:1; or

b) having an amino acid sequence at least 80% identical to SEQ ID NO:2, SEQ ID NO:3, or to a sequence of a polypeptide that is encoded by a polynucleotide comprising the sequence of nucleotides 2845-5547 of SEQ ID NO. 1, and having a biological or immunologically-effective activity of a polypeptide encoded by SEQ ID NO:2, or SEQ ID NO:3 or of a polypeptide that is encoded by a polynucleotide comprising the sequence of nucleotides 2845-5547 of SEQ ID NO:1.

[0012c] In another aspect, there is provided an isolated porcine parvovirus 5A (PPV5A), comprising

a) a nucleic acid sequence of SEQ ID NO:1, or

b) a nucleic acid sequence at least 80% identical to SEQ ID NO:1, which encodes a polypeptide having a biological or immunologically-effective activity of a polypeptide of SEQ ID NO:2, or SEQ ID NO:3 or of a polypeptide that is encoded by a polynucleotide comprising the sequence of nucleotides 2845-5547 of SEQ ID NO:1.

[0013] Immunogenic compositions of the ~~invention~~ disclosure which comprise at least one or more PPV5A polypeptides as defined herein may further comprise a physiologically-acceptable vehicle such as a pharmaceutically or veterinary-acceptable carrier, adjuvant, or combination thereof.

[0014] Any of the PPV5A polypeptides provided herewith or any immunogenic compositions comprising one or more of these PPV5A polypeptides provided herewith can be used as a medicament, preferably as a vaccine or immunogenic composition, most preferably for the prophylaxis or treatment of a subject against a PPV5A infection.

[0014a] In another aspect, there is provided a vaccine for treating or preventing an infection by a virulent PPV5A, comprising a killed or attenuated form of a PPV5A as defined herein. In another aspect, there is provided a vaccine for treating or preventing an infection by a virulent PPV5A, comprising a subunit of a killed or attenuated form of a PPV5A as defined herein. In another aspect there is provided a PPV5A as defined herein for use as a vaccine. In another aspect, there is provided a polypeptide as defined herein for use as a vaccine. In another aspect, there is provided a vaccine as defined herein for use as a medicament. In another aspect, there is provided the PPV5A, the polypeptide, or the vaccine as defined herein for use in the treatment and/or prevention of PPV5A infection.

[0015] Particularly preferred PPV5A polypeptides include those with immunogenic epitopes that induce an immunological response that is specific for PPV5A. Preferred PPVA polypeptides include those having an amino acid sequences predicted in related PPV1 to be surface antigens (Simpson et al. JMB 315, 2002) and include, but is not limited to residues 141-156, 272-278, and 329-339 of SEQ ID NO:4.

[0016] Those of skill in the art will understand that the compositions used herein may incorporate known injectable, physiologically acceptable sterile solutions. For preparing a

ready-to-use solution for parenteral injection or infusion, aqueous isotonic solutions, e.g. saline or plasma protein solutions, are readily available. In addition, the immunogenic and vaccine compositions of the present ~~invention~~ disclosure can include veterinary-acceptable carriers, diluents, isotonic agents, stabilizers, or adjuvants.

[0016a] In another aspect, there is provided an immunogenic preparation comprising an immunologically-effective amount of a polypeptide as defined herein, and a pharmaceutical- or veterinary-acceptable carrier, excipient or diluent.

[0017] Methods of the ~~invention~~ disclosure include, but are not limited to, a method of provoking an immune response against a PPV5A infection in a subject comprising the step of administering to the subject an immunogenic composition comprising one or more PPV5A polypeptides as defined herein. Preferably, the immune response is provoked against more than one serotype or strain of PPV5A. Compositions of the ~~invention~~ disclosure may be used to treat or alternatively to prevent a PPV5A infection. Preferably, such immune response reduces the incidence of or severity of one or more clinical signs associated with or caused by the infection with one or more PPV5A serotypes.

[0018] Herein, suitable subjects and subjects in need to which compositions of the ~~invention~~ disclosure may be administered include animals in need of either prophylactic or treatment for a viral, microbial, parasitic, protozoan, bacterial, or fungal associated infection, disease, or condition. Animals in which the immune response is stimulated by use of compositions or methods of the ~~invention~~ disclosure include livestock, such as porcine, bovine, poultry (e.g. chickens, ducks, geese, or turkeys) caprine, and ovine, and domestic animals, such as mice, rabbits, dogs, cats, and horses. Preferred animals include swine, murids, equids, lagomorphs, and bovids. Most preferably, an immune response is stimulated in swine.

[0019] The ~~invention~~ disclosure also provides a method of reducing the incidence of or severity of one or more clinical signs associated with or caused by PPV5A infection, comprising the step of administering an immunogenic composition of the ~~invention~~ disclosure that comprises one or more PPV5A peptides as provided herewith and preferably a carrier molecule, such that the incidence of or the severity of a clinical sign of the PPV5A infection is reduced by at least 10%, preferably at least 20%, even more preferred at least 30%, even more preferred at least 50%, even more preferred at least 70%, most preferred at least 100% relative to a subject that has not received the immunogenic composition as provided herewith. Such clinical signs include viremia and immunosuppression as a result from an infection with PPV5A alone. Such clinical signs may include neurological signs (depression, ataxia, lethargy), diarrhea, dyspnea, loss of body condition, swelling of joints (resulting in lameness and recumbency), decreased average daily weight gain, mortality, and polyserositis as a result of a co-infection with another organism, e.g., Mycoplasma hyorhinis.

[0020] ~~According to a f~~Further ~~aspect~~, the present ~~invention~~ disclosure also relates to a method for the prophylaxis of a PPV5A infection, wherein said PPV5A infection may be caused by PPV5A having 100% sequence identity with the nucleotide sequences of SEQ ID NOs 1, 2, 3 and/or 4, having at least 95% sequence identity with the nucleotides sequences of SEQ ID NOs 1, 2, 3 and/or 4, having at least 90% sequence identity with the nucleotides sequences of SEQ ID NOs 1, 2, 3 and/or 4, or having at least 85% sequence identity with the nucleotides sequences of SEQ ID NOs 1, 2, 3 and/or 4, comprising the step of administering an immunogenic composition of the ~~invention~~ disclosure that comprises one or more PPV5A peptides as provided herewith.

[0021] The ~~invention~~ disclosure also provides a method of preparing any of the immunogenic compositions provided herewith that method comprises mixing one or more PPV5A peptides as provided herewith with a carrier molecule, preferably such that the one or more PPV5A peptides and carrier molecule are covalently coupled or conjugated to one another. Such conjugates may be multivalent or univalent. Multivalent compositions or vaccines include an immuno-conjugation of multiple PPV5A peptides with a carrier molecule. ~~In a f~~Further ~~aspect~~, the ~~invention~~ disclosure provides a method of producing one or more PPV5A peptides that method comprises transforming a host cell, preferably a prokaryotic cell such as E. coli with a nucleic acid molecule that codes for any of the PPV5A peptides as provided herewith. Alternatively, the host cell may be a eukaryotic cell such as an animal cell, an insect cell, a protist cell, a plant cell, or a fungal cell. Preferably the eukaryotic cell is a mammalian cell such as CHO, BHK or COS, or a fungal cell such as Saccharomyces cerevisiae, or an insect cell such as Sf9. Baculovirus expression of the nucleic acids of the instant ~~invention~~ disclosure are also preferred. In another aspect, there is provided a host cell comprising a vector as defined herein.

[0022] ~~Another aspect of t~~The ~~invention~~ disclosure provides a method of producing one or more PPV5A peptides that induce an immune response against at least one genetic variants of PPV5A and more preferably two or more genetic variants of PPV5A. This comprises culturing a transformed expression vector coding for and expressing one or more PPV5A peptides disclosed herein. In another aspect, there is provided a vector or plasmid that comprises a polynucleotide as defined herein. The expressed proteins are either retained by the expression organism or secreted into the culture medium. Expression is conducted under conditions sufficient to produce a PPV5A peptide capable of inducing an immune response to PPV5A. The PPV5A serotypes to which the PPV5A peptides induce an immune response include but are not limited to sequences having at least 99, 98, 97, 96, 95, 94, 93, 92, 91 or 90% identity.

[0023] Methods of making compositions of the ~~invention~~ disclosure may further comprise admixing the conjugate of one or more PPV5A peptides and a carrier molecule with a physiologically-acceptable vehicle such as a pharmaceutically- or veterinary-acceptable carrier, adjuvant, or combination thereof. Those of skill in the art will recognize that the choice of vehicle, adjuvant, or combination will be determined by the delivery route, personal preference, and animal species among others.

[0024] ~~In another aspect, t~~The ~~invention~~ disclosure provides a method of diagnosing a PPV5A infection in a subject. That method comprises providing one or more PPV5A peptides; contacting the one or more PPV5A peptides with a sample obtained from the subject; and identifying the subject as having a PPV5A infection if an antibody capable of binding the one or more PPV5A peptides is detected in the sample.

[0025] In another respect, the ~~invention~~ disclosure provides a method of ascertaining that a subject has been previously exposed to a PPV5A infection and is able to express an immune response to PPV5A. That method comprises providing one or more PPV5A peptides; contacting the one or more PPV5A peptides with a sample obtained from the subject; and identifying the subject as having a PPV5A infection if an antibody capable of binding the one or more PPV5A peptides is detected in the sample. In another aspect, there is provided a method of identifying the presence of PPV5A in a biological sample, comprising (a) contacting the biological sample with an antibody as defined herein, (b) detecting the formation of a complex between the antibody and a PPV5A polypeptide, wherein the presence of said complex indicates the presence of PPV5A in the biological sample.

[0026] The ~~invention~~ disclosure also provides kits that comprise an immunogenic composition that comprises one or more PPV5A peptides, preferably together with a carrier molecule; a container for packaging the immunogenic composition; a set of printed instructions; and a dispenser capable of administering the immunogenic composition to an animal. Optionally, the one or more PPV5A peptides and the carrier molecule may be packaged as a conjugate or as separate compounds. When supplied separately, a means of conjugating the one or more PPV5A peptides and carrier molecule, as well as appropriate printed instructions, is also supplied. In another aspect, there is provided a diagnostic kit for identifying the presence of PPV5A in a biological sample, comprising (a) an antibody as defined herein, and (b) reagents for detecting the formation of a complex between the antibody and a PPV5A polypeptide.

[0027] The ~~invention~~ disclosure also provides kits for vaccinating an animal comprising a set of printed instructions; a dispenser capable of administering the immunogenic composition provided herewith comprising one or more PPV5A peptides to an animal; and wherein at least one of PPV5A peptides effectively immunizes the animal against at least one disease associated with PPV5A infection. Preferably, the one or more PPV5A peptides are selected from those

provided herewith. Kits of the ~~invention~~ disclosure may further comprise a veterinary acceptable carrier, adjuvant, or combination thereof. In another aspect, there is provided an immunogenic kit, comprising (a) at least one immunogenic PPV5A peptide as defined herein which is effective to immunize an animal against at least one disease associated with PPV5A infection; (b) at least one carrier or adjuvant molecule; (c) a container for packaging the immunogenic composition; (d) a set of printed instructions; and (e) a dispenser capable of administering the immunogenic composition to an animal and wherein said immunogenic kit optionally further comprises at least one immunogenic protein which is effective to immunize said animal against at least one other porcine pathogenic virus or bacteria which causes a disease associated with an infection with said virus or bacteria.

[0028] The dispenser in a kit of the ~~invention~~ disclosure is capable of dispensing its contents as droplets; and the immunogenic composition comprises the PPV5A peptides as provided herewith included in the kit is capable of reducing the severity of at least one clinical sign of a PPV5A infection when administered intranasally, orally, intradermally, or intramuscularly to an animal.

Preferably, the severity of a clinical sign is reduced by at least 10% preferably by at least 20%, even more preferred by at least 30%, even more preferred by at least 50%, even more preferred by at least 70%, most preferred by at least 100% as compared to an untreated, infected animal.

[0029] Methods for the treatment or prophylaxis of infections caused by PPV5A are also disclosed. The method comprises administering an effective amount of the immunogenic composition of the present ~~invention~~ disclosure to a subject, wherein said treatment or prophylaxis is selected from the group consisting of reducing signs of PPV5A infection, reducing the severity of or incidence of clinical signs of PPV5A infection, reducing the mortality of subjects from PPV5A infection, and combinations thereof.

[0030] Compositions of the ~~invention~~ disclosure further comprise a veterinary-acceptable carrier, adjuvant, or combination thereof. Such compositions may be used as a vaccine and comprise one or more additional attenuated vaccines, inactivated vaccines, or combinations thereof. Such vaccines elicit a protective immunological response against at least one disease associated with viruses selected from the group consisting of porcine parvoviruses 1, 2, 3, 4, 5A, 5B, other porcine parvovirus species, other porcine pathogenic viruses and bacteria, and combinations thereof. Other types of vaccines that could be co-administered in combination with a vaccine to PPV5A include, but are not limited to, porcine circovirus type 2 (e.g.,Ingelvac® CircoFLEX, Ingelvac® CircoFLEX-MycoFLEX), porcine reproductive and respiratory syndrome virus (e.g., Ingelvac® PRRS ATP, Ingelvac® PRRSV MLV,), porcine parvovirus (e.g., ReproCyc® PRRSV-PLE), Mycoplasma (e.g., Ingelvac® MycoFLEX), etc.

[0031] Those of skill in the art will understand that the compositions used herein may incorporate known injectable, physiologically acceptable sterile solutions. For preparing a ready-to-use solution for parenteral injection or infusion, aqueous isotonic solutions, e.g. saline or plasma protein solutions, are readily available. In addition, the immunogenic and vaccine compositions of the present ~~invention~~ disclosure can include pharmaceutical- or veterinary-acceptable carriers, diluents, isotonic agents, stabilizers, or adjuvants.

[0032] Methods of the ~~invention~~ disclosure may also comprise admixing a composition of the ~~invention~~ disclosure with a veterinarily acceptable carrier, adjuvant, or combination thereof. Those of skill

in the art will recognize that the choice of carrier, adjuvant, or combination will be determined by the delivery route, personal preference, and animal species among others.

[0033] The ~~invention~~ disclosure also provides a method of reducing the severity of an ongoing PPV5A infection in an animal by administration of a composition to the animal. The composition may include an attenuated viral culture or one or more PPV5A peptides in combination with an acceptable veterinary carrier.

[0034] Preferred routes of administration include intranasal, oral (e.g., in drinking water), intradermal, and intramuscular. Intramuscular administration, most preferably in a single dose, is preferred. The skilled artisan will recognize that compositions of the ~~invention~~ disclosure may also be administered in two or more doses, as well as, by other routes of administration. For example, such other routes include subcutaneously, intracutaneously, intravenously, intravascularly, intraarterially, intraperitnoeally, intrathecally, intratracheally, intracutaneously, intracardially, intralobally, intramedullarly, intrapulmonarily, or intravaginally. Depending on the desired duration and effectiveness of the treatment, the compositions according to the ~~invention~~ disclosure may be administered once or several times, also intermittently, for instance on a daily basis for several days, weeks or months and in different dosages.

[0035] The ~~invention~~ disclosure also provides kits for vaccinating an animal comprising a set of printed instructions; a dispenser capable of administering a vaccine to an animal; and at least one isolate from a cell culture, including but not limited to a bacterial, fungal, insect or mammalian cell culture that effectively immunizes the animal against at least one disease associated with PPV5A, other parvovirus strains, other pathogens, and/or a combination thereof. Kits of the ~~invention~~ disclosure may further comprise a veterinary-acceptable carrier, adjuvant, or combination thereof.

[0036] The dispenser in a kit of the ~~invention~~ disclosure is capable of dispensing its contents as droplets; and the isolate included in the kit is capable of reducing the severity of at least one clinical sign of a PPV5A infection when administered intranasally, orally, intradermally, or intramuscularly to an animal. In some kits, the isolate is also capable of reducing the severity of at least one clinical sign of a PPV5A infection. Preferably, the severity of a clinical sign is reduced by at least 10% as compared to an untreated, infected animal.

[0037] Other objects, features and advantages of the present ~~invention~~ disclosure will become apparent from the following detailed description. It should be understood, however, that the detailed description and the specific examples, while indicating preferred embodiments of the ~~invention~~disclosure, are given by way of illustration only, since various changes and modifications within the spirit and scope of the ~~invention~~ disclosure will become apparent to those skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038] The following drawings form part of the present specification and are included to further demonstrate certain aspects of the present invention. The invention may be better understood by reference to one or more of these drawings in combination with the detailed description of specific embodiments presented herein. The application contains at least one drawing executed in color. Copies of this patent application publication with color drawing(s) will be provided by the Office upon request and payment of the necessary fee.

[0039] FIG. 1. shows the nucleic acid sequence of PPV5A (SEQ ID NO:1).

[0040] FIG. 2. shows the protein sequence of the PPV5A replicase (SEQ ID NO:2).

[0041] FIG. 3. shows the protein sequence of the PPV5A open reading frame (ORF) protein (SEQ ID NO:3).

[0042] FIG. 4. shows the protein sequence of the PPV5A capsid protein (SEQ ID NO:4).

[0043] FIG. 5. shows pair-wise amino acid identity comparisons of the protein sequences of the PPV5A capsid protein and numerous other viral sequences. References for the viral sequences are listed in Table 1:

CLAIMS

What is claimed is:

1. An isolated polynucleotide, comprising a polynucleotide

   a) having the nucleic acid sequence of SEQ ID NO:1;

   b) having a nucleic acid sequence that encodes

   - a polypeptide of SEQ ID NO:2,

   - a polypeptide SEQ ID NO:3, or

   - ~~SEQ ID NO:4~~a polypeptide that is encoded by a polynucleotide comprising the sequence of nucleotides 2845-5547 of SEQ ID NO. 1; or

   c) having a nucleic acid sequence at least 80% identical to SEQ ID NO:1, which encodes a polypeptide having a biological or immunologically-effective activity of a polypeptide of SEQ ID NO:2~~,~~ or SEQ ID NO:3 or ~~SEQ ID NO:4~~;of a polypeptide that is encoded by a polynucleotide comprising the sequence of nucleotides 2845-5547 of SEQ ID NO:1

   ~~d) that is a fragment of the nucleic acid sequence of SEQ ID NO:1, comprising at least 30 contiguous nucleotide sequences of SEQ ID NO:1, or~~

   ~~e) that is a fragment of the nucleic acid sequence of SEQ ID NO:1, comprising at least 30 contiguous nucleotide sequences of SEQ ID NO:1, and which encode an immunologically-effective activity of an amino acid sequence of SEQ ID NO:2, SEQ ID NO:3 or SEQ ID NO:4~~.

2. An isolated polypeptide, comprising a polypeptide

   a) having the amino acid sequence of SEQ ID NO:2~~,~~ or SEQ ID NO:3, or ~~SEQ ID NO:4~~that is encoded by a polynucleotide comprising the sequence of nucleotides 2845-5547 of SEQ ID NO:1; or

   b) having an amino acid sequence at least 80% identical to SEQ ID NO:2, SEQ ID NO:3, ~~or SEQ ID NO:4~~, or to a sequence of a polypeptide that is encoded by a polynucleotide comprising the sequence of nucleotides 2845-5547 of SEQ ID NO. 1, and having a biological or immunologically-effective activity of a polypeptide encoded by SEQ ID NO:2~~,~~ or SEQ ID NO:3 or ~~SEQ ID NO:4~~;of a polypeptide that is encoded by a polynucleotide comprising the sequence of nucleotides 2845-5547 of SEQ ID NO:1.

c) that is a fragment of the amino acid sequence of SEQ ID NO:2, SEQ ID NO:3 or SEQ ID NO:4, comprising at least 15 contiguous amino acids of SEQ ID NO:2, SEQ ID NO:3 or SEQ ID NO:4;

d) that is a fragment of the amino acid sequence of SEQ ID NO:2, SEQ ID NO:3 or SEQ ID NO:4, comprising at least 15 contiguous amino acids of SEQ ID NO:2, SEQ ID NO:3 or SEQ ID NO:4, and having an immunologically effective activity; or

e) ~~a protein fragment that is encoded by a polynucleotide that comprises at least 15, nucleotides included in the sequences of nucleotides 87-1967 of SEQ ID NO:1, nucleotides 1975-2844 of SEQ ID NO:1, or nucleotides 2845-5547 of SEQ ID NO:1.~~

3. An isolated porcine parvovirus 5A (PPV5A), comprising

a) a nucleic acid sequence of SEQ ID NO:1, or

b) a nucleic acid sequence at least 80% identical to SEQ ID NO:1, which encodes a polypeptide having a biological or immunologically-effective activity of a polypeptide of SEQ ID NO:2~~,~~ or SEQ ID NO:3 or ~~SEQ ID NO:4~~ of a polypeptide that is encoded by a polynucleotide comprising the sequence of nucleotides 2845-5547 of SEQ ID NO:1.

4. The PPV5A of claim 3, comprising an attenuated, non-virulent form of a PPV5A.

5. A vaccine for treating or preventing an infection by a virulent PPV5A, comprising a killed or attenuated form of a PPV5A of claim 3.

6. A vaccine for treating or preventing an infection by a virulent PPV5A, comprising a subunit of a killed or attenuated form of a PPV5A of claim 3.

7. A vaccine of claim 6, wherein the subunit is a capsid protein ~~of SEQ ID NO:4~~, wherein said capsid protein is a polypeptide that is encoded by a polynucleotide comprising the sequence of nucleotides 2845-5547 of SEQ ID NO: 1.

~~8. A vaccine of claim 6, wherein the subunit is an immunologically-effective fragment of a polypeptide of SEQ ID NO:4.~~

~~9.~~8. An immunogenic preparation comprising an immunologically-effective amount of a polypeptide of claim 2, and a pharmaceutical- ~~-~~or veterinary-acceptable carrier, excipient or diluent.

~~10.~~9. A PPV5A of claim 3 for use ~~in generating an immune response in a mammal~~as a vaccine.

~~11.~~10. A polypeptide of claim 2 for use ~~in generating an immune response in a mammal~~as a vaccine.

~~12.~~11. A vaccine of any one of claims 5 to 7 for use ~~in generating an immune response in a mammal~~as a medicament.

~~13. A vaccine of claim 6 for use in generating an immune response in a mammal.~~

~~14. A vaccine of claim 7 for use in generating an immune response in a mammal.~~

~~15.~~12. ~~A~~ The PPV5A for use of claim ~~10~~9, ~~wherein the mammal is a swine, and the immune response provides protective immunity to disease caused by~~the polypeptide for use of claim 10, or the vaccine for use of claim 11, for use in the treatment and/or prevention of PPV5A infection.

~~16. A polypeptide of claim 11, wherein the mammal is a swine, and the immune response provides protective immunity to disease caused by PPV5A infection.~~

~~17. A vaccine of claim 12, wherein the mammal is a swine, and the immune response provides protective immunity to disease caused by PPV5A infection.~~

~~18. A vaccine of claim 13, wherein the mammal is a swine, and the immune response provides protective immunity to disease caused by PPV5A infection.~~

~~19. A vaccine of claim 14, wherein the mammal is a swine, and the immune response provides protective immunity to disease caused by PPV5A infection.~~

~~20.~~13. An isolated antibody that specifically binds to a PPV5A polypeptide encoded by a ~~porcine parvovirus 5A~~ PPV5A polynucleotide having a sequence of SEQ ID NO:1, said polypeptide having an amino acid sequence of SEQ ID NO:2~~,~~ or SEQ ID NO:3 or ~~SEQ ID~~

~~NO:4~~of a polypeptide that is encoded by a polynucleotide comprising the sequence of nucleotides 2845-5547 of SEQ ID NO: 1, and wherein said antibody does not bind to a polypeptide encoded by a different parvovirus.

~~21.~~14. A method of identifying the presence of PPV5A in a biological sample, comprising

a) contacting the biological sample with an antibody of claim ~~21~~13,

b) detecting the formation of a complex between the antibody and a PPV5A polypeptide,

wherein the presence of said complex indicates the presence of PPV5A in the biological sample.

~~22.~~15. A vector or plasmid that comprises a polynucleotide of claim 1.

~~23.~~16. A host cell comprising a vector of claim ~~22~~15.

~~24.~~17. A hybridoma that expresses an antibody of claim ~~20~~13.

~~25.~~18. A diagnostic kit for identifying the presence of PPV5A in a biological sample, comprising

a) an antibody of claim ~~21~~13, and

b) reagents for detecting the formation of a complex between the antibody and a PPV5A polypeptide.

~~26.~~19. An immunogenic kit, comprising

a) at least one immunogenic PPV5A peptide of claim 14 which is effective to immunize an animal against at least one disease associated with PPV5A infection;

b) at least one carrier or adjuvant molecule;

c) a container for packaging the immunogenic composition;

d) a set of printed instructions; and

e) a dispenser capable of administering the immunogenic composition to an animal~~.~~,

~~27. An~~ and wherein said immunogenic kit ~~of claim 26,~~optionally further ~~comprising~~ comprises at least one immunogenic protein which is effective to immunize said animal against at least one other porcine pathogenic virus or bacteria which causes a disease associated with an infection with said virus or bacteria.