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(54) Title: USE OF RECOMBINANT ANTIGENS TO DETERMINE THE IMMUNE STATUS OF AN ANIMAL

(57) Abstract: The present invention includes a method to determine the immune status of an animal that includes the steps of (a) contacting a biological specimen of the animal with a recombinant infectious agent antigen that is specific for detecting an antibody selective for that infectious agent, under conditions suitable for formation of a complex between the recombinant antigen and the antibody and (b) detecting the presence or absence of the complex, wherein presence or absence of a complex is indicative of the immune status of the animal. Preferably such a method indicates whether the animal should be vaccinated. The present invention also includes an assay comprising (a) a recombinant infectious agent antigen that is specific for detecting an antibody selective for that infectious agent; and (b) a means to detect an antibody that selectively binds to the recombinant antigen. Also included in the present invention are recombinant antigens and nucleic acid molecules encoding such antigens as well as methods to produce and use such nucleic acid molecule and recombinant antigens.

USE OF RECOMBINANT ANTIGENS
TO DETERMINE THE IMMUNE STATUS OF AN ANIMAL

FIELD OF THE INVENTION

The present invention relates generally to materials and methods useful for the
5 detection of antibodies in an animal. In particular, the invention relates to the use of
recombinant antigens to determine the immune status of an animal in order to
determine whether the animal has antibodies indicative of protection from infection by
an infectious agent.

BACKGROUND OF THE INVENTION

10 The need for vaccinations against pathogens has long been recognized in
humans and other animals. The long term efficacy of vaccines, especially vaccines
against viruses, has become a topic of interest more recently. One recent study, for
example, showed that neutralizing antibody titers against feline parvovirus (FPV),
feline herpesvirus (FHV), and feline calicivirus (FCV) remain in cats for at least three
15 years following vaccination; see Scott, *et al.*, 1997, *Feline Practice* 25, 12-19. The
antibody titers do decline over time, however, and the exact time that any given cat
remains protected against disease cannot be predicted without testing. Current
guidelines for vaccination recommend that cats be revaccinated every three years; see,
for example, Elston, *et al.*, 1998, *Feline Practice* 26, 14-16; Elston, *et al.*, 1998, *J. Am.*
20 *Vet. Med. Assoc.* 212, 227-241. For dogs, the current recommendation is to
revaccinate against canine parvovirus and canine distemper virus yearly.

Vaccinations, however, are not risk-free. Anaphylaxis, post-vaccine canine
distemper encephalitis, polyarthritis, glomerulonephritis, immune-mediated hemolytic
anemia, autoimmune nonregenerative anemia and immune-mediated
25 thrombocytopenia are all reported adverse reactions to vaccinations; see, for example,
McCaw, *et al.*, 1998, *J. Am. Vet. Med. Assoc.* 213, 72-75. A small proportion of cats
have also been reported to develop fibrosarcomas after multiple vaccine injections;
see, for example, Hershey *et al.*, 2000, *J. Am. Vet. Med. Assoc.* 216, 58-61. The risks
associated with vaccination, coupled with recent research demonstrating that at least
30 some cats may not require certain vaccinations for more than seven years and that at
least some dogs may not require revaccination for more than two years, are indicative

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of the desirability of measuring antibody titers to determine the immune status of animals prior to vaccination; see, Scott, *et al.*, 1999, *Am. J. Vet. Res.* 60, 652-58 1999; McCaw, *et al.*, *ibid.*

The duration of immunity experiments performed by Scott, *et al.*, 1999, *ibid.*,
5 and McCaw, *et al.*, *ibid.*, however, utilized virus neutralization (“VN”) tests to determine the amount of protective antibodies in test animals. Depending on the particular assay, VN tests typically require between three and four days to perform, and can require as long as six or seven days. Time is only one disadvantage of the VN test: the test also requires skilled laboratory personnel to perform, incurs significant cost,
10 and involves the use of live virus, presenting a biohazard risk.

An enzyme-linked immunosorbent assay (ELISA) represents an alternative to VN tests. ELISAs usually require an overnight coating step, with the actual test being performed in less than one day. This test does require multiple steps and requires a relatively skilled technician for performance and analysis. Standard methods use
15 whole virus or virus-infected cells as the antigen for the detection of protective antibodies, again posing a biohazard risk. See, for example, Hill, *et al.*, 1995, *Am. J. Vet. Res.* 56, 1181-1187; Spencer, *et al.*, 1991, *J. Wildl. Dis.* 27, 578-583; Fiscus, *et al.*, 1985, *Am. J. Vet. Res.* 46, 859-63. Furthermore, whole virus preparations are contaminated with antigens from the cells used to grow the virus. The procedure for
20 obtaining canine parvovirus (CPV) in Fiscus, *et al.*, *ibid.*, for example, is not sufficient to completely remove such cellular antigens from the preparation. When using a biological specimen such as blood or serum from a vaccinated animal as a test sample, cellular antigens in the virus preparation can react with antibodies previously produced by the animal in response to such cellular proteins being in the virus preparation with
25 which the animal was previously vaccinated. The presence of such cellular antigens in an immunoassay frequently increases the level of the signal in the assay, thereby leading to false positive or ambiguous results.

Thus, the methods currently practiced to determine the immune status of an animal suffer from a number of disadvantages, which are multiplied with each
30 antibody type that one wishes to detect. Accordingly, there remains a need for an improved assay for the detection of antibodies in a test sample that does not require the

use of biohazardous material and does not utilize materials containing contaminants that lead to false positives. There also remains a need for an assay for the detection of antibodies to one or more infectious agents that can be performed in a relatively short time period, in a veterinarian's office, inexpensively, by unskilled personnel. There
5 further remains a need for antigen reagents that not only are stable and economic to produce but also are consistent from batch to batch.

SUMMARY OF THE INVENTION

The present invention relates generally to materials and methods useful for the detection of the immune status of an animal. In particular, the invention relates to
10 recombinant antigens and their use as reagents to determine the presence of antibodies indicative of protection against disease in an animal.

One embodiment of the present invention is a method to determine the immune status of an animal. Such a method includes the steps of: (a) contacting a biological specimen of the animal with a recombinant infectious agent antigen that is specific for
15 detecting an antibody selective for that infectious agent, under conditions suitable for formation of a complex between the recombinant antigen and the antibody; and (b) detecting the presence or absence of the complex, wherein presence or absence of a complex is indicative of the immune status of the animal. For example, presence of a complex indicates that the animal is not susceptible to (i.e., is protected from)
20 infection by the infectious agent.

Another embodiment of the present invention is a method to determine whether to vaccinate an animal. Such a method includes the steps of: (a) contacting a biological specimen of the animal with a recombinant infectious agent antigen that is specific for detecting an antibody selective for that infectious agent, under conditions
25 suitable for formation of a complex between the recombinant antigen and the antibody; and (b) detecting the presence or absence of the complex. Presence of such a complex indicates that the animal need not be vaccinated, whereas absence of such a complex indicates that the animal should be vaccinated.

Yet another embodiment of the present invention is an assay to determine the
30 immune status of an animal. Such an assay includes (a) a recombinant infectious agent

antigen that is specific for detecting an antibody selective for that infectious agent; and (b) a means to detect an antibody that selectively binds to the recombinant antigen.

The present invention also includes the following recombinant antigens:

PFCVCP₆₇₁, PFCVCP₅₄₇, PFPVVP2₅₈₄, PFPVVP2C₂₄₃, PFPVpVP12₆₂₀, PFPVpVP2₄₇₇,
 5 PFHVgB₉₄₃, PFHVgB₂₅₀, PFHVgC₅₃₄, PFHVgC₄₆₇, PFHVgC_{467(opt)}, PFHVgD₃₇₄,
 PFHVgD₃₀₀, PFeLVp27₂₅₃, PFeLVp27₆₁₉, PFeLVp27-gp70₆₁₁, PCDVH₆₀₄, and
 PCDVF₆₆₂. These recombinant antigens are represented, respectively by the following
 amino acid sequences: SEQ ID NO:2, SEQ ID NO:4, SEQ ID NO:6, SEQ ID NO:8,
 SEQ ID NO:10, SEQ ID NO:12, SEQ ID NO:14, SEQ ID NO:16, SEQ ID NO:18,
 10 SEQ ID NO:20, SEQ ID NO:22, SEQ ID NO:24, SEQ ID NO:26, SEQ ID NO:28,
 SEQ ID NO:30, SEQ ID NO:32, SEQ ID NO:34 and SEQ ID NO:36. Also included
 are nucleic acid molecules encoding such recombinant antigens as well as nucleic acid
 molecules fully complementary to such coding sequences. Also included are
 recombinant molecules and recombinant cells including such nucleic acid molecules as
 15 well as methods to produce such nucleic acid molecules, recombinant molecules,
 recombinant cells, and recombinant antigens.

DETAILED DESCRIPTION OF THE INVENTION

The present invention includes a method to determine the immune status of an animal. As used herein, the phrase to determine the immune status of an animal refers
 20 to a method to detect antibodies in that animal that are selective for a given infectious agent. Presence of such antibodies indicates that the animal is protected from infection by the infectious agent. Such an animal need not be vaccinated as it is not susceptible to infection by the infectious agent. A method of the present invention to determine the immune status of an animal includes the steps of: (a) contacting a biological
 25 specimen of the animal with a recombinant infectious agent antigen that is specific for detecting an antibody selective for that infectious agent, under conditions suitable for formation of a complex between the recombinant antigen and the antibody; and (b) detecting the presence or absence of the complex, wherein presence or absence of a complex is indicative of the immune status of the animal. In one embodiment, such a
 30 method is used to determine whether to vaccinate an animal. The present invention also includes an assay to determine the immune status of an animal as well as

recombinant antigens that can be used in such a method or assay. Also included are nucleic acid molecules encoding such recombinant antigens, recombinant molecules and recombinant cells as well as methods to produce and use such molecules and cells.

It was surprising to the inventors that recombinant antigens are essential to a
5 method to accurately determine the immune status of an animal. Use of whole virus in such a method was found to be unacceptable due to the potential for false positives caused by cellular antigens co-purifying with the virus preparation. The problem with cellular antigens was compounded when virus was isolated in a large-scale preparation. Although attempts were made to overcome these problems, using, for
10 example, ultracentrifugation or cesium chloride purification techniques to purify virus, unacceptable levels of cellular antigens remained. As described in more detail in the Examples, not only did reagents containing feline calicivirus (FCV), feline herpesvirus (FHV), or feline parvovirus (FPV) purified from Crandell feline kidney (CRFK) cells in which the respective virus had grown (i.e., FCV or FHV purified by
15 ultracentrifugation or FPV through cesium chloride) yield positive results in an ELISA to detect antibodies in cats previously administered the respective virus, but so did the respective "control" reagents purified from uninfected CRFK cells in the same manner. Data obtained from the "control" reagents represented unacceptable false positive results, leading the inventors to pursue alternative routes to develop an
20 immune status assay. The inventors subsequently found that a recombinantly produced viral antigen yields unexpectedly good results, with acceptable background levels, in the determination of the immune status of an animal by immunoassay.

As such, the present invention includes a method to determine the immune status of an animal that includes the following steps: (a) contacting a biological
25 specimen of the animal with a recombinant infectious agent antigen that is specific for detecting an antibody selective for that infectious agent, under conditions suitable for formation of a complex between the recombinant antigen and the antibody; and (b) detecting the presence or absence of the complex, wherein presence or absence of a complex is indicative of the immune status of the animal. It is to be noted that the
30 term "a" entity or "an" entity refers to one or more of that entity; for example, a recombinant antigen refers to one or more antigens or at least one antigen. As such,

the terms "a" (or "an"), "one or more" and "at least one" can be used interchangeably herein. It is also to be noted that the terms "comprising", "including", and "having" can be used interchangeably.

As used herein, a recombinant infectious agent antigen is an antigen of an
5 infectious agent that is produced using recombinant nucleic acid technology. Such an antigen, also referred to herein as a recombinant antigen of the present invention or simply as a recombinant antigen, can be identified in a straight-forward manner by its ability to specifically detect an antibody selective for that infectious agent. As used
10 herein, an antibody selective for an infectious agent, also referred to herein as an anti-infectious agent antibody, is an antibody that selectively binds to that infectious agent in that it preferentially binds to that infectious agent as opposed to binding to a different, unrelated, infectious agent. It is to be noted that, in accordance with the present invention, such an antibody exists in a biological specimen of an animal because a given infectious agent, upon infecting the animal, induces an immune
15 response that includes the production of such an antibody selective for that infectious agent. A recombinant antigen of the present invention is also able to specifically detect the presence of such an antibody in that the recombinant antigen is sufficiently similar to the corresponding antigen on the infectious agent to enable such detection. The specificity of such detection enables one to ascertain that an animal has antibodies
20 to a given infectious agent rather than to an unrelated infectious agent. Binding of an antigen and antibody can be measured using a variety of methods known to those skilled in the art, such as, but not limited to, those methods disclosed elsewhere herein. Preferably, a recombinant antigen of the present invention has a binding affinity of from about 10^8 liters per mole (M^{-1}) to about 10^{12} M^{-1} for an anti-infectious agent
25 antibody of the present invention.

A recombinant infectious agent antigen of the present invention can correspond exactly to the antigen as found on the infectious agent or the recombinant antigen can be a homolog of such a native antigen. Examples of homologs include proteins in which amino acids have been deleted (e.g., a truncated version of the protein, such as a
30 peptide), inserted, inverted, substituted and/or derivatized (e.g., by glycosylation, phosphorylation, acetylation, myristoylation, prenylation, palmitoylation, amidation

and/or addition of glycerophosphatidyl inositol) such that the homolog includes at least one epitope capable of forming an immunocomplex, also referred to herein as a complex, with an anti-infectious agent antibody. As used herein, the term epitope refers to the smallest portion of a protein or other antigen capable of selectively
5 binding to the antigen binding site of an antibody. It is well accepted by those skilled in the art that the minimal size of a protein epitope is about four amino acids. In one embodiment, a recombinant antigen of the present invention is modified to produce a more soluble antigen. Methods to produce more soluble antigens by modifying either a nucleic acid sequence or the protein itself are well known to those skilled in the art.
10 One example of such a method, not intended to be limiting, is protein iodoacetimidation.

A recombinant antigen homolog can be the result of natural allelic variation or natural mutation. Homologs of the present invention can also be produced using techniques known in the art including, but not limited to, direct modifications to the
15 protein or modifications to the nucleic acid molecule encoding the protein using, for example, classic or recombinant nucleic acid molecule techniques to effect random or targeted mutagenesis.

It is to be appreciated that recombinant antigens of the present invention include, but are not limited to, full-length proteins, proteins that are encoded by allelic
20 variants of a given nucleic acid sequence, hybrid proteins, fusion proteins, multivalent proteins, and proteins that are truncated homologs of, or are proteolytic products of, at least a portion of a protein. As used herein, the term hybrid protein refers to a single protein produced from at least two different proteins; i.e., having domains from at least two different proteins.

25 Due to the method by which it is produced, a recombinant antigen of the present invention is removed from its natural milieu. As such, a recombinant antigen is isolated or biologically pure. Such terms do not reflect the extent to which a recombinant antigen is purified. A preferred recombinant antigen is purified from the recombinant cell which expresses the protein. Examples of methods to produce
30 recombinant antigens of the present invention are disclosed elsewhere herein.

A recombinant infectious agent antigen of the present invention is any recombinant antigen that corresponds to (e.g., is derived from) an infectious agent. Preferred is an infectious agent for which one desires to determine if an animal is susceptible to infection by that agent. Suitable infectious agents include, but are not limited to, viruses, bacteria, fungi, endoparasites and ectoparasites. As such, suitable recombinant infectious agent antigens include, but are not limited to, recombinant viral, bacterial, fungal, endoparasite and ectoparasite antigens. Examples of viral infectious agents include, but are not limited to, adenoviruses, caliciviruses, coronaviruses, distemper viruses, hepatitis viruses, herpesviruses, immunodeficiency viruses, infectious peritonitis viruses, leukemia viruses, oncogenic viruses, papilloma viruses, parainfluenza viruses, parvoviruses, rabies viruses, and reoviruses, as well as other cancer-causing or cancer-related viruses. Examples of bacterial infectious agents include, but are not limited to, *Actinomyces*, *Bacillus*, *Bacteroides*, *Bartonella*, *Bordetella*, *Borrelia*, *Brucella*, *Campylobacter*, *Capnocytophaga*, *Clostridium*, *Corynebacterium*, *Coxiella*, *Dermatophilus*, *Ehrlichia*, *Enterococcus*, *Escherichia*, *Francisella*, *Fusobacterium*, *Haemobartonella*, *Helicobacter*, *Klebsiella*, L-form bacteria, *Leptospira*, *Listeria*, *Mycobacteria*, *Mycoplasma*, *Neorickettsia*, *Nocardia*, *Pasteurella*, *Peptococcus*, *Peptostreptococcus*, *Proteus*, *Pseudomonas*, *Rickettsia*, *Rochalimaea*, *Salmonella*, *Shigella*, *Staphylococcus*, *Streptococcus*, and *Yersinia*. Examples of fungal infectious agents include, but are not limited to, *Absidia*, *Acremonium*, *Alternaria*, *Aspergillus*, *Basidiobolus*, *Bipolaris*, *Blastomyces*, *Candida*, *Chlamydia*, *Coccidioides*, *Conidiobolus*, *Cryptococcus*, *Curvalaria*, *Epidermophyton*, *Exophiala*, *Geotrichum*, *Histoplasma*, *Madurella*, *Malassezia*, *Microsporium*, *Moniliella*, *Mortierella*, *Mucor*, *Paecilomyces*, *Penicillium*, *Phialemonium*, *Phialophora*, *Prototheca*, *Pseudallescheria*, *Pseudomicrodochium*, *Pythium*, *Rhinosporidium*, *Rhizopus*, *Scolecobasidium*, *Sporothrix*, *Stemphylium*, *Trichophyton*, *Trichosporon*, and *Xylohypha*. Example of protozoan parasite infectious agents include, but are not limited to, *Babesia*, *Balantidium*, *Besnoitia*, *Cryptosporidium*, *Eimeria*, *Encephalitozoon*, *Entamoeba*, *Giardia*, *Hammondia*, *Hepatozoon*, *Isospora*, *Leishmania*, *Microsporidia*, *Neospora*, *Nosema*, *Pentatrichomonas*, *Plasmodium*, *Pneumocystis*, *Sarcocystis*, *Schistosoma*, *Theileria*, *Toxoplasma*, and *Trypanosoma*.

Examples of helminth parasite infectious agents include, but are not limited to, *Acanthocheilonema*, *Aelurostrongylus*, *Ancylostoma*, *Angiostrongylus*, *Ascaris*, *Brugia*, *Bunostomum*, *Capillaria*, *Chabertia*, *Cooperia*, *Crenosoma*, *Dictyocaulus*, *Dioctophyme*, *Dipetalonema*, *Diphyllobothrium*, *Diplydium*, *Dirofilaria*, *Dracunculus*,
5 *Enterobius*, *Filaroides*, *Haemonchus*, *Lagochilascaris*, *Loa*, *Mansonella*, *Muellerius*, *Nanophyetus*, *Necator*, *Nematodirus*, *Oesophagostomum*, *Onchocerca*, *Opisthorchis*, *Ostertagia*, *Parafilaria*, *Paragonimus*, *Parascaris*, *Physaloptera*, *Protostrongylus*, *Setaria*, *Spirocerca*, *Spirometra*, *Stephanofilaria*, *Strongyloides*, *Strongylus*, *Thelazia*, *Toxascaris*, *Toxocara*, *Trichinella*, *Trichostrongylus*, *Trichuris*. *Uncinaria*, and
10 *Wuchereria*. Examples of ectoparasite infectious agents include, but are not limited to, fleas; ticks, including hard ticks and soft ticks; flies, such as midges, mosquitos, sand flies, black flies, horse flies, horn flies, deer flies, tsetse flies, stable flies, myiasis-causing flies and biting gnats; ants; spiders, lice; mites; and true bugs, such as bed bugs and kissing bugs.

15 Preferred recombinant antigens of the present invention include an adenovirus protein, a calicivirus protein, a coronavirus protein, a distemper virus protein, a herpesvirus protein, an immunodeficiency virus protein, an influenza virus protein, a leukemia virus protein, a parvovirus protein, a rabies virus protein, a *Bartonella* protein, an *Ehrlichia* protein, a *Haemobartonella* protein, a *Leptospira* protein, a
20 *Streptococcus* protein, a protozoan myeloencephalitis protein, a *Dirofilaria* protein, and a *Giardia* protein. More preferred recombinant antigens include a feline calicivirus protein, a feline coronavirus protein, a feline herpesvirus protein, a feline leukemia virus protein, a feline parvovirus protein, a canine adenovirus protein, a canine coronavirus protein, a canine distemper virus protein, a canine parvovirus protein, a
25 rabies virus protein, an equine herpesvirus I protein, an equine herpesvirus IV protein, an equine influenza virus protein, a *Streptococcus equii* protein, and an *Ehrlichia* protein. Even more preferred recombinant antigens of the present invention include a feline calicivirus capsid protein (a rFCVCP protein), a feline herpesvirus glycoprotein B (gB) protein (a rFHVgB protein), a feline herpesvirus glycoprotein C (gC) protein (a
30 rFHVgC protein), a feline herpesvirus glycoprotein D (gD) protein (a rFHV gD protein), a feline parvovirus VP12 protein (a rFPVVP12 protein), a feline parvovirus

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VP2 protein (a rFPVVP2 protein), a feline leukemia virus p27 protein (a rFeLVp27 protein), a feline leukemia virus glycoprotein70 protein (a rFeLVgp70 protein), a p27/gp70 fusion protein (a rFeLVp27-gp70 protein), a canine distemper virus fusion protein (a rCDVF protein), and a canine distemper virus hemagglutinin protein (a rCDVH protein). Even more preferred recombinant antigens of the present invention

5 include PFCVCP₆₇₁, PFCVCP₅₄₇, PFPVVP2₅₈₄, PFPVVP2C₂₄₃, PFPVpVP12₆₂₀, PFPVpVP2₄₇₇, PFHVgB₉₄₃, PFHVgB₂₅₀, PFHVgC₅₃₄, PFHVgC₄₆₇, PFHVgC_{467(opt)}, PFHVgD₃₇₄, PFHVgD₃₀₀, PFeLVp27₂₅₃, PFeLVp27₆₁₉, PFeLVp27-gp70₆₁₁, PCDVH₆₀₄, and PCDVF₆₆₂, the characteristics and production of which are described in the

10 Examples. Such recombinant proteins have the following respective amino acid sequences: SEQ ID NO:2, SEQ ID NO:4, SEQ ID NO:6, SEQ ID NO:8, SEQ ID NO:10, SEQ ID NO:12, SEQ ID NO:14, SEQ ID NO:16, SEQ ID NO:18, SEQ ID NO:20, SEQ ID NO:22, SEQ ID NO:24, SEQ ID NO:26, SEQ ID NO:28, SEQ ID NO:30, SEQ ID NO:32, SEQ ID NO:34 and SEQ ID NO:36.

15 Particularly preferred recombinant antigens of the present invention include proteins having at least one of the following amino acid sequences: SEQ ID NO:2, SEQ ID NO:4, SEQ ID NO:6, SEQ ID NO:8, SEQ ID NO:10, SEQ ID NO:12, SEQ ID NO:14, SEQ ID NO:16, SEQ ID NO:18, SEQ ID NO:20, SEQ ID NO:22, SEQ ID NO:24, SEQ ID NO:26, SEQ ID NO:28, SEQ ID NO:30, SEQ ID NO:32, SEQ ID

20 NO:34 and SEQ ID NO:36. Also preferred are recombinant antigens that are fragments of any of such antigens having such cited amino acid sequences, the fragments being able to bind to antibodies selective for the corresponding infectious agent. Preferred recombinant antigens can be encoded by nucleic acid molecules that:

(a) have at least one of the following nucleic acid sequences: SEQ ID NO:1, SEQ ID

25 NO:3, SEQ ID NO:5, SEQ ID NO:7, SEQ ID NO:9, SEQ ID NO:11, SEQ ID NO:13, SEQ ID NO:15, SEQ ID NO:17, SEQ ID NO:19, SEQ ID NO:21, SEQ ID NO:23, SEQ ID NO:25, SEQ ID NO:27, SEQ ID NO:29, SEQ ID NO:31, SEQ ID NO:33, and SEQ ID NO:35; (b) are degenerates of the nucleic acid sequences of (a); (c) are allelic variants of the nucleic acid sequences of (a); or (d) are fragments of any of the nucleic

30 acid molecules of (a), (b), or (c). The foregoing SEQ ID NOs represent nucleic acid and amino acid sequences deduced according to methods disclosed in the Examples. It

should be noted that since nucleic acid sequencing technology is not entirely error-free, the foregoing SEQ ID NOs, at best, represent apparent nucleic acid and amino acid sequences of certain nucleic acid molecules and recombinant antigens, respectively, of the present invention. In addition, variation seen in the foregoing SEQ ID NOs can
5 also be due, at least in part, to allelic variation, which can be caused by, among other factors, genetic drift.

Additional preferred recombinant antigens of the present invention share at least about 70%, preferably at least about 75%, more preferably at least about 80%, more preferably at least about 85%, more preferably at least about 90%, more
10 preferably at least about 95%, and more preferably about 100% identity at the amino acid level with a protein having at least one of the following amino acid sequences: SEQ ID NO:2, SEQ ID NO:4, SEQ ID NO:6, SEQ ID NO:8, SEQ ID NO:10, SEQ ID NO:12, SEQ ID NO:14, SEQ ID NO:16, SEQ ID NO:18, SEQ ID NO:20, SEQ ID NO:22, SEQ ID NO:24, SEQ ID NO:26, SEQ ID NO:28, SEQ ID NO:30, SEQ ID
15 NO:32, SEQ ID NO:34 and SEQ ID NO:36. Also preferred are fragments of such antigens, and particularly fragments that are at least about 5, 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 650, 700, 750, 800, 850, or 900 amino acids in length.

The present invention also includes a recombinant antigen nucleic acid
20 molecule. Recombinant antigen nucleic acid molecules of the present invention include any recombinant nucleic acid molecule that encodes a recombinant antigen of the present invention as well as a nucleic acid molecule fully complementary to any such coding sequence. A nucleic acid molecule of the present invention can be single-stranded or double-stranded. In accordance with the present invention, an isolated
25 nucleic acid molecule is a nucleic acid molecule that has been removed from its natural milieu, i.e., that has been subjected to human manipulation, and can include DNA, RNA, or derivatives of either DNA or RNA. It is to be noted that the term isolated does not reflect the extent to which the nucleic acid molecule has been purified. A recombinant antigen nucleic acid molecule of the present invention can be
30 isolated from its natural source or produced using recombinant DNA technology, e.g., polymerase chain reaction (PCR) amplification or cloning, or chemical synthesis.

Although the phrase, nucleic acid molecule, primarily refers to the physical nucleic acid molecule and the phrase, nucleic acid sequence, primarily refers to the sequence of nucleotides on the nucleic acid molecule, the two phrases can be used interchangeably.

5 A nucleic acid molecule of the present invention can be a natural isolate or a homolog thereof. Nucleic acid molecule homologs include natural allelic variants and nucleic acid molecules modified by one or more nucleotide insertions, deletions, substitutions, and/or inversions in a manner such that the modification(s) do not substantially interfere with the nucleic acid molecule's ability to encode a recombinant
10 antigen of the present invention. A nucleic acid molecule homolog of the present invention can be produced using a number of methods known to those skilled in the art; see, for example, Sambrook et al., 1989, *Molecular Cloning: A Laboratory Manual*, Cold Spring Harbor Labs Press; Sambrook et al., *ibid.*, is incorporated by reference herein in its entirety. For example, nucleic acid molecules can be modified
15 using a variety of techniques including, but not limited to, classic mutagenesis and recombinant DNA techniques such as site-directed mutagenesis, chemical treatment, restriction enzyme cleavage, ligation of nucleic acid fragments, PCR amplification, synthesis of oligonucleotide mixtures and ligation of mixture groups to build a mixture of nucleic acid molecules, and combinations thereof. Nucleic acid molecule homologs
20 can be selected by hybridization or by screening for the function of a protein encoded by the nucleic acid molecule, e.g., ability to detect antibodies selective for the corresponding infectious agent.

Suitable and preferred nucleic acid molecules of the present invention encode suitable and preferred recombinant antigens as disclosed herein. Particularly preferred
25 nucleic acid molecules of the present invention include the following nucleic acid sequences: SEQ ID NO:1, SEQ ID NO:3, SEQ ID NO:5, SEQ ID NO:7, SEQ ID NO:9, SEQ ID NO:11, SEQ ID NO:13, SEQ ID NO:15, SEQ ID NO:17, SEQ ID NO:19, SEQ ID NO:21, SEQ ID NO:23, SEQ ID NO:25, SEQ ID NO:27, SEQ ID NO:29, SEQ ID NO:31, SEQ ID NO:33, and SEQ ID NO:35; as well as nucleic acid
30 molecules having nucleic acid sequences fully complementary to such sequences. Particularly preferred double-stranded nucleic acid molecules include nFCVCP₂₀₁₃,

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nFCVCP₁₆₄₁, nFPVVP2₁₇₅₂, nFPVVP2C₇₂₉, nFPVpVP12₁₈₆₀, nFPVpVP2₁₄₃₁,
nFHVgB₂₈₂₉, nFHVgB₇₅₀, nFHVgC₁₆₀₂, nFHVgC₁₄₀₁, nFHVgC_{1401(opt)}, nFHVgD₁₁₂₂,
nFHVgD₉₀₀, nFeLVp27₇₅₉, nFeLVp27₁₈₅₇, nFeLVp27-gp70₁₈₃₃, nCDVH₁₈₁₂, and
nCDVF₁₉₈₆. Also preferred are nucleic acid molecules having degenerate sequences to
5 any of the afore-mentioned nucleic acid molecules having cited nucleic acid sequences
and nucleic acid molecules that are allelic variants thereof as well as fragments of any
of the above-mentioned nucleic acid molecules. As used herein a nucleic acid
molecule having a sequence that is degenerate as compared to a cited nucleic acid
sequence is a nucleic acid molecule that encodes the same protein as the nucleic acid
10 molecule having the cited sequence, but has a different nucleic acid sequence due to
the degeneracy of the genetic code. As used herein, an allelic variant of a nucleic acid
molecule having a cited nucleic acid sequence is a nucleic acid molecule that is a gene
occurring at essentially the same locus (or loci) in the genome as the gene including
the particular SEQ ID NO's cited herein, but which, due to natural variations caused
15 by, for example, mutation or recombination, has a similar but not identical sequence.
Also included in the term allelic variant are allelic variants of cDNAs derived from
such genes. Because natural selection typically selects against alterations that affect
function, allelic variants usually encode proteins having similar activity to that of the
protein encoded by the gene to which they are being compared. Allelic variants of
20 nucleic acid molecules can also comprise alterations in the 5' or 3' untranslated regions
of the gene (e.g., in regulatory control regions), or can involve alternative splicing of a
nascent transcript, thereby bringing alternative exons into juxtaposition. Allelic
variants are well known to those skilled in the art and would be expected to be found
within a given infectious agent.

25 Additional preferred recombinant antigen nucleic acid molecules of the present
invention share at least about 70%, preferably at least about 75%, more preferably at
least about 80%, more preferably at least about 85%, more preferably at least about
90%, more preferably at least about 95%, and more preferably about 100% identity at
the nucleic acid level with a nucleic acid molecule having at least one of the following
30 nucleic acid sequences: SEQ ID NO:1, SEQ ID NO:3, SEQ ID NO:5, SEQ ID NO:7,
SEQ ID NO:9, SEQ ID NO:11, SEQ ID NO:13, SEQ ID NO:15, SEQ ID NO:17, SEQ

ID NO:19, SEQ ID NO:21, SEQ ID NO:23, SEQ ID NO:25, SEQ ID NO:27, SEQ ID NO:29, SEQ ID NO:31, SEQ ID NO:33, and SEQ ID NO:35. Also preferred are fragments of such nucleic acid molecules, and particularly fragments that are at least about 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100, 150, 200, 250, 300, 350, 400, 450,
5 500, 550, 600, 650, 700, 750, 800, 850, 900, 950, 1000, 1100, 1200, 1300, 1400, 1500, 1600, 1700, 1800, 1900, 2000, 2100, 2200, 2300, 2400, 2500, 2600, 2700, or 2800 nucleotides in length.

The minimal size of a recombinant antigen of the present invention is a size sufficient to be encoded by a nucleic acid molecule capable of forming a stable hybrid
10 (i.e., hybridize under stringent hybridization conditions) with the complementary sequence of a nucleic acid molecule encoding the corresponding protein. The size of a nucleic acid molecule encoding such a protein is dependent on the nucleic acid composition and the percent homology between the nucleic acid molecule and the complementary nucleic acid sequence. It can easily be understood that the extent of
15 homology required to form a stable hybrid under stringent conditions can vary depending on whether the homologous sequences are interspersed throughout a given nucleic acid molecule or are clustered (i.e., localized) in distinct regions on a given nucleic acid molecule.

The minimal size of a nucleic acid molecule capable of forming a stable hybrid
20 with a nucleic acid molecule encoding a recombinant antigen is typically at least about 12 to about 15 nucleotides in length if the nucleic acid molecule is GC-rich and at least about 15 to about 17 nucleotides in length if it is AT-rich. The minimal size of a nucleic acid molecule used to encode a recombinant antigen homolog of the present invention is from about 12 to about 18 nucleotides in length. Thus, the minimal size
25 of a recombinant antigen homolog of the present invention is from about 4 to about 6 amino acids in length. There is no limit, other than a practical limit, on the maximal size of a nucleic acid molecule encoding a recombinant antigen of the present invention because a nucleic acid molecule of the present invention can include a portion of a full-length coding region, a full-length coding region, or multiple coding
30 regions (either partial or full-length). The preferred size of a protein encoded by a

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nucleic acid molecule of the present invention depends on whether a full-length, fusion, multivalent, or functional portion of such a protein is desired.

Stringent hybridization conditions are determined based on defined physical properties of the target nucleic acid molecule to which a nucleic acid molecule is being hybridized, and can be defined mathematically. Stringent hybridization conditions are those experimental parameters that allow an individual skilled in the art to identify significant similarities between heterologous nucleic acid molecules, i.e., those conditions that allow the identification of nucleic acid molecules that are at least about 70% identical, or that share less than about 30% mismatch. These conditions are well known to those skilled in the art. See, for example, Sambrook, et al., 1989, *ibid.*, and Meinkoth, et al., 1984, *Anal. Biochem.* 138, 267-284; Meinkoth, et al., is incorporated by reference herein in its entirety.

Furthermore, it is known in the art that there are commercially available computer programs for determining the degree of similarity between two nucleic acid sequences or amino acid sequences. These computer programs include various known methods to determine the percentage identity and the number and length of gaps between nucleic acid molecules and proteins. It is further known that the various available sequence analysis programs produce substantially similar results when the two compared molecules encode amino acid sequences that have greater than 30% amino acid identity. See Johnson et al., 1993 *J. Mol. Biol.* 233, 716-738, 1993, and Feng et al., 1985, *J. Mol. Evol.* 21, 112-125, 1985, each of which is incorporated by reference herein in its entirety. Preferred methods to determine the percent identity among amino acid sequences and also among nucleic acid sequences include analysis using one or more of the commercially available computer programs designed to compare and analyze nucleic acid or amino acid sequences. These computer programs include, but are in no way limited to, GCG™ (available from Genetics Computer Group, Madison, WI), DNAsis™ (available from Hitachi Software, San Bruno, CA) and MacVector™ (available from the Eastman Kodak Company, New Haven, CT). A particularly preferred method to determine the percent identity among amino acid sequences and also among nucleic acid sequences is to perform the analysis using the DNAsis™ computer program, using default parameters.

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The present invention also includes mimetopes of recombinant antigens of the present invention. In accordance with the present invention, a "mimotope" refers to any compound that is able to mimic the ability of a recombinant antigen of the present invention to bind to an antibody. A mimotope can be a peptide that has been modified
5 to decrease its susceptibility to degradation but that still retains antibody-binding activity. Other examples of mimetopes include, but are not limited to, carbohydrate-based compounds, lipid-based compounds, nucleic acid-based compounds, natural organic compounds, synthetically derived organic compounds, anti-idiotypic antibodies and/or catalytic antibodies, or fragments thereof. A mimotope can be
10 obtained by, for example, screening libraries of synthetic compounds for compounds capable of binding to anti-infectious agent antibodies. A mimotope can also be obtained by, for example, rational drug design. In a rational drug design procedure, the three-dimensional structure of a compound of the present invention can be analyzed by, for example, nuclear magnetic resonance (NMR) or x-ray crystallography.
15 The three-dimensional structure can then be used to predict structures of potential mimetopes by, for example, computer modeling. The predicted mimotope structures can then be produced by, for example, chemical synthesis, recombinant DNA technology, or by isolation from a natural source.

One embodiment of the present invention includes a recombinant vector that
20 includes at least one isolated nucleic acid molecule of the present invention, inserted into any vector capable of delivering the nucleic acid molecule into a host cell. Such a vector contains heterologous nucleic acid sequences, that is nucleic acid sequences that are not naturally found adjacent to nucleic acid molecules of the present invention and that preferably are derived from a species other than the species from which the
25 nucleic acid molecule(s) are derived. The vector can be either RNA or DNA, either prokaryotic or eukaryotic, and typically is a virus or a plasmid. Recombinant vectors can be used in the cloning, sequencing, and/or otherwise manipulating of antigen nucleic acid molecules of the present invention.

One type of recombinant vector, referred to herein as a recombinant molecule,
30 comprises a nucleic acid molecule of the present invention operatively linked to an expression vector. The phrase operatively linked refers to insertion of a nucleic acid

molecule into an expression vector in a manner such that the molecule is able to be expressed when transformed into a host cell. As used herein, an expression vector is a DNA or RNA vector that is capable of transforming a host cell and of effecting expression of a specified nucleic acid molecule. Preferably, the expression vector is also capable of replicating within the host cell. Expression vectors can be either prokaryotic or eukaryotic, and are typically viruses or plasmids. Expression vectors of the present invention include any vectors that function (i.e., direct gene expression) in recombinant cells of the present invention, including in bacterial, fungal, parasite, insect, other animal, and plant cells. Preferred expression vectors of the present invention can direct gene expression in bacterial, yeast, insect and mammalian cells, and more preferably in bacteria.

In particular, expression vectors of the present invention contain regulatory sequences such as transcription control sequences, translation control sequences, origins of replication, and other regulatory sequences that are compatible with the recombinant cell and that control the expression of nucleic acid molecules of the present invention. In particular, recombinant molecules of the present invention include transcription control sequences. Transcription control sequences are sequences which control the initiation, elongation, and termination of transcription. Particularly important transcription control sequences are those which control transcription initiation, such as promoter, enhancer, operator and repressor sequences. Suitable transcription control sequences include any transcription control sequence that can function in at least one of the recombinant cells of the present invention. A variety of such transcription control sequences are known to those skilled in the art. Preferred transcription control sequences include those which function in bacterial, yeast, insect or mammalian cells. More preferred transcription control sequences include those that function in bacteria, such as, but not limited to, *tac*, *lac*, *trp*, *trc*, oxy-pro, omp/lpp, *rrnB*, bacteriophage lambda (such as lambda p_L and lambda p_R and fusions that include such promoters), bacteriophage T7, T7*lac*, bacteriophage T3, bacteriophage SP6, bacteriophage SP01, and antibiotic resistance gene transcription control sequences.

Suitable and preferred nucleic acid molecules to include in recombinant vectors of the present invention are as disclosed herein. Preferred nucleic acid molecules to

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include in recombinant vectors, and particularly in recombinant molecules, include nFCVCP₂₀₁₃, nFCVCP₁₆₄₁, nFPVVP2₁₇₅₂, nFPVVP2C₇₂₉, nFPVpVP12₁₈₆₀, nFPVpVP2₁₄₃₁, nFHVgB₂₈₂₉, nFHVgB₇₅₀, nFHVgC₁₆₀₂, nFHVgC₁₄₀₁, nFHVgC_{1401(opt)}, nFHVgD₁₁₂₂, nFHVgD₉₀₀, nFeLVp27₇₅₉, nFeLVp27₁₈₅₇, nFeLVp27-gp70₁₈₃₃,
 5 nCDVH₁₈₁₂, and nCDVF₁₉₈₆. Particularly preferred recombinant molecules of the present invention include pλP_RHis-nFCVCP₂₀₁₃, pλP_R-nFCVCP₁₆₄₁, pλP_RHis-nFPVVP2₁₇₅₂, pλP_RHis-nFPVVP2C₇₂₉, pλP_R-nFPVVP2C₇₂₉, pλP_RHis-nFPVpVP12₁₈₆₀, pλP_RHis-nFPVpVP2₁₄₃₁, pλP_R-nFPVpVP2₁₄₃₁, pλP_RHis-nFHVgB₂₈₂₉, pλP_RHis-nFHVgB₇₅₀, pλP_RHis-nFHVgC₁₆₀₂, pλP_RHis-nFHVgC₁₄₀₁, pλP_R-nFHVgC_{1401(opt)},
 10 pλP_RHis-nFHVgD₁₁₂₂, pλP_RHis-nFHVgD₉₀₀, pλP_R-nFeLVp27₇₅₉, pλP_RHis-nFeLVp27₁₈₅₇, pλP_R-nFeLVp27-gp70₁₈₃₃, pλP_RHis-nCDVH₁₈₁₂, and pλP_RHis-nCDVF₁₉₈₆, the production of which are described in the Examples section.

Recombinant molecules of the present invention may also (a) contain secretory signals (i.e., signal segment nucleic acid sequences) to enable an expressed antigen of
 15 the present invention to be secreted from the cell that produces the protein and/or (b) contain fusion sequences which lead to the expression of nucleic acid molecules of the present invention as fusion proteins. Examples of suitable signal segments include any signal segment capable of directing the secretion of a protein of the present invention. Suitable fusion segments for use with the present invention include, but are not limited
 20 to, segments that can: enhance a protein's stability, enhance attachment of a protein to a substrate, and/or assist purification of a isolated antigen of the present invention (e.g., by affinity chromatography). A suitable fusion segment can be a domain of any size that has the desired function (e.g., imparts increased stability, enhances attachment to a substrate, and/or simplifies purification of a protein). Fusion segments can be
 25 joined to amino and/or carboxyl termini of the of the protein and can be susceptible to cleavage in order to enable straight-forward recovery of a isolated antigen of the present invention. Fusion proteins are preferably produced by culturing a recombinant cell transformed with a fusion nucleic acid molecule that encodes a protein including the fusion segment attached to either the carboxyl and/or amino terminal end of a
 30 domain. Preferred fusion segments include a metal binding domain (e.g., a poly-histidine segment); an immunoglobulin binding domain (e.g., Protein A; Protein G; T

cell; B cell; Fc receptor or complement protein antibody-binding domains); a sugar binding domain (e.g., a maltose binding domain); and/or a "tag" domain (e.g., at least a portion of β -galactosidase, a strep tag peptide, other domains that can be purified using compounds that bind to the domain, such as monoclonal antibodies). A more preferred fusion segment is a metal binding domain. Examples of particularly preferred fusion proteins of the present invention include PHis-PFCVCP₆₇₁, PHis-PFCVCP₅₄₇, PHis-PFPVVP2₅₈₄, PHis-PFPVVP2C₂₄₃, PHis-PFPVpVP12₆₂₀, PHis-PFPVpVP2₄₇₇, PHis-PFHVgB₉₄₃, PHis-PFHVgB₂₅₀, PHis-PFHVgC₅₃₄, PHis-PFHVgC₄₆₇, PHis-PFHVgC_{467(opt)}, PHis-PFHVgD₃₇₄, PHis-PFHVgD₃₀₀, PHis-PFeLVp27₂₅₃, PHis-PFeLVp27₆₁₉, PHis-PFeLVp27-gp70₆₁₁, PHis-PCDVH₆₀₄, and PHis-PCDVF₆₆₂; methods to produce such fusion proteins are disclosed in the Examples. The present invention also includes post-translational modification of a recombinant antigen to introduce a ligand. Examples of ligands include biotin, biotin-like compounds, avidin, avidin-like compounds, metal binding compounds, sugar binding compounds, immunoglobulin binding domains, and other tag domains.

Another embodiment of the present invention includes a recombinant cell comprising a host cell transformed with one or more nucleic acid molecules or recombinant molecules of the present invention. Transformation of a nucleic acid molecule into a cell can be accomplished by any method by which a nucleic acid molecule can be inserted into the cell. Transformation techniques include, but are not limited to, transfection, electroporation, microinjection, lipofectin, adsorption, and protoplast fusion. Transformed nucleic acid molecules of the present invention can remain extrachromosomal or can integrate into one or more sites within a chromosome of the transformed (i.e., recombinant) cell in such a manner that their ability to be expressed is retained. Suitable nucleic acid molecules with which to transform a cell include any nucleic acid molecules disclosed herein that encode a recombinant antigen. Particularly preferred nucleic acid molecules with which to transform a cell include nFCVCP₂₀₁₃, nFCVCP₁₆₄₁, nFPVVP2₁₇₅₂, nFPVVP2C₇₂₉, nFPVpVP12₁₈₆₀, nFPVpVP2₁₄₃₁, nFHVgB₂₈₂₉, nFHVgB₇₅₀, nFHVgC₁₆₀₂, nFHVgC₁₄₀₁, nFHVgC_{1401(opt)}, nFHVgD₁₁₂₂, nFHVgD₉₀₀, nFeLVp27₇₅₉, nFeLVp27₁₈₅₇, nFeLVp27-gp70₁₈₃₃, nCDVH₁₈₁₂, and nCDVF₁₉₈₆.

Suitable host cells to transform include any cell that can be transformed with a nucleic acid molecule of the present invention. Host cells can be either untransformed cells or cells that are already transformed with at least one nucleic acid molecule. Host cells of the present invention can be any cell capable of producing at least one protein of the present invention, and include bacterial, fungal (including yeast), parasite (including helminth, protozoa and ectoparasite), other insect, other animal and plant cells. Preferred host cells include bacterial, mycobacterial, yeast, insect and mammalian cells. More preferred host cells include *Salmonella*, *Escherichia*, *Bacillus*, *Listeria*, *Saccharomyces*, *Pichia*, *Spodoptera*, *Mycobacteria*, and *Trichoplusia* cells. Particularly preferred host cells are *Escherichia coli*.

A recombinant cell is preferably produced by transforming a host cell with a recombinant molecule encoding a recombinant antigen of the present invention operatively linked to an expression vector containing a transcription control sequence. Particularly preferred recombinant molecules include p λ P_RHis-nFCVCP₂₀₁₃, p λ P_R-nFCVCP₁₆₄₁, p λ P_RHis-nFPVVP2₁₇₅₂, p λ P_RHis-nFPVVP2C₇₂₉, p λ P_R-nFPVVP2C₇₂₉, p λ P_RHis-nFPVpVP12₁₈₆₀, p λ P_RHis-nFPVpVP2₁₄₃₁, p λ P_R-nFPVpVP2₁₄₃₁, p λ P_RHis-nFHVgB₂₈₂₉, p λ P_RHis-nFHVgB₇₅₀, p λ P_RHis-nFHVgC₁₆₀₂, p λ P_RHis-nFHVgC₁₄₀₁, p λ P_R-nFHVgC_{1401(opl)}, p λ P_RHis-nFHVgD₁₁₂₂, p λ P_RHis-nFHVgD₉₀₀, p λ P_R-nFeLVp27₇₅₉, p λ P_RHis-nFeLVp27₁₈₅₇, p λ P_R-nFeLVp27-gp70₁₈₃₃, p λ P_RHis-nCDVH₁₈₁₂, and p λ P_RHis-nCDVF₁₉₈₆. Particularly preferred recombinant cells include *E. coli*:p λ P_RHis-nFCVCP₂₀₁₃, *E. coli*:p λ P_R-nFCVCP₁₆₄₁, *E. coli*:p λ P_RHis-nFPVVP2₁₇₅₂, *E. coli*:p λ P_RHis-nFPVVP2C₇₂₉, *E. coli*:p λ P_R-nFPVVP2C₇₂₉, *E. coli*:p λ P_RHis-nFPVpVP12₁₈₆₀, *E. coli*:p λ P_RHis-nFPVpVP2₁₄₃₁, *E. coli*:p λ P_R-nFPVpVP2₁₄₃₁, *E. coli*:p λ P_RHis-nFHVgB₂₈₂₉, *E. coli*:p λ P_RHis-nFHVgB₇₅₀, *E. coli*:p λ P_RHis-nFHVgC₁₆₀₂, *E. coli*:p λ P_RHis-nFHVgC₁₄₀₁, *E. coli*:p λ P_R-nFHVgC_{1401(opl)}, *E. coli*:p λ P_RHis-nFHVgD₁₁₂₂, *E. coli*:p λ P_RHis-nFHVgD₉₀₀, *E. coli*:p λ P_R-nFeLVp27₇₅₉, *E. coli*:p λ P_RHis-nFeLVp27₁₈₅₇, *E. coli*:p λ P_R-nFeLVp27-gp70₁₈₃₃, *E. coli*:p λ P_RHis-nCDVH₁₈₁₂, and *E. coli*:p λ P_RHis-nCDVF₁₉₈₆. Details regarding the production of these recombinant cells are disclosed herein.

Recombinant DNA technologies can be used to improve expression of transformed nucleic acid molecules by manipulating, for example, the number of

copies of the nucleic acid molecules within a host cell, the efficiency with which those nucleic acid molecules are transcribed, the efficiency with which the resultant transcripts are translated, and the efficiency of post-translational modifications.

Recombinant techniques useful for increasing the expression of nucleic acid molecules of the present invention include, but are not limited to, operatively linking nucleic acid molecules to high-copy number plasmids, integration of the nucleic acid molecules into one or more host cell chromosomes, addition of vector stability sequences to plasmids, substitutions or modifications of transcription control signals (e.g., promoters, operators, enhancers), substitutions or modifications of translational control signals (e.g., ribosome binding sites, Shine-Dalgarno sequences), modification of nucleic acid molecules of the present invention to correspond to the codon usage of the host cell, deletion of sequences that destabilize transcripts, and use of control signals that temporally separate recombinant cell growth from recombinant enzyme production during fermentation. The activity of an expressed recombinant antigen of the present invention may be improved by fragmenting, modifying, or derivatizing a nucleic acid molecule encoding such an antigen.

Recombinant antigens of the present inventions can be produced in a variety of ways known to those skilled in the art. In one embodiment, a recombinant antigen of the present invention is produced by culturing a cell capable of expressing the antigen under conditions effective to produce the antigen, and recovering the antigen. A preferred cell to culture is a recombinant cell of the present invention. Effective culture conditions include, but are not limited to, effective media, bioreactor, temperature, pH and oxygen conditions that permit protein production. An effective, medium refers to any medium in which a cell is cultured to produce a recombinant antigen of the present invention. Such medium typically comprises an aqueous medium having assimilable carbon, nitrogen and phosphate sources, and appropriate salts, minerals, metals and other nutrients, such as vitamins. Recombinant cells of the present invention can be cultured in conventional fermentation bioreactors, shake flasks, test tubes, microtiter dishes, and petri plates. Culturing can be carried out at a temperature, pH and oxygen content appropriate for a recombinant cell. Such

culturing conditions are within the expertise of one of ordinary skill in the art.

Examples of suitable conditions are included in the Examples section.

Depending on the vector and host system used for production, the expressed recombinant antigens may either remain within the recombinant cell; be secreted into
5 the fermentation medium; be secreted into a space between two cellular membranes, such as the periplasmic space in *E. coli*; or be retained on the outer surface of a cell or viral membrane.

The phrase "recovering the antigen", as well as similar phrases, refers to collecting the whole fermentation medium containing the recombinant product and
10 need not imply additional steps of separation or purification. Proteins of the present invention can be purified using a variety of standard protein purification techniques, such as, but not limited to, affinity chromatography, ion exchange chromatography, filtration, electrophoresis, hydrophobic interaction chromatography, gel filtration chromatography, reverse phase chromatography, Concanavalin A chromatography,
15 chromatofocusing and differential solubilization. Recombinant antigens of the present invention are preferably retrieved in "substantially pure" form. As used herein, "substantially pure" refers to a purity that allows for the effective use of the protein as a detection reagent. Preferably, such a recombinant antigen reagent does not cause false positive reactions. In a preferred embodiment, recombinant antigens of the
20 present invention are at least about 60% pure, preferably at least about 65% pure, more preferably at least about 70% pure, more preferably at least about 75% pure, more preferably at least about 80% pure, more preferably at least about 85% pure, more preferably at least about 90% pure, and more preferably at least about 95% pure. In one embodiment, a recombinant antigen of the present invention is at least about 98%
25 to 100% pure.

One embodiment of the present invention is a method to determine the immune status of an animal to a desired infectious agent by detecting antibodies in that animal that selectively bind to that infectious agent. The method includes the steps of: (a) contacting a biological specimen of the animal with a recombinant infectious agent
30 antigen that is specific for detecting an antibody selective for that infectious agent, under conditions suitable for formation of a complex between the recombinant antigen

and the antibody; and (b) detecting the presence or absence of the complex, wherein presence or absence of a complex is indicative of the immune status of the animal. Presence of a complex indicates that an animal is protected from, or is not susceptible to, infection by that infectious agent, and as such, that animal need not be vaccinated.

5 Absence of a complex suggests that an animal may not be protected from, or may be susceptible to, infection by that infectious agent, and as such, it is desirable to vaccinate that animal.

Antibodies to be detected can be maternal antibodies transferred to the offspring or can be generated (i.e., produced) in response to a natural infection by an
10 infectious agent or vaccination. Vaccination can be accomplished in a variety of ways known to those skilled in the art including, but not limited to, administering the infectious agent itself or any immunogenic form thereof, such as, but not limited to, a modified live infectious agent, an inactivated, disrupted, fractionated or attenuated infectious agent, a native or recombinant antigen, or a nucleic acid molecule that
15 invokes an immune response against the infectious agent. Antibodies to be detected can be of any class, i.e., immunoglobulin A (IgA), immunoglobulin D (IgD), immunoglobulin E (IgE), immunoglobulin G (IgG), or immunoglobulin M (IgM) antibodies IgE, IgG, or IgM antibodies. Preferred antibodies to detect are IgA, IgG and IgM antibodies.

20 Any animal that possesses maternal antibodies or generates antibodies in response to an infectious agent or corresponding vaccine can be tested in accordance with the present invention. In one embodiment, a preferred animal to test is an animal that was vaccinated (i.e., administered a vaccine) at least about six months, one year, two years, or three years prior to testing. In another embodiment, a preferred animal
25 to test is an animal for whom infection or vaccination status is unknown. Suitable animals for whom to determine an immune status include, but are not limited to, cats (i.e., felids), dogs (i.e., canids), horses (i.e., equids), humans and other primates, ferrets and other Mustelids, cattle, sheep, swine, and rodents, as well as other companion animals (i.e., pets), food animals, work animals, or zoo animals. Preferred animals to
30 test include cats, dogs, horses and other companion animals, with cats, dogs and horses being even more preferred. As used herein, a cat refers to any member of the cat

family (i.e., Felidae), including domestic cats, wild cats and zoo cats. Examples of cats include, but are not limited to, domestic cats, lions, tigers, leopards, panthers, cougars, bobcats, lynx, jaguars, cheetahs, and servals. A preferred cat to test is a domestic cat. As used herein, a dog refers to any member of the family Canidae, including, but not limited to, domestic dogs, wild dogs, foxes, wolves, jackals, and coyotes and other members of the family Canidae. As used herein, a horse refers to an equid. An equid is a hoofed mammal and includes, but is not limited to, domestic horses and wild horses, such as, horses, asses, donkeys, and zebras. Preferred horses to test include domestic horses, including race horses.

10 A biological specimen refers to any sample that can be collected (i.e. obtained) from an animal in which antibodies may be found. A suitable biological specimen includes, but is not limited to, a bodily fluid composition or a cellular composition. Examples of a bodily fluid include, but are not limited to, blood, serum, plasma, saliva, urine, tears, aqueous humor, cerebrospinal fluid, lymph, nasal secretion, 15 tracheobronchial aspirate, milk, colostrum, intestinal secretion, and feces, with blood, serum, plasma, saliva, urine, tears, milk and colostrum being preferred and blood, serum or plasma being even more preferred.

As used herein, the term contacting refers to combining or mixing, in this case, a biological specimen and a recombinant antigen of the present invention. Formation 20 of a complex, or immunocomplex, between a recombinant antigen and any antibody selective for an infectious agent (i.e., an anti-infectious agent antibody) present in the biological specimen refers to the ability of the recombinant antigen to selectively bind to the antibody in order to form a stable complex that can be detected. As used herein, the term selectively binds to an antibody or specific for an antibody refers to the ability 25 of a recombinant antigen of the present invention to preferentially bind to an antibody that indicates that the animal is protected from disease, without being able to substantially bind to other, unrelated, antibodies. Binding between the recombinant antigen and anti-infectious agent antibody is effected under conditions suitable to form a complex; such conditions (e.g., appropriate concentrations, buffers, temperatures, 30 reaction times) as well as methods to optimize such conditions are known to those skilled in the art, and examples are disclosed herein. Examples of complex formation

conditions are also disclosed in, for example, in Sambrook et al., *ibid.*, and Harlow, et al., 1988, *Antibodies, a Laboratory Manual*, Cold Spring Harbor Labs Press; Harlow et al., *ibid.*, in incorporated herein by reference in its entirety.

As used herein, the phrase detecting the presence or absence of a complex
5 refers to determining if any complex is formed, i.e., assaying for the presence (i.e., existence) or absence (i.e., non-existence) of a complex. If complexes are formed, the amount of complexes formed can, but need not be, determined. Complex formation, or selective binding, between a recombinant antigen and anti-infectious agent antibody can be measured (i.e., detected, determined) using a variety of methods standard in the
10 art; see, for example, Sambrook, et al., *ibid.*, Harlow, et al., *ibid.*, and examples herein.

A complex can be measured in a variety of ways including, but not limited to, one of the following assays: an enzyme-linked immunoassay, a radioimmunoassay, a fluorescence immunoassay, a luminescence assay (such as a chemi-luminescent assay or a bio-luminescent assay), a phosphorescence assay, an immunoblot assay (e.g., a
15 Western blot), an immunodot assay, an immunoprecipitation assay, a lateral flow assay, a flow-through assay, an agglutination assay, a particulate-based assay (e.g., using particulates such as, but not limited to, magnetic particles or plastic polymers, such as latex or polystyrene beads), and an electronic sensory assay (e.g., using an electronic chip). In one embodiment, it is preferred not to use a virus neutralization
20 assay, a hemagglutination assay, or a complement fixation assay. Such assays are well known to those skilled in the art; see for, example, Harlow, et al., *ibid.* Assays can be used to give qualitative or quantitative results depending on how they are used.

Some assays, such as agglutination, particulate separation, and
immunoprecipitation, can be observed visually (e.g., either by eye or by a machines,
25 such as a densitometer or spectrophotometer) without the need for a detectable marker. In other assays, conjugation (i.e., attachment, joining) of a detectable marker to a recombinant antigen of the present invention or to an antibody-binding partner of the present invention that selectively binds to the antibody being detected aids in measuring complex formation. Conjugation is conducted in such a manner that the
30 ability of a recombinant antigen or antibody-binding partner to selectively bind to anti-infectious agent antibodies is not compromised. Conjugation can be accomplished, for

example, by joining a detectable marker to a recombinant antigen or antibody-binding partner or by constructing a genetic chimera that encodes a recombinant antigen fused to a detectable marker or an antibody-binding partner fused to a detectable marker.

Examples of detectable markers include, but are not limited to, an enzyme, a
5 radioactive label, a fluorescent label, a luminescent label (e.g., a bio-luminescent label or a chemi-luminescent label), a chromophoric (e.g., colorimetric) label, a metal sol label, a metal-binding label, a physical label, an electronic label, or a ligand. A ligand refers to a molecule that binds selectively to another molecule. Preferred detectable markers include, but are not limited to, a phosphatase (e.g., alkaline phosphatase), a
10 peroxidase (e.g., horseradish peroxidase), a beta-galactosidase, a luciferase, fluorescein, a radioisotope, a bead (e.g., a color bead, a magnetic bead), colloidal gold, biotin, avidin, and biotin-related compounds or avidin-related compounds (e.g., streptavidin or ImmunoPure® NeutrAvidin).

An antibody-binding partner of the present invention is any compound that can
15 bind to an anti-infectious agent antibody of the present invention. Preferably an antibody-binding partner binds to the constant region of such an antibody, such as to the Fc region of an IgA, IgD, IgE, IgG, or IgM antibody. Examples of such antibody-binding partners include anti-isotype antibodies (e.g., anti-IgA antibodies, anti-IgD antibodies, anti-IgE antibodies, anti-IgG antibodies, and anti-IgM antibodies) that
20 selectively bind to the constant region of antibodies of the animal being tested, antibody Fc receptors (e.g., IgA receptors, IgD receptors, IgE receptors, IgG receptors, IgM receptors), antibody-binding bacterial surface proteins (e.g., Protein A or Protein G, or recombinant forms of these proteins), antibody-binding cells (e.g., a B cell, T cell, or a macrophage), other antibody-binding eukaryotic cell surface proteins, and
25 antibody-binding complement proteins, as well as any portion of these proteins that selectively bind to an anti-infectious agent antibody. Preferred antibody-binding partners include Protein A, Protein G, an anti-IgG antibody, an anti-IgM antibody, an anti-IgA antibody, an anti-IgE antibody, an Fc_γ receptor molecule, an Fc_ε receptor molecule, an Fc_μ receptor molecule, and an Fc_α receptor molecule as well as any
30 portion of any of such proteins that selectively bind to the constant region of an anti-infectious agent antibody. It is within the scope of the present invention that a

complex between an anti-infectious agent antibody and a recombinant antigen of the present invention can be determined using one or more layers and/or types of secondary antibodies or other binding compounds. For example, an unlabeled secondary antibody can be bound to an anti-infectious agent antibody and the
5 unlabeled secondary antibody can then be bound by a labeled tertiary antibody.

In one embodiment of the present invention, the presence or absence of a complex is detected by applying a detection reagent that binds to the complex, if present, to obtain a test signal. The term applying refers to adding a detection reagent to the biological specimen after the recombinant antigen is combined with the
10 specimen under conditions to form a complex with any anti-infectious agent antibody in the specimen. The detection reagent binds to any complex present and such binding results in a test signal, i.e., an event that can be detected. If anti-infectious agent antibody is present in the biological specimen, a test signal will ensue. If there is no anti-infectious agent antibody present, no test signal will occur. Preferably, the
15 detection reagent comprises an antibody-binding partner of the present invention conjugated to a detectable marker of the present invention.

In one embodiment a complex can be formed and measured in solution. In another embodiment, a recombinant antigen of the present invention or an antibody-binding partner of the present invention can be immobilized on (e.g., coated onto) a
20 substrate. Preferably, a recombinant antigen of the present invention is immobilized on a substrate. Immobilization techniques are known to those skilled in the art. Suitable substrates on which to immobilize a recombinant antigen or antibody-binding partner of the present invention or a composition include, but are not limited to, plastic, glass, gel, celluloid, paper, fabric, electronic chip, and particulate materials
25 such as latex, polystyrene, nylon, nitrocellulose, agarose, cotton, PVDF (polyvinylidene-fluoride), and magnetic resin. Suitable substrates include, but are not limited to, a well (e.g., microtiter dish well), a plate, a dipstick, a strip, a bead, a sponge, a lateral flow apparatus, a membrane, a filter, a tube, a dish, a celluloid-type matrix, a magnetic particle, an electronic sensory device (e.g., an electronic sensory
30 chip), and other particulates. In one embodiment, a substrate, such as a particulate, can include a detectable marker.

In a preferred embodiment, a method to determine the immune status of an animal can be conducted within about one day, more preferably within about two hours, more preferably within about one hour, and even more preferably within a time period of between about one minute and about fifteen minutes.

5 A method of the present invention to detect immune status can be qualitative, quantitative, or semi-quantitative. In one embodiment, the method includes a step of comparing the intensity of a test signal of the present invention with a reference signal obtained by contacting a reference reagent with the detection reagent to determine the amount of anti-infectious agent antibody in the biological specimen. In one
10 embodiment, the reference signal represents a threshold, such that if the test signal is more intense than the reference signal the animal from which the biological specimen is collected is deemed to be protected from infection by the infectious agent. In one embodiment the reference reagent is immobilized on a substrate, preferably on the same substrate as is a recombinant antigen. Suitable reference reagents include
15 antibodies isolated from the same species of animal as is being tested. Preferred reference reagents to use in immune status assays for cats, dogs and horses, include feline antibodies, canine antibodies and equine antibodies, respectively.

 One embodiment of a method of the present invention to determine the immune status of an animal is to determine the immune status with respect to more
20 than one infectious agent. It is contemplated that any number of recombinant antigens can be used in such a determination. In one embodiment, a biological specimen from an animal is contacted with a recombinant calicivirus antigen, a recombinant herpesvirus antigen and a recombinant parvovirus antigen under conditions such that the immune status of the animal to calicivirus, herpesvirus and parvovirus infection is
25 determined.

 Another embodiment of the present invention includes the use of an immune status assay to determine whether a human should be treated for rabies virus infection. In such an embodiment, a biological specimen is collected from an animal suspected of having exposed the human to rabies virus infection and contacted with a
30 recombinant rabies virus antigen in accordance with the present invention. Presence of a complex indicates that the human should be treated for rabies infection.

A preferred method to detect anti-infectious agent antibodies is an immunosorbent assay. In one embodiment, a recombinant antigen of the present invention is immobilized on a substrate, such as a microtiter dish well or a dipstick. A biological specimen collected from an animal is applied to the substrate and incubated
5 under conditions sufficient to allow for complex formation. Excess fluid, if any, is removed and a detection reagent that can selectively bind to the anti-infectious agent antibody is added to the substrate and incubated to allow formation of a complex between the detection reagent and the recombinant antigen:anti-infectious agent antibody complex. Excess detection reagent is removed, a developing agent is added
10 if required, and the substrate is submitted to a detection device for analysis. Alternatively, an antibody-binding partner as described above is immobilized on a substrate, and a biological specimen is incubated with the antibody-binding partner to form a complex. Complex detection can then be accomplished by applying a detectable marker-conjugated recombinant antigen of the present invention to the
15 complex.

Another preferred method to determine the immune status of an animal is a lateral flow assay, examples of which are disclosed in U.S. Patent No. 5,424,193, issued June 13, 1995, by Pronovost et al.; U.S. Patent No. 5,415,994, issued May 16, 1995, by Imrich et al; WO 94/29696, published December 22, 1994, by Miller et al.;
20 and WO 94/01775, published January 20, 1994, by Pawlak et al.; each of these patent publications is incorporated by reference herein in its entirety. Another preferred method to determine the immune status of an animal is a flow-through assay, examples of which are disclosed in U.S. Patent No. 4,632,901, issued December 30, 1986 by Valkirs et al., and U.S. Patent No. 4,727,019, issued February 23, 1988, by Valkirs et
25 al; U.S. Patent No. 4,632,901, *ibid.*, and U.S. Patent No. 4,727,019, *ibid.*, are both incorporated by reference herein in their entireties.

Another embodiment of the present invention is a method to determine whether to vaccinate an animal. Such a method includes the steps of: (a) contacting a biological specimen of the animal with a recombinant infectious agent antigen that is
30 specific for detecting an antibody selective for that infectious agent, under conditions suitable for formation of a complex between the recombinant antigen and the antibody;

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and (b) detecting the presence or absence of the complex. Presence of such a complex indicates that the animal need not be vaccinated, whereas absence of such a complex indicates that the animal should be vaccinated. Detection of such a complex can be accomplished in a manner similar to that disclosed herein for determining the immune status of an animal.

Yet another embodiment of the present invention is an assay, or kit, to determine the immune status of an animal and/or to determine whether to vaccinate an animal. Such an assay includes (a) a recombinant infectious agent antigen that is specific for detecting an antibody selective for that infectious agent; and (b) a means to detect an antibody that selectively binds to the recombinant antigen. In one embodiment, the means includes a detection reagent of the present invention. An assay of the present invention can also, but need not, include (a) a solid support comprising a test area and a reference area; and (b) a reference reagent. Preferably the test area includes one or more recombinant antigens of the present invention and the reference area comprises one or more reference reagents of the present invention. An assay of the present invention can also, but need not, include a control area for assay validation. Preferably, a recombinant infectious agent antigen of the present invention is immobilized on a substrate such as those disclosed herein. Particularly preferred assays are ELISAs, lateral flow assays, and flow-through assays.

The following examples are provided for the purposes of illustration and are not intended to limit the scope of the present invention.

EXAMPLES

It is to be noted that the Examples include a number of molecular biology, microbiology, immunology and biochemistry techniques considered to be known to those skilled in the art. Disclosure of such techniques can be found, for example, in Sambrook et al., *ibid.*, Harlow et al., *ibid.*, and related references.

Example 1

This Example demonstrates that use of a whole virus preparation to determine the immune status of an animal leads to false positives and, as such, is an unacceptable reagent.

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A. Purification of feline calicivirus and feline rhinotracheitis virus

Feline rhinotracheitis virus (also known as feline herpesvirus, or FHV) and feline calicivirus (FCV) were cultured in Crandall Reese Feline Kidney (CRFK) cells in DMEM high glucose (available from Gibco BRL, Gaithersburg, MD) with 2% fetal
5 bovine serum (FBS) for FHV and no fetal bovine serum for FCV. Aliquots of titered (TCID₅₀) virus-containing tissue culture supernatant were collected and stored at -70°C until use.

FCV- or FHV-containing supernatant aliquots were each thawed quickly in a 37°C water bath and clarified by centrifugation at 1000 x g for 10 min at 4°C. Five
10 volumes of a 60% (w/v) Iodixanol solution (available from OptiPrep^a, Nycomed, Oslo, Norway) were mixed with one volume of 0.8% NaCl, 60 mM HEPES, pH 7.4 to produce a 50% Iodixanol solution. Three ml of the Iodixanol-containing supernatant aliquot were transferred to 16 x 102 mm Beckman Ultra Clear centrifuge tubes (available from Beckman, Fullerton, CA). Three ml of the 50% Iodixanol solution
15 were underlaid under the supernatant aliquot. The virus was sedimented by centrifugation at 100,000 x g for 1 hr at 4°C using a Beckman SW28 fixed-angle rotor (available from Beckman). The virus formed a sharp band on top of the Iodixanol cushion. Three ml of the supernatant were removed. The residual content of the tube was mixed to produce a concentrated virus suspension in approximately 25%
20 Iodixanol. The suspension was transferred to 16 x 76 mm Beckman Quickseal tubes (available from Beckman). The residual air space in the heat seal tubes was filled with the 0.8% NaCl, 60 mM HEPES buffer and the tubes heat sealed. The tubes were centrifuged at 350,000 x g for 1 to 3 hr at 4°C using a Beckman VTi-65.1 rotor (available from Beckman). The rotor was allowed to decelerate from 21 x g (500 rpm)
25 without the brake. The seals on the tubes were ruptured, and most of the supernatant was removed with a long Pasteur pipette. Approximately 1 ml of fluid was left in each tube. This material was transferred to a common tube and the original tube was rinsed with 0.5 ml of 0.8% NaCl / 60 mM HEPES buffer and that material was added to the common tube. Total protein was determined by the BioRad Protein Assay (available
30 from BioRad, Richmond, CA). Aliquots of virus were stored at -70°C. Preparation purity was determined by ELISA. FCV purified in this manner is referred to as an

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Optiprep-purified FCV preparation, or Optiprep-purified FCV. FHV purified in this manner is referred to as an Optiprep-purified FHV preparation, or Optiprep-purified FHV.

B. Purification of feline panleukopenia virus

5 Feline panleukopenia virus (FPV) was cultured in Crandall Reese Feline Kidney (CRFK) cells in DMEM high glucose with 2% fetal bovine serum. Aliquots of titered (TCID₅₀) virus-containing tissue culture supernatant were collected and stored at -70°C until use.

A FPV-containing supernatant aliquot was clarified by centrifugation at 7000 x
10 g for 15 min at 4°C. The pellet was discarded and virus was precipitated from the supernatant by the addition of solid polyethylene glycol (PEG) 3350 to 0.75 M PEG, and 0.2 M sodium chloride. The mixture was incubated 30 min on ice and then centrifuged at 7000 x g for 30 min at 4°C. The pellet was resuspended in 0.2 M boric acid buffer (pH 7.4) with 0.5M NaCl. The material was centrifuged at 450 x g for 5
15 min to remove insoluble matter. The virus was banded in an isopyknic cesium chloride (CsCl) gradient (1.40 g/ml) by equilibrium centrifugation at 150,000 x g for 20 hr at 4°C (40,000 rpm in Beckman SW65 Ti rotor). Total protein was determined by the BioRad Protein Assay. Aliquots of virus were stored at -70°C. Preparation
purity was determined by ELISA. FPV purified in this manner is referred to as a CsCl-
20 purified FPV preparation, or CsCl-purified FPV.

C. Testing of a whole FCV preparation as an immune status reagent

A Optiprep-purified FCV preparation, produced as described in Example 1A, as well as a preparation prepared in the same manner but in which CRFK cells were not infected with FCV (i.e., an Optiprep-purified non-infected cell, or NIC,
25 preparation) was each tested for its ability to react with serum from FCV-vaccinated (positive) cats or barrier control (negative) cats by ELISA.

The ELISA was conducted as follows. The Optiprep-purified FCV and NIC preparations were each diluted according to protein concentration as indicated in Table 1 into 50 mM carbonate/bicarbonate buffer (pH 9.6). After dilution, plates were
30 coated with a 100-μL aliquot of each dilution in wells in a PolySorp strip (Nunc, available from VWR Scientific, West Chester, PA). Each strip was placed in a strip

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holder plate and incubated overnight at 4°C. The coated wells were washed four times with PBST (10 mM PBS, containing 8.5 g NaCl, 0.20 g KH₂PO₄, and 1.16 g Na₂HPO₄ in 1L water, at pH = 7.2, 0.05% Tween-20 (C₅₈H₁₁₄O₂₆; FW=1227, available from Fisher Scientific, Pittsburgh, PA), using an automatic plate washer (available from

5 Bio-tek Instruments, Inc., Winooski, VT). After washing, a 200-μL aliquot of StabilCoat (available from SurModics, Eden Prairie, MN) was added to each well and the strips were incubated for one hour at 22°C. The wells were then washed four times with PBST using an automatic plate washer. Vaccinated (positive) or barrier

(negative) cat serum was diluted 1:50 prior to addition to the wells with diluent A

10 (PBST, 4% FBS, 0.5% ProClin 300 (available from Supelco, Bellefonte, PA). A 100-μL aliquot of the appropriate diluted serum was then added to each of the appropriate wells, and the plate was incubated for two hours at 22°C, followed by four washes with PBST using an automatic plate washer. Goat anti-cat IgG (H & L)-HRP

(available from Kirkegaard & Perry Laboratories, Gaithersburg, MD) was diluted in

15 diluent A to 500 ng/ml, and a 100-μL aliquot was then added to each well. The plates were incubated for one hour at 22°C, followed by four washes with PBST using an automatic plate washer. A 100-μL aliquot of two-component substrate (TMB Peroxidase Substrate System, available from Kirkegaard & Perry Laboratories) was

added to each of wells, which were then incubated at 22°C for 5 min. Reactions were

20 stopped by adding 100 μL of 1M H₃PO₄ to each of the wells, at which time an automatic plate reader was used to determine O.D at 450 nm (using, for example, Molecular Devices SpectraMax 250, available from Molecular Devices, Sunnyvale, CA). ELISA results are shown in Table 1.

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Table 1: ELISA using Optiprep-purified FCV or NIC to test serum collected from FCV-vaccinated (positive) or barrier (negative) cats

	protein (ng/ml)	positive (FCV)	negative (FCV)	positive (NIC)	negative (NIC)
5	20000	4.15	0.61		
	10000	4.15	0.70	3.368	0.616
	5000	4.15	0.88	3.231	0.506
	2500	4.15	0.84	2.901	0.396
	1250	4.15	0.86	2.485	0.362
10	625	4.15	0.74	2.035	0.303
	313	4.04	0.66	1.586	0.264
	156	4.00	0.62	1.204	0.244
	78	3.72	0.52	0.782	0.216
	39	3.22	0.45	0.721	0.165
15	20	2.68	0.36	0.629	0.134
	10	2.34	0.36	0.598	0.124
	5	2.16	0.31	0.653	0.13

These data indicate that although an Optiprep-purified FCV preparation can detect antibodies in FCV-vaccinated cats, so does an Optiprep-purified NIC preparation (i.e., a preparation produced from uninfected cells using a similar procedure). As such, whole FCV is an unacceptable reagent for the determination of the immune status of a cat due to the possibility of a high percentage of false positive reactions due to the presence of cellular proteins that react with serum from vaccinated cats.

D. Testing of a whole FHV preparation as an immune status reagent

A Optiprep-purified FHV preparation, produced as described in Example 1A, as well as a preparation prepared in the same manner but in which CRFK cells were not infected with FHV (i.e., an Optiprep-purified non-infected cell, or NIC, preparation) was each tested for its ability to react with serum from FHV-vaccinated (positive) cats or barrier control (negative) cats by ELISA.

The ELISA was conducted as described in Example 1C except that an Optiprep-purified FHV preparation was used instead of an Optiprep-purified FCV preparation, serum from FHV-vaccinated cats was used, and preparation dilutions were conducted as indicated in Table 2. Results are shown in Table 2.

Table 2: ELISA using Optiprep-purified FHV or NIC to test serum collected from FHV-vaccinated (positive) or barrier (negative) cats

	protein (ng/ml)	positive (FHV)	negative (FHV)	positive (NIC)	negative (NIC)
5	20000	4.13	0.02		
	10000	4.13	0.02	3.368	0.616
	5000	4.15	0.00	3.231	0.506
	2500	4.14	0.01	2.901	0.396
	1250	4.01	0.13	2.485	0.362
10	625	3.73	0.37	2.035	0.303
	313	3.47	0.46	1.586	0.264
	156	2.95	0.40	1.204	0.244
	78	2.25	0.47	0.782	0.216
	39	1.68	0.38	0.721	0.165
15	20	1.40	0.50	0.629	0.134
	10	0.80	0.26	0.598	0.124
	5	0.72	0.17	0.653	0.13

These data indicate that although an Optiprep-purified FHV preparation can detect antibodies in FHV-vaccinated cats, so does an Optiprep-purified NIC preparation (i.e., a preparation produced from uninfected cells using a similar procedure). As such, whole FHV is an unacceptable reagent for the determination of the immune status of a cat due to the possibility of a high percentage of false positive reactions due to the presence of cellular proteins that react with serum from vaccinated cats.

25 E. Testing of a whole FPV preparation as an immune status reagent

A CsCl-purified FPV preparation, produced as described in Example 1B, as well as a preparation prepared in the same manner but in which CRFK cells were not infected with FPV (i.e., a CsCl-purified non-infected cell, or NIC, preparation) was each tested for its ability to react with serum from FPV-vaccinated (positive) cats or barrier control (negative) cats by ELISA.

30 The ELISA was conducted as described in Example 1C except that a CsCl-purified FPV preparation was used instead of an Optiprep-purified FCV preparation, serum from FPV-vaccinated cats was used, and preparation dilutions were conducted as indicated in Table 3. Results are shown in Table 3.

Table 3: ELISA using CsCl-purified FPV or NIC to test serum collected from FPV-vaccinated (positive) or barrier (negative) cats

	protein (ng/ml)	positive (FPV)	negative (FPV)	positive (NIC)	negative (NIC)
5	10000	4.082	0.468	3.368	0.616
	5000	4.031	0.474	3.231	0.506
	2500	3.947	0.492	2.901	0.396
	1250	3.799	0.5	2.485	0.362
	625	3.233	0.481	2.035	0.303
10	313	2.58	0.393	1.586	0.264
	156	1.929	0.287	1.204	0.244
	78	1.115	0.21	0.782	0.216
	39	0.836	0.16	0.721	0.165
	20	0.655	0.134	0.629	0.134
15	10	0.752	0.111	0.598	0.124
	5	0.527	0.103	0.653	0.13

These data indicate that although a CsCl-purified FPV preparation can detect antibodies in FPV-vaccinated cats, so does a CsCl-purified NIC preparation (i.e., a preparation produced from uninfected cells using a similar procedure). As such, whole FPV is an unacceptable reagent for the determination of the immune status of a cat due to the possibility of a high percentage of false positive reactions due to the presence of cellular proteins that react with serum from vaccinated cats.

Example 2

This Example describes the isolation and expression of nucleic acid molecules of the present invention that encode feline calicivirus coat proteins (FCVCPs) of the present invention. Also described is the purification of recombinant feline calicivirus coat proteins (rFCVCPs) of the present invention.

A. A nucleic acid molecule of 2016 nucleotides designated herein as nFCVCP₂₀₁₃ with a coding strand represented by SEQ ID NO:1, encoding a full-length FCVCP, was produced by PCR amplification and TA cloning using standard techniques, such as those described in Sambrook et al., *ibid*. Nucleic acid molecule nFCVCP₂₀₁₃ was ligated to recombinant vector λ P_Rcro/T² ori/RSET-B, described in PCT Publication No. WO 98/12563, published March 26, 1998, by Grieve et al., in such a manner that the nucleotides of the recombinant vector encoding the N-terminal histidine (His) tag were ligated in frame with the nucleotides encoding the feline calicivirus coat protein. The resulting recombinant molecule, designated herein as

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p λ P_RHis-nFCVCP₂₀₁₃, was transformed into *Escherichia coli* to produce recombinant cell *E. coli*:p λ P_RHis-nFCVCP₂₀₁₃ using standard techniques, such as those disclosed in Sambrook et al., *ibid.* Recombinant cell *E. coli*:p λ P_RHis-nFCVCP₂₀₁₃ was cultured as described in WO 98/12563, *ibid.*, to produce a 672-amino acid FCVCP protein, having
5 SEQ ID NO:2, designated PFCVCP₆₇₁, fused to a His tag. The fusion protein, referred to herein as PHis-PFCVCP₆₇₁, was purified from *E. coli* by standard protein purification techniques.

B. A nucleic acid molecule of 1644 nucleotides, designated herein as nFCVCP₁₆₄₁ with a coding strand represented by SEQ ID NO:3, which spans
10 nucleotides 373 to 2016 of SEQ ID NO:1, encoding a mature FCVCP, was produced by PCR amplification and TA cloning as described in Example 2A. Nucleic acid molecule nFCVCP₁₆₄₁ was ligated to recombinant vector λ P_Rcro/T² ori/RSET-B/Hisless, a modified version of recombinant vector λ PR cro/T² ori/RSET-B (described in Example 2A) from which codons encoding the His tag had been removed. The
15 resulting recombinant molecule, designated herein as p λ P_R-nFCVCP₁₆₄₁, was transformed into *Escherichia coli* to produce recombinant cell *E. coli*:p λ P_R-nFCVCP₁₆₄₁ as described in Example 2A. Recombinant cell *E. coli*:p λ P_R-nFCVCP₁₆₄₁ was cultured as described in Example 2A WO 98/12563, *ibid.*, to produce a 548-amino acid FCVCP protein, designated PFCVCP₅₄₇, the amino acid sequence of which is
20 represented herein as SEQ ID NO:4. PFCVCP₅₄₇ was purified from *E. coli* by standard protein purification techniques.

Example 3

This Example describes the isolation and expression of nucleic acid molecules of the present invention that encode feline parvovirus capsid proteins (FPVVPs) of the
25 present invention. Also described is the purification of recombinant feline parvovirus capsid proteins (rFPVVPs) of the present invention.

A. A nucleic acid molecule of 1755 nucleotides, designated herein as nFPVVP2₁₇₅₂ with a coding strand represented by SEQ ID NO:5, encoding a full-length feline parvovirus VP2 capsid protein, was produced by PCR amplification and
30 TA cloning as described in Example 2A. Nucleic acid molecule nFPVVP2₁₇₅₂ was ligated to recombinant vector λ P_Rcro/T² ori/RSET-B as described in Example 2A to

produce recombinant molecule $p\lambda P_R\text{His-nFPVVP2}_{1752}$, which was then transformed into *Escherichia coli* to produce recombinant cell *E. coli:p\lambda P_R\text{His-nFPVVP2}_{1752}* as described in Example 2A. Recombinant cell *E. coli:p\lambda P_R\text{His-nFPVVP2}_{1752}* was cultured as described in Example 2A to produce a 585-amino acid FPVVP2 protein, having SEQ ID NO:6, designated PFPVVP2₅₈₄, fused to a His tag. The fusion protein, referred to herein as PHis-PFPVVP2₅₈₄, was purified from *E. coli* by standard protein purification techniques.

B. A nucleic acid molecule of 729 nucleotides, designated herein as nFPVVP2C₇₂₉ with a coding strand represented by SEQ ID NO:7, which spans nucleotides 703 to 1431 of SEQ ID NO:5, encoding a truncated VP2 capsid protein, was produced by PCR amplification and TA cloning as described in Example 2A. Nucleic acid molecule nFPVVP2C₇₂₉ was ligated to recombinant vector $\lambda P_{R\text{cro/T}^2}$ ori/RSET-B as described in Example 2A to produce recombinant molecule $p\lambda P_R\text{His-nFPVVP2C}_{729}$, which was then transformed into *Escherichia coli* to produce recombinant cell *E. coli:p\lambda P_R\text{His-nFPVVP2C}_{729}* as described in Example 2A. Recombinant cell *E. coli:p\lambda P_R\text{His-nFPVVP2C}_{729}* was cultured as described in Example 2A to produce a 243-amino acid FPVVP2 protein, having SEQ ID NO:8, designated PFPVVP2C₂₄₃, fused to a His tag. The fusion protein, referred to herein as PHis-PFPVVP2C₂₄₃, was purified from *E. coli* by standard protein purification techniques.

Nucleic acid molecule nFPVVP2C₇₂₉ was also ligated to recombinant vector $\lambda P_{R\text{cro/T}^2}$ ori/RSET-B/Hisless as described in Example 2B to produce recombinant molecule $p\lambda P_R\text{-nFPVVP2C}_{729}$, which was then transformed into *Escherichia coli* to produce recombinant cell *E. coli:p\lambda P_R\text{-nFPVVP2C}_{729}* as described in Example 2A. Recombinant cell *E. coli:p\lambda P_R\text{-nFPVVP2C}_{729}* was cultured as described in Example 2A to produce a 243-amino acid FPVVP2 protein, designated herein as PFPVVP2C₂₄₃, the amino acid sequence of which is represented herein as SEQ ID NO:8. PFPVVP2C₂₄₃ was purified from *E. coli* by standard protein purification techniques.

C. A nucleic acid molecule of 1860 nucleotides, designated herein as nFPVpVP12₁₈₆₀ with a coding strand represented by SEQ ID NO:9, encoding a truncated VP1-VP2 capsid protein, was produced by PCR amplification and TA cloning as described in Example 2A. Nucleic acid molecule nFPVpVP12₁₈₆₀ was

ligated to recombinant vector $\lambda P_{R}cro/T^2$ ori/RSET-B as described in Example 2A to produce recombinant molecule $p\lambda P_{R}His- nFPVpVP12_{1860}$, which was then transformed into *Escherichia coli* to produce recombinant cell *E. coli:p\lambda P_{R}His- nFPVpVP12_{1860}* as described in Example 2A. Recombinant cell *E. coli:p\lambda P_{R}His- nFPVpVP12_{1860}* was
5 cultured as described in Example 2A to produce a 620-amino acid FPVVP12 protein, having SEQ ID NO:10, designated PFPVpVP12₆₂₀, fused to a His tag. The fusion protein, referred to herein as PHis-PFPVpVP12₆₂₀, was purified from *E. coli* by standard protein purification techniques.

D. A nucleic acid molecule of 1431 nucleotides, designated herein as
10 $nFPVpVP2_{1431}$ with a coding strand represented by SEQ ID NO:11, which spans nucleotides 1 to 1431 of SEQ ID NO:5, encoding a truncated VP2 capsid protein, was produced by PCR amplification and TA cloning as described in Example 2A. Nucleic acid molecule $nFPVpVP2_{1431}$ was ligated to recombinant vector $\lambda P_{R}cro/T^2$ ori/RSET-B/Hisless as described in Example 2B to produce recombinant molecule $p\lambda P_{R}-$
15 $nFPVpVP2_{1431}$, which was then transformed into *Escherichia coli* to produce recombinant cell *E. coli:p\lambda P_{R}- nFPVpVP2_{1431}* as described in Example 2A. Recombinant cell *E. coli:p\lambda P_{R}- nFPVpVP2_{1431}* was cultured as described in Example 2A to produce a 477-amino acid truncated FPVVP2 protein, designated PFPVpVP2₄₇₇, the amino acid sequence of which is represented as SEQ ID NO:12. PFPVpVP2₄₇₇
20 was purified from *E. coli* by standard protein purification techniques.

Nucleic acid molecule $nFPVpVP2_{1431}$ was also ligated to recombinant vector $\lambda P_{R}cro/T^2$ ori/RSET-B as described in Example 2A to produce recombinant molecule $p\lambda P_{R}His- nFPVpVP2_{1431}$, which was then transformed into *Escherichia coli* to produce recombinant cell *E. coli:p\lambda P_{R}His- nFPVpVP2_{1431}* as described in Example 2A.
25 Recombinant cell *E. coli:p\lambda P_{R}His- nFPVpVP2_{1431}* was cultured as described in Example 2A to produce a 477-amino acid truncated FPVVP2 protein, designated PFPVpVP2₄₇₇, with SEQ ID NO:12, fused to a His tag. The fusion protein, designated PHis-PFPVpVP2₄₇₇ was purified from *E. coli* by standard protein purification techniques.

Example 4

This Example describes the isolation and expression of nucleic acid molecules of the present invention that encode feline herpesvirus glycoproteins of the present invention. Also described is the purification of recombinant feline herpesvirus glycoproteins (rFHVgB, rFHVgC, and rFHV gD proteins) of the present invention.

5 A. A nucleic acid molecule of 2832 nucleotides, designated herein as nFHVgB₂₈₂₉ with a coding strand represented by SEQ ID NO:13, encoding a full-length feline herpesvirus glycoprotein B protein, was produced by PCR amplification and TA cloning as described in Example 2A. Nucleic acid molecule nFHVgB₂₈₂₉ was ligated to recombinant vector λP_R cro/T² ori/RSET-B as described in Example 2A to produce recombinant molecule p λP_R His-nFHVgB₂₈₂₉, which was then transformed into *Escherichia coli* to produce recombinant cell *E. coli*:p λP_R His-nFHVgB₂₈₂₉ as described in Example 2A. Recombinant cell *E. coli*:p λP_R His-nFHVgB₂₈₂₉ was cultured as described in Example 2A to produce a 944-amino acid FHVgB protein, having SEQ ID NO:14, designated PFHVgB₉₄₃, fused to a His tag. The fusion protein, referred to here as PHis-PFHVgB₉₄₃, was purified from *E. coli* by standard protein purification techniques.

B. A nucleic acid molecule of 750 nucleotides, designated herein as nFHVgB₇₅₀ with a coding strand represented by SEQ ID NO:15, spanning nucleotides 1 to 750 of SEQ ID NO:13, encoding a truncated feline herpesvirus glycoprotein B protein, was produced by PCR amplification and TA cloning as described in Example 2A. Nucleic acid molecule nFHVgB₇₅₀ was ligated to recombinant vector λP_R cro/T² ori/RSET-B as described in Example 2A to produce recombinant molecule p λP_R His-nFHVgB₇₅₀, which was then transformed into *Escherichia coli* to produce recombinant cell *E. coli*:p λP_R His-nFHVgB₇₅₀ as described in Example 2A. Recombinant cell *E. coli*:p λP_R His-nFHVgB₇₅₀ was cultured as described in Example 2A to produce a 250-amino acid FHVgB protein, having SEQ ID NO:16, designated PFHVgB₂₅₀, fused to a His tag. The fusion protein, referred to herein as PHis-PFHVgB₂₅₀, was purified from *E. coli* by standard protein purification techniques.

30 C. A nucleic acid molecule of 1605 nucleotides, designated herein as nFHVgC₁₆₀₂ with a coding strand represented by SEQ ID NO:17, encoding a full-

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length feline herpesvirus glycoprotein C protein, was produced by PCR amplification and TA cloning as described in Example 2A. Nucleic acid molecule nFHVgC₁₆₀₂ was ligated to recombinant vector $\lambda P_{R}cro/T^2$ ori/RSET-B as described in Example 2A to produce recombinant molecule $p\lambda P_{R}His-nFHVgC_{1602}$, which was then transformed into *Escherichia coli* to produce recombinant cell *E. coli:p $\lambda P_{R}His-nFHVgC_{1602}$* as described in Example 2A. Recombinant cell *E. coli:p $\lambda P_{R}His-nFHVgC_{1602}$* was cultured as described in Example 2A to produce a 535-amino acid FHVgC protein, having SEQ ID NO:18, designated PFHVgC₅₃₄, fused to a His tag. The fusion protein, referred to herein as PHis-PFHVgC₅₃₄, was purified from *E. coli* by standard protein purification techniques.

D. A nucleic acid molecule of 1401 nucleotides, designated herein as nFHVgC₁₄₀₁ with a coding strand represented by SEQ ID NO:19, spanning nucleotides 97 to 1497 of SEQ ID NO:17, encoding a truncated feline herpesvirus glycoprotein C protein was produced by PCR amplification and TA cloning as described in Example 2A. Nucleic acid molecule nFHVgC₁₄₀₁ was ligated to recombinant vector $\lambda P_{R}cro/T^2$ ori/RSET-B as described in Example 2A to produce recombinant molecule $p\lambda P_{R}His-nFHVgC_{1401}$, which was then transformed into *Escherichia coli* to produce recombinant cell *E. coli:p $\lambda P_{R}His-nFHVgC_{1401}$* as described in Example 2A. Recombinant cell *E. coli:p $\lambda P_{R}His-nFHVgC_{1401}$* was cultured as described in Example 2A to produce a 467-amino acid FHVgC protein, having SEQ ID NO:20, designated PFHVgC₄₆₇, fused to a His tag. The fusion protein, referred to herein as PHis-PFHVgC₄₆₇, was purified from *E. coli* by standard protein purification techniques.

E. A nucleic acid molecule of 1401 nucleotides, designated nFHVgC_{1401(opt)}, encoding feline herpesvirus protein PFHVgC₄₆₇ but in which a number of codons were optimized for expression in *E. coli* was produced as follows. A series of PCR mutagenesis steps was performed on nFHVgC₁₄₀₁, the coding strand of which is represented by SEQ ID NO:19, using standard techniques, such as those described in Sambrook et al., *ibid.*, to target the following codons: two arginine codons spanning nucleotides 119 to 124 of SEQ ID NO:19; three serine codons spanning nucleotides 133 to 141 of SEQ ID NO:19; a glycine codon spanning nucleotides 724 to 726 of SEQ ID NO:19; and a leucine codon spanning nucleotides

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727 to 729 of SEQ ID NO:19. The resulting nucleic acid molecule, namely nFHVgC_{1401(opt)}, has a coding strand sequence as represented in SEQ ID NO:21. Nucleic acid molecule nFHVgC_{1401(opt)} was ligated to recombinant vector $\lambda P_{R}cro/T^2$ ori/RSET-B/Hisless as described in Example 2B to produce recombinant molecule

5 p λP_{R} -nFHVgC_{1401(opt)}, which was then transformed into *Escherichia coli* to produce recombinant cell *E. coli*:p λP_{R} -nFHVgC_{1401(opt)} as described in Example 2A. Recombinant cell *E. coli*:p λP_{R} -nFHVgC_{1401(opt)} was cultured as described in Example 2A to produce a 467-amino acid FHVgC protein, designated PFHVgC_{467(opt)}. PFHVgC_{467(opt)}, the amino acid sequence of which is represented as SEQ ID NO:22,

10 which is identical to SEQ ID NO:20, was purified from *E. coli* by standard protein purification techniques.

F. A nucleic acid molecule of 1125 nucleotides, designated herein as nFHVgD₁₁₂₂ with a coding strand represented by SEQ ID NO:23, encoding a full-length feline herpesvirus glycoprotein D protein, was produced by PCR amplification

15 and TA cloning as described in Example 2A. Nucleic acid molecule nFHVgD₁₁₂₂ was ligated to recombinant vector $\lambda P_{R}cro/T^2$ ori/RSET-B as described in Example 2A to produce recombinant molecule p λP_{R} His-nFHVgD₁₁₂₂, which was then transformed into *Escherichia coli* to produce recombinant cell *E. coli*:p λP_{R} His-nFHVgD₁₁₂₂ as described in Example 2A. Recombinant cell *E. coli*:p λP_{R} His-nFHVgD₁₁₂₂ was cultured as

20 described in Example 2A to produce a 375-amino acid FHVgD protein, having SEQ ID NO:24, designated PFHVgD₃₇₄, fused to a His tag. The fusion protein, referred to herein as PHis-PFHVgD₃₇₄, was purified from *E. coli* by standard protein purification techniques.

G. A nucleic acid molecule of 900 nucleotides, designated herein as

25 nFHVgD₉₀₀ with a coding strand represented by SEQ ID NO:25, spanning nucleotides 85 to 894 of SEQ ID NO:23, encoding a truncated feline herpesvirus glycoprotein D protein, was produced by PCR amplification and TA cloning as described in Example 2A. Nucleic acid molecule nFHVgD₉₀₀ was ligated to recombinant vector $\lambda P_{R}cro/T^2$ ori/RSET-B as described in Example 2A to produce recombinant molecule p λP_{R} His-

30 nFHVgD₉₀₀, which was then transformed into *Escherichia coli* to produce recombinant cell *E. coli*:p λP_{R} His-nFHVgD₉₀₀ as described in Example 2A. Recombinant cell *E.*

coli:p λ P_RHis-nFHVgD₉₀₀ was cultured as described in Example 2A to produce a 300-amino acid FHVgD protein, having SEQ ID NO:26, designated PFHVgD₃₀₀, fused to a His tag. The fusion protein, referred to herein as PHis-PFHVgD₃₀₀, was purified from *E. coli* by standard protein purification techniques.

5 Example 5

This Example describes the isolation and expression of nucleic acid molecules of the present invention that encode feline leukemia virus (FeLV) proteins of the present invention. Also described is the purification of recombinant feline herpesvirus proteins (rFeLVp27 and rFeLVgp70 proteins) of the present invention.

10 A. A nucleic acid molecule of 789 nucleotides, designated herein as nFeLVp27₇₅₉ with a coding strand represented by SEQ ID NO:27, encoding a mature FeLV p27 protein, was produced by PCR amplification and TA cloning as described in Example 2A. Nucleic acid molecule nFeLVp27₇₅₉ was ligated to recombinant vector λ P_R*cro*/T² ori/RSET-B/Hisless as described in Example 2B to produce recombinant
15 molecule p λ P_R-nFeLVp27₇₅₉, which was then transformed into *Escherichia coli* to produce recombinant cell *E. coli*:p λ P_R-nFeLVp27₇₅₉ as described in Example 2A. Recombinant cell *E. coli*:p λ P_R-nFeLVp27₇₅₉ was cultured as described in Example 2A to produce a 263-amino acid FeLV p27 protein designated PFeLVp27₂₅₃, the amino acid sequence of which is represented as SEQ ID NO:28. PFeLVp27₂₅₃ was purified
20 from *E. coli* by standard protein purification techniques.

 B. A nucleic acid molecule of 1857 nucleotides, designated herein as nFeLVgp70₁₈₃₀ with a coding strand represented by SEQ ID NO:29, encoding a mature FeLV envelope glycoprotein 70 (gp70) protein, was produced by PCR amplification and TA cloning as described in Example 2A. Nucleic acid molecule nFeLVgp70₁₈₃₀
25 was ligated to recombinant vector λ P_R*cro*/T² ori/RSET-B as described in Example 2A to produce recombinant molecule p λ P_RHis-nFeLVp27₁₈₅₇, which was then transformed into *Escherichia coli* to produce recombinant cell *E. coli*:p λ P_RHis-nFeLVp27₁₈₅₇ as described in Example 2A. Recombinant cell *E. coli*:p λ P_RHis-nFeLVp27₁₈₅₇ was cultured as described in Example 2A to produce a 619-amino acid FeLV gp70 protein
30 designated PFeLVgp70₆₁₀, the amino acid sequence of which is represented as SEQ ID

NO:30, fused to a His tag. The fusion protein, referred to herein as PHis-PFeLVgp70₆₁₀, was purified from *E. coli* by standard protein purification techniques.

C. A nucleic acid molecule of 1833 nucleotides, designated herein as nFeLVp27-gp70₁₈₃₃ with a coding strand represented by SEQ ID NO:31, encoding a fusion protein of the carboxy-terminus of FeLV Pr65-gag and gp70, was produced by PCR amplification and TA cloning as described in Example 2A. Nucleic acid molecule nFeLVp27-gp70₁₈₃₃ was ligated to recombinant vector λ P_Rcro/T² ori/RSET-B/Hisless as described in Example 2B to produce recombinant molecule p λ P_R-nFeLVp27-gp70₁₈₃₃ which was then transformed into *Escherichia coli* to produce recombinant cell *E. coli*:p λ P_R-nFeLVp27-gp70₁₈₃₃ as described in Example 2A. Recombinant cell *E. coli*:p λ P_R-nFeLVp27-gp70₁₈₃₃ was cultured as described in Example 2A to produce a 611-amino acid fusion protein, designated as PFeLVp27-gp70₆₁₁, the amino acid sequence of which is represented as SEQ ID NO:32. PFeLVp27-gp70₆₁₁ was purified from *E. coli* by standard protein purification techniques.

Nucleic acid molecule nFeLVp27-gp70₁₈₃₃ was also ligated to recombinant vector λ P_Rcro/T² ori/RSET-B as described in Example 2B to produce recombinant molecule p λ P_RHis-nFeLVp27-gp70₁₈₃₃ which was then transformed into *Escherichia coli* to produce recombinant cell *E. coli*:p λ P_RHis-nFeLVp27-gp70₁₈₃₃ as described in Example 2A. Recombinant cell *E. coli*:p λ P_RHis-nFeLVp27-gp70₁₈₃₃ was cultured as described in Example 2A to produce a 611-amino acid fusion protein, designated as PFeLVp27-gp70₆₁₁, the amino acid sequence of which is represented as SEQ ID NO:32, fused to a His tag. The fusion protein, designated PHis-PFeLVp27-gp70₆₁₁, was purified from *E. coli* by standard protein purification techniques.

25 Example 6

This Example describes the isolation and expression of nucleic acid molecules of the present invention that encode canine distemper virus (CDV) proteins of the present invention. Also described is the purification of recombinant CDV hemagglutinin (rCDVH) and fusion (rCDVF) proteins of the present invention.

30 A. A nucleic acid molecule of 1812 nucleotides, designated herein as nCDVH₁₈₁₂ with a coding strand represented by SEQ ID NO:33, encoding a CDV

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hemagglutinin protein, was produced by PCR amplification and TA cloning as described in Example 2A. Nucleic acid molecule nCDVH₁₈₁₂ was ligated to recombinant vector $\lambda P_{Rcro}/T^2$ ori/RSET-B as described in Example 2A to produce recombinant molecule $p\lambda P_{RHis}$ -nCDVH₁₈₁₂, which was then transformed into

5 *Escherichia coli* to produce recombinant cell *E. coli*: $p\lambda P_{RHis}$ -nCDVH₁₈₁₂ as described in Example 2A. Recombinant cell *E. coli*: $p\lambda P_{RHis}$ -nCDVH₁₈₁₂ was cultured as described in Example 2A to produce a 604-amino acid protein designated PCDVH₆₀₄, the amino acid sequence of which is represented as SEQ ID NO:34, fused to a His tag. The fusion protein, designated PHis-PCDVH₆₀₄, was purified from *E. coli* by standard

10 protein purification techniques.

B. A nucleic acid molecule of 1986 nucleotides, designated herein as nCDVF₁₉₈₆ with a coding strand represented by SEQ ID NO:35, encoding a CDV fusion protein, was produced by PCR amplification and TA cloning as described in Example 2A. Nucleic acid molecule nCDVF₁₉₈₆ was ligated to recombinant vector

15 $\lambda P_{Rcro}/T^2$ ori/RSET-B as described in Example 2A to produce recombinant molecule $p\lambda P_{RHis}$ -nCDVF₁₉₈₆, which was then transformed into *Escherichia coli* to produce recombinant cell *E. coli*: $p\lambda P_{RHis}$ -nCDVF₁₉₈₆ as described in Example 2A. Recombinant cell *E. coli*: $p\lambda P_{RHis}$ -nCDVF₁₉₈₆ was cultured as described in Example 2A to produce a 662-amino acid protein designated PCDVF₆₆₂, the amino acid

20 sequence of which is represented as SEQ ID NO:36, fused to a His tag. The fusion protein, designated PHis-PCDVF₆₆₂, was purified from *E. coli* by standard protein purification techniques.

Example 7

This Example demonstrates an immune status assay of the present invention.

25 In particular, this Example demonstrates a correlation between humoral immune responses in cats previously vaccinated with panleukopenia (FPV), herpesvirus 1 (FHV-1), and calicivirus (FCV) vaccines and protection of such cats from challenge infections.

Forty cats were treated in the following manner: 14 cats were vaccinated with

30 FCV, FHV-1 and FPV vaccines once, 6 months prior to challenge; 12 cats were vaccinated with FCV, FHV-1 and FPV vaccines either once or twice, with the last

vaccine given 30 to 36 months prior to challenge; and 14 cats were unvaccinated. Challenge was accomplished following USDA challenge protocols utilized for vaccine approval. An immune status ELISA was utilized to determine the amounts of anti-FCV antibodies, anti-FHV antibodies, and anti-FPV antibodies in the serum of each of the cats prior to challenge using, respectively, the following recombinant antigens of the present invention: recombinant FCV coat protein (rFCVCP) protein PFCVCP₅₄₇, the amino acid sequence of which is represented as SEQ ID NO:4, and the production of which is described in Example 2B; recombinant FHV glycoprotein C (rFHVgC) protein PHis-PFHVgC₄₆₇, a fusion protein of FHVgC₄₆₇, the amino acid sequence of which is represented by SEQ ID NO:22, the production of which is described in Example 4D; and recombinant FPV VP2 capsid protein (rFPVVP2) protein PFPVpVP2₄₇₇, the amino acid sequence of which is represented as SEQ ID NO:12, and the production of which is described in Example 3D. Cutoff values were based on results from 30 unvaccinated cats. ELISAs were conducted in a similar manner to those described in Example 1C, with the following modifications: The specified recombinant antigens were used to coat plates (100 μ L per well) at the following concentrations: : rFCVCP protein PFCVCP₅₄₇ (starting concentration of 3 mg/ml) was diluted to 20 ng/ml (1:150,000 dilution); rFHVgC protein PFHVgC₄₆₇ (starting concentration of 2.24 mg/ml) was diluted to 50 ng/ml (1:44,800); and rFPVVP2 protein PFPVpVP2₄₇₇ (starting concentration of 1.12 mg/ml) was diluted to 120 ng/ml (1:9333). For wells containing rFCVCP and rFHVgC antigens, cat serum being tested was diluted 1:800 in diluent A; for wells containing rFPVVP2 antigen, the cat serum being tested was diluted 1:100 with diluent A.

Antibody levels were compared to clinical scores (FCV, FHV-1) or development of neutropenia (FPV). Cats were considered protected against FCV or FHV-1 if the clinical score was \leq 50% of the mean of the unvaccinated cat group clinical score. Correlations between anti-FCV, anti-FHV and anti-FPV antibody levels and respective clinical scores for FCV, clinical scores for FHV-1, and development of neutropenia (FPV) are shown, respectively in Tables 4, 5, and 6.

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Table 4: Correlation between clinical scores after FCV challenge and anti-FCV antibody levels measured by ELISA using recombinant antigen PFCVCP₅₄₇

	Sample	Group	OD Ave	OD SD	ELISA	Clin Score
5	79	vaccine I	4.200	0.000	+	0
	80	vaccine I	4.200	0.000	+	1
	93	vaccine I	4.200	0.000	+	5
	100	vaccine I	4.200	0.000	+	3
10	116	vaccine I	4.200	0.000	+	0
	118	vaccine I	4.200	0.000	+	4
	119	vaccine I	4.200	0.000	+	1
	122	vaccine I	4.200	0.000	+	0
15	123	vaccine I	4.200	0.000	+	1
	130	vaccine I	4.200	0.000	+	8
	148	vaccine I	4.200	0.000	+	0
	155	vaccine I	4.200	0.000	+	2
20	156	vaccine I	4.200	0.000	+	0
	7029	vaccine I	4.200	0.000	+	0
	QVY3	vaccine II	4.200	0.000	+	2
	AMI4	vaccine II	4.200	0.000	+	0
25	AMX1	vaccine II	4.200	0.000	+	0
	G444	vaccine II	4.200	0.000	+	0
	BWN3	vaccine II	4.200	0.000	+	0
	QWM3	vaccine II	4.200	0.000	+	0
30	QVF3	vaccine II	4.200	0.000	+	0
	G087	vaccine II	4.200	0.000	+	0
	3592	vaccine II	4.200	0.000	+	0
	1959	vaccine II	4.200	0.000	+	2
35	AME5	vaccine II	4.200	0.000	+	0
	3513	vaccine II	4.200	0.000	+	0
	7086	control I			-	7
	7090	control I			-	17
40	7113	control I			-	19
	7115	control I			-	23
	7122	control I			-	12
	7123	control I			-	27
45	7124	control I			-	24
	7131	control I			-	21
	7132	control I			-	34
	7133	control I			-	25
45	ALV3	control II			-	44
	ALT2	control II			-	35
	ALV5	control II			-	38
	ALZ1	control II			-	47
45	AIY2	negative	0.447	0.213	-	
	AIW5	negative	0.383	0.098	-	
	AIY3	negative	0.514	0.255	-	
	AIU5	negative	0.479	0.206	-	
	AIW7	negative	0.463	0.094	-	

	Sample	Group	OD Ave	OD SD	ELISA	Clin Score
5	AIY2	negative	0.345	0.090	-	
	AIU4	negative	0.440	0.118	-	
	AIW6	negative	0.389	0.071	-	
	AIV1	negative	0.427	0.111	-	
	AIW1	negative	0.307	0.098	-	
	AIW3	negative	0.299	0.104	-	
	AIU3	negative	0.389	0.041	-	
	AIW4	negative	0.368	0.197	-	
10	AIW2	negative	0.429	0.181	-	
	AIY1	negative	2.370	1.125	+	
		Neg. Ave	0.406			
		Neg. SD	0.064			
		Ave + 2SD	0.533			

Table 5: Correlation between clinical scores after FHV-1 challenge and anti-FHV antibody levels measured by ELISA using recombinant antigen PFHVgC₄₆₇

	Sample	Group	OD Ave	OD SD	ELISA	Clin Score
15	79	vaccine I	0.612	0.238	+/-	1
	80	vaccine I	0.823	0.219	+	12
	93	vaccine I	0.412	0.152	-	38
	100	vaccine I	1.203	0.087	+	2
	116	vaccine I	0.776	0.165	+	5
20	118	vaccine I	3.064	0.405	+	1
	119	vaccine I	0.697	0.047	+	5
	122	vaccine I	0.702	0.148	+	7
	123	vaccine I	0.929	0.134	+	4
	130	vaccine I	1.291	0.352	+	14
25	148	vaccine I	0.769	0.297	+	6
	155	vaccine I	3.659	0.473	+	3
	156	vaccine I	3.563	0.212	+	1
30	7029	vaccine I	0.460	0.080	-	42
	3512	vaccine II	0.285	0.109	-	10
	3514	vaccine II	1.764	0.596	+	8
	3515	vaccine II	0.663	0.239	+	8
	3519	vaccine II	1.349	0.389	+	14
	3522	vaccine II	0.575	0.178	-	11
	3528	vaccine II	0.660	0.257	+	11
	3530	vaccine II	0.922	0.205	+	13
	3531	vaccine II	0.404	0.101	-	11
	3532	vaccine II	0.708	0.294	+	8
35	3535	vaccine II	1.574	0.584	+	16
	3537	vaccine II	2.761	0.338	+	9
	3542	vaccine II	0.407	0.173	-	17
40	7086	control I	0.271	0.036	-	24
	7090	control I	0.207	0.015	-	19
	7113	control I	0.296	0.070	-	19
	7115	control I	0.327	0.209	-	15

	Sample	Group	OD Ave	OD SD	ELISA	Clin Score
5	7122	control I	0.259	0.055	-	22
	7123	control I	0.258	0.039	-	16
	7124	control I	0.215	0.016	-	18
	7131	control I	0.807	0.118	+	16
	7132	control I	0.290	0.102	-	27
	7133	control I	0.259	0.042	-	14
	10	2110	control II	0.377	0.287	-
2112		control II	0.396	0.125	-	33
2116		control II	0.185	0.076	-	37
2119		control II	0.295	0.116	-	42
15	AIY2	negative	0.208	0.036	-	
	AIW5	negative	0.271	0.128	-	
	AIY3	negative	0.402	0.031	-	
	AIU5	negative	0.192	0.008	-	
	AIY1	negative	0.222	0.024	-	
20	AIW7	negative	0.310	0.021	-	
	AIY2	negative	0.240	0.038	-	
	AIU4	negative	0.402	0.158	-	
	AIW6	negative	0.199	0.049	-	
25	AIV1	negative	0.374	0.056	-	
	AIW1	negative	0.233	0.045	-	
	AIW3	negative	0.283	0.045	-	
	AIU3	negative	0.175	0.046	-	
	AIW4	negative	0.164	0.057	-	
	AIW2	negative	0.323	0.070	-	
		Neg. Ave	0.266			
		Neg. SD	0.040			
		Ave + 2SD	0.346			

Table 6: Correlation between development of neutropenia after FPV challenge and anti-FPV antibodies measured by ELISA using recombinant antigen PFPVpVP₂₄₇₇

	Sample	Group	OD Ave.	OD SD	ELISA	Panleuk?
30	79	vaccine I	3.952	0.294	+	no
	80	vaccine I	0.748	0.099	+	no
	100	vaccine I	1.625	0.324	+	no
	116	vaccine I	2.915	0.373	+	no
35	118	vaccine I	3.432	0.374	+	no
	119	vaccine I	2.820	0.428	+	no
	122	vaccine I	2.174	0.278	+	no
	123	vaccine I	2.780	0.410	+	no
40	130	vaccine I	0.678	0.194	+	no
	148	vaccine I	0.300	0.073	-	no
	155	vaccine I	1.550	0.247	+	no
	156	vaccine I	0.808	0.206	+	no
	7029	vaccine I	1.041	0.136	+	no
	3512	vaccine II	0.505	0.122	-	no

-50-

	Sample	Group	OD Ave.	OD SD	ELISA	Panleuk?
	3514	vaccine II	0.450	0.074	-	no
	3515	vaccine II	0.547	0.115	-	no
	3519	vaccine II	1.675	0.214	+	no
5	3522	vaccine II	0.292	0.042	-	no
	3528	vaccine II	0.395	0.091	-	no
	3530	vaccine II	0.369	0.102	-	no
	3531	vaccine II	0.534	0.155	-	no
	3532	vaccine II	0.427	0.145	-	no
10	3535	vaccine II	0.345	0.078	-	no
	3537	vaccine II	1.221	0.353	+	no
	3542	vaccine II	0.377	0.061	-	no
	7132	control I	1.115	0.297	+	yes
	7086	control I	0.301	0.063	-	yes
15	7090	control I	0.262	0.012	-	yes
	7113	control I	0.275	0.065	-	yes
	7115	control I	0.596	0.157	-	yes
	7122	control I	0.278	0.087	-	yes
	7123	control I	0.378	0.213	-	yes
20	7124	control I	0.615	0.308	+/-	yes
	7131	control I	0.377	0.083	-	yes
	7133	control I	0.310	0.114	-	yes
	2110	control II	0.299	0.071	-	yes
	2112	control II	0.578	0.199	-	yes
25	2116	control II	0.324	0.125	-	yes
	2119	control II	0.306	0.079	-	yes
	AIY2	negative	0.236	0.042	-	
	AIW5	negative	0.145	0.093	-	
	AIY3	negative	0.240	0.071	-	
30	AIU5	negative	0.153	0.055	-	
	AIY1	negative	0.266	0.081	-	
	AIW7	negative	0.195	0.092	-	
	AIY2	negative	0.214	0.138	-	
	AIU4	negative	0.196	0.111	-	
35	AIW6	negative	0.162	0.043	-	
	AIV1	negative	0.292	0.074	-	
	AIW1	negative	0.228	0.068	-	
	AIW3	negative	0.121	0.030	-	
	AIU3	negative	0.122	0.037	-	
40	AIW4	negative	0.165	0.053	-	
	AIW2	negative	0.209	0.066	-	
		Neg. Ave	0.196			
		Neg. SD	0.030			
		Ave + 2SD	0.256			

These data indicate the utility of an immune status of the present invention in predicting that a cat is protected from viral challenge. Specifically, the results in Table 4 indicate that all 26 vaccinated cats were protected from FCV challenge and that each

of those cats had antibody levels predicting protection. The results in Table 5 indicate that 22 of 26 vaccinated cats were protected from FHV-1 challenge and that 18 of the 22 protected cats had antibody levels predicting protection. Of the four cats in this group that were not protected, 2 cats had antibody levels predicting lack of protection
5 and 2 cats had antibody levels predicting protection. The results in Table 6 indicate that neutropenia was detected in all 14 unvaccinated cats but in none of the vaccinated cats, confirming panleukopenia in the unvaccinated cats. Of the vaccinated cats, 14 of the 25 cats available for study had FPV antibody levels predicting protection.

In conclusion, an immune status assay of the present invention shows high
10 positive correlation with protection from challenge in healthy, vaccinated cats exposed to virulent FCV, FHV-1, or FPV.

While various embodiments of the present invention have been described in detail, it is apparent that modifications and adaptations of those embodiments will occur to those skilled in the art. It is to be expressly understood, however, that such
15 modifications and adaptations are within the scope of the present invention, as set forth in the following claims.

What is claimed is:

1. A method to determine the immune status of an animal, said method comprising the steps of:
 - (a) contacting a biological specimen of said animal with a
5 recombinant infectious agent antigen that is specific for detecting an antibody selective for said infectious agent, under conditions suitable for formation of a complex between said recombinant antigen and said antibody; and
 - (b) detecting the presence or absence of said complex, wherein
presence or absence of said complex is indicative of the immune status of said animal.
- 10 2. A method to determine whether to vaccinate an animal, said method comprising the steps of:
 - (a) contacting a biological specimen of said animal with a
recombinant infectious agent antigen that is specific for detecting an antibody selective
for said infectious agent, under conditions suitable for formation of a complex between
15 said recombinant antigen and said antibody; and
 - (b) detecting the presence or absence of said complex, wherein
presence of said complex indicates that said animal need not be vaccinated and
wherein absence of said complex indicates that said animal should be vaccinated.
- 20 3. An assay to determine the immune status of an animal, said assay comprising:
 - (a) a recombinant infectious agent antigen that is specific for
detecting an antibody in a biological specimen, said antibody being selective for said
infectious agent, presence of said antibody being indicative of the immune status of
said animal; and
 - 25 (b) a means to detect an antibody that selectively binds to said
recombinant antigen.
4. A recombinant antigen comprising a recombinant protein having an amino acid sequence selected from the group consisting of SEQ ID NO:2, SEQ ID NO:4, SEQ ID NO:6, SEQ ID NO:8, SEQ ID NO:10, SEQ ID NO:12, SEQ ID NO:14,
30 SEQ ID NO:16, SEQ ID NO:18, SEQ ID NO:20, SEQ ID NO:22, SEQ ID NO:24, SEQ ID NO:26, SEQ ID NO:28, SEQ ID NO:30, SEQ ID NO:32, SEQ ID NO:34,

SEQ ID NO:36, and an amino acid sequence encoded by an allelic variant of a nucleic acid sequence encoding any of said amino acid sequences.

5 5. The method of Claim 2, wherein said step of detecting comprises applying a detection reagent that binds to said complex, if present, to obtain a test signal, wherein presence of said test signal indicates that said animal need not be vaccinated and wherein absence of said test signal indicates that said animal should be vaccinated.

6. The method of Claim 2, wherein presence of said complex is indicative of non-susceptibility to infection by said infectious agent.

10 7. The invention of Claim 1, 2, or 3, wherein said antibody is selected from the group consisting of a maternally-derived antibody, an antibody generated in response to natural infection by said infectious agent and an antibody generated in response to vaccination against said infectious agent.

15 8. The invention of Claim 1, 2, or 3, wherein said biological specimen is selected from the group consisting of blood, serum, plasma, saliva, urine, tears, aqueous humor, cerebrospinal fluid, lymph, nasal secretion, tracheobronchial aspirate, milk, colostrum, intestinal secretion, and feces.

9. The invention of Claim 1, 2, or 3, wherein said animal is selected from the group consisting of a cat, dog, and horse.

20 10. The invention of Claim 1, 2, or 3, wherein said recombinant antigen is immobilized on a substrate.

25 11. The method of Claim 1 or 2, wherein said method comprises performing an assay or the assay of Claim 3, wherein said assay of Claim 1, 2, or 3 is selected from the group consisting of an enzyme-linked immunoassay, a radioimmunoassay, a fluorescence immunoassay, a luminescence assay, a phosphorescence assay, an immunoblot assay, an immunodot assay, an immunoprecipitation assay, a lateral flow assay, a flow-through assay, an agglutination assay, a particulate-based assay, and an electronic sensory assay.

30 12. The method of Claim 1, wherein said step of detecting comprises applying a detection reagent that binds to said complex, if present, to obtain a test

signal, wherein presence or absence of a test signal is indicative of the immune status of said animal.

13. The invention of Claim 5, 12, or 29, wherein said detection reagent comprises an antibody-binding partner conjugated to a detectable marker.

5 14. The invention of Claim 13, wherein said antibody-binding partner is selected from the group consisting of an Fc-binding antibody, an Fc receptor, and an antibody-binding bacterial surface protein.

15 15. The invention of Claim 13, wherein said detectable marker is selected from the group consisting of an enzyme, a radioactive label, a fluorescent label, a luminescent label, a phosphorescent label, a chromophoric label, a metal sol label, a metal-binding label, a physical label, an electronic label, and a ligand.

16. The invention of Claim 1, 2, or 4, wherein said recombinant antigen further comprises a detectable marker.

15 17. The method of Claim 1 or 2, wherein said method is conducted within about one day.

18. The method of Claim 1 or 2, wherein said method is conducted within about one hour.

19. The method of Claim 1 or 2, wherein said method is conducted in a time period of between about one minute and about fifteen minutes.

20 20. The invention of Claim 1, 2, or 3, wherein said recombinant antigen is selected from the group consisting of a recombinant viral antigen, a recombinant bacterial antigen, a recombinant fungal antigen, a recombinant endoparasite antigen, and a recombinant ectoparasite antigen.

25 21. The invention of Claim 1, 2, or 3, wherein said recombinant antigen is a recombinant viral antigen.

22. The invention of Claim 1, 2, or 3, wherein said recombinant antigen is selected from the group consisting of a calicivirus protein, a distemper virus protein, a herpesvirus protein, a leukemia virus protein, and a parvovirus protein.

30 23. The invention of Claim 1, 2, or 3, wherein said recombinant antigen is selected from the group consisting of a feline calicivirus capsid protein, a feline herpesvirus glycoprotein B protein, a feline herpesvirus glycoprotein C protein, a

feline herpesvirus glycoprotein D protein, a feline parvovirus VP12 protein, a feline parvovirus VP2 protein, a feline leukemia virus p27 protein, a feline leukemia virus gp70 protein, a feline leukemia virus p27-gp70 fusion protein, a canine distemper virus fusion protein, and a canine distemper virus hemagglutinin protein.

5 24. The invention of Claim 1, 2, or 3, wherein said recombinant antigen is selected from the group consisting of PFCVCP₆₇₁, PFCVCP₅₄₇, PFPVVP2₅₈₄, PFPVVP2C₂₄₃, PFPVpVP12₆₂₀, PFPVpVP2₄₇₇, PFHVgB₉₄₃, PFHVgB₂₅₀, PFHVgC₅₃₄, PFHVgC₄₆₇, PFHVgC_{467(opt)}, PFHVgD₃₇₄, PFHVgD₃₀₀, PFeLVp27₂₅₃, PFeLVp27₆₁₉, PFeLVp27-gp70₆₁₁, PCDVH₆₀₄, PCDVF₆₆₂, PHis-PFCVCP₆₇₁, PHis-PFCVCP₅₄₇, PHis-
10 PFPVVP2₅₈₄, PHis-PFPVVP2C₂₄₃, PHis-PFPVpVP12₆₂₀, PHis-PFPVpVP2₄₇₇, PHis-PFHVgB₉₄₃, PHis-PFHVgB₂₅₀, PHis-PFHVgC₅₃₄, PHis-PFHVgC₄₆₇, PHis-PFHVgC_{467(opt)}, PHis-PFHVgD₃₇₄, PHis-PFHVgD₃₀₀, PHis-PFeLVp27₂₅₃, PHis-PFeLVp27₆₁₉, PHis-PFeLVp27-gp70₆₁₁, PHis-PCDVH₆₀₄, and PHis-PCDVF₆₆₂.

15 25. The invention of Claim 1, 2, or 3, wherein said recombinant antigen comprises a recombinant protein selected from the group consisting of PFCVCP₆₇₁, PFCVCP₅₄₇, PFPVVP2₅₈₄, PFPVVP2C₂₄₃, PFPVpVP12₆₂₀, PFPVpVP2₄₇₇, PFHVgB₉₄₃, PFHVgB₂₅₀, PFHVgC₅₃₄, PFHVgC₄₆₇, PFHVgC_{467(opt)}, PFHVgD₃₇₄, PFHVgD₃₀₀, PFeLVp27₂₅₃, PFeLVp27₆₁₉, PFeLVp27-gp70₆₁₁, PCDVH₆₀₄, and PCDVF₆₆₂.

20 26. The method of Claim 1, 2, or 3, wherein said recombinant antigen comprises an amino acid sequence selected from the group consisting of SEQ ID NO:2, SEQ ID NO:4, SEQ ID NO:6, SEQ ID NO:8, SEQ ID NO:10, SEQ ID NO:12, SEQ ID NO:14, SEQ ID NO:16, SEQ ID NO:18, SEQ ID NO:20, SEQ ID NO:22, SEQ ID NO:24, SEQ ID NO:26, SEQ ID NO:28, SEQ ID NO:30, SEQ ID NO:32, SEQ ID NO:34 and SEQ ID NO:36.

25 27. The method of Claim 1, 2, or 3, wherein said recombinant antigen is encoded by a nucleic acid sequence selected from the group consisting of SEQ ID NO:1, SEQ ID NO:3, SEQ ID NO:5, SEQ ID NO:7, SEQ ID NO:9, SEQ ID NO:11, SEQ ID NO:13, SEQ ID NO:15, SEQ ID NO:17, SEQ ID NO:19, SEQ ID NO:21, SEQ ID NO:23, SEQ ID NO:25, SEQ ID NO:27, SEQ ID NO:29, SEQ ID NO:31,
30 SEQ ID NO:33, and SEQ ID NO:35.

28. The method of Claim 1 or 2, wherein said biological specimen is contacted with a recombinant calicivirus antigen, a recombinant herpesvirus antigen and a recombinant parvovirus antigen under conditions such that the immune status in accordance with Claim 1 or the vaccination status in accordance with Claim 2 of said animal to calicivirus, herpesvirus and parvovirus infection is determined.

29. The assay of Claim 3, wherein said means comprises a detection reagent.

30. The assay of Claim 3, wherein said assay further comprises:

- (a) a solid support comprising a test area and a reference area; and
- (b) a reference reagent.

31. The assay of Claim 3, wherein said test area comprises said recombinant antigen.

32. The assay of Claim 3, wherein said assay further comprises a control area for assay validation.

33. The invention of Claim 1, 2, 3, or 4, wherein said recombinant antigen is encoded by a nucleic acid molecule comprising a nucleic acid sequence selected from the group consisting of SEQ ID NO:1, SEQ ID NO:3, SEQ ID NO:5, SEQ ID NO:7, SEQ ID NO:9, SEQ ID NO:11, SEQ ID NO:13, SEQ ID NO:15, SEQ ID NO:17, SEQ ID NO:19, SEQ ID NO:21, SEQ ID NO:23, SEQ ID NO:25, SEQ ID NO:27, SEQ ID NO:29, SEQ ID NO:31, SEQ ID NO:33, and SEQ ID NO:35, a nucleic acid molecule comprising an allelic variant of a nucleic acid molecule comprising any of said nucleic acid sequences, and a nucleic acid molecule comprising a degenerate of a nucleic acid molecule comprising any of said nucleic acid sequences.

34. A nucleic acid molecule selected from the group consisting of: (a) a nucleic acid molecule encoding a protein of Claim 4; (b) a nucleic acid molecule encoding a protein comprising an amino acid sequence selected from the group consisting of SEQ ID NO:2, SEQ ID NO:4, SEQ ID NO:6, SEQ ID NO:8, SEQ ID NO:10, SEQ ID NO:12, SEQ ID NO:14, SEQ ID NO:16, SEQ ID NO:18, SEQ ID NO:20, SEQ ID NO:22, SEQ ID NO:24, SEQ ID NO:26, SEQ ID NO:28, SEQ ID NO:30, SEQ ID NO:32, SEQ ID NO:34 and SEQ ID NO:36; (c) a nucleic acid molecule comprising a nucleic acid sequence selected from the group consisting of

SEQ ID NO:1, SEQ ID NO:3, SEQ ID NO:5, SEQ ID NO:7, SEQ ID NO:9, SEQ ID NO:11, SEQ ID NO:13, SEQ ID NO:15, SEQ ID NO:17, SEQ ID NO:19, SEQ ID NO:21, SEQ ID NO:23, SEQ ID NO:25, SEQ ID NO:27, SEQ ID NO:29, SEQ ID NO:31, SEQ ID NO:33, and SEQ ID NO:35; (d) a nucleic acid molecule comprising
5 an allelic variant of a nucleic acid molecule of (c); (e) a nucleic acid molecule comprising a degenerate of a nucleic acid molecule of (c); and (f) a nucleic acid molecule fully complementary to any of said nucleic acid molecules of (a), (b), (c), (d) or (e).

35. A recombinant molecule comprising a nucleic acid molecule of
10 Claim 33.

36. A recombinant cell comprising a nucleic acid molecule of Claim 33.

37. A method to produce a recombinant antigen of Claim 4, said method comprising culturing a recombinant cell of Claim 35 wherein said cell encodes said recombinant antigen and recovering said recombinant antigen.

15 38. The recombinant antigen of Claim 4, wherein said recombinant antigen further comprises a component selected from the group consisting of a fusion segment and a ligand.

39. The recombinant antigen of Claim 4, wherein said recombinant antigen further comprises a detectable marker.

SEQUENCE LISTING

<110> HESKA CORPORATION
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<120> USE OF RECOMBINANT ANTIGENS TO DETERMINE THE IMMUNE STATUS OF AN ANIMAL

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485	490
495	
aac aac aag atc aat ccc tgt aat acc ata gac cag tca aag atc gtc	1536
Asn Asn Lys Ile Asn Pro Cys Asn Thr Ile Asp Gln Ser Lys Ile Val	
500	505
510	
gtg ttt caa gac aac cat gtt gga aag aaa gcg caa acc tca gac gat	1584
Val Phe Gln Asp Asn His Val Gly Lys Lys Ala Gln Thr Ser Asp Asp	
515	520
525	
aca ttg gcc ctg ctt ggt tac act ggc att ggt gag cag gcc atc ggg	1632
Thr Leu Ala Leu Leu Gly Tyr Thr Gly Ile Gly Glu Gln Ala Ile Gly	
530	535
540	
tct gat agg gac cgg gtt gtg cgc atc agc act ctc cct gaa act ggt	1680
Ser Asp Arg Asp Arg Val Val Arg Ile Ser Thr Leu Pro Glu Thr Gly	
545	550
555	560
gct cga ggc ggt aac cac cca att ttc tac aag aac tcc att aaa ttg	1728
Ala Arg Gly Gly Asn His Pro Ile Phe Tyr Lys Asn Ser Ile Lys Leu	
565	570
575	
gga tat gta att agg tct att gat gtc ttt aat tca caa atc ttg cac	1776
Gly Tyr Val Ile Arg Ser Ile Asp Val Phe Asn Ser Gln Ile Leu His	
580	585
590	
act tcc aga cag tta tcg cta aat cat tac cta ctc cca cct gat tct	1824
Thr Ser Arg Gln Leu Ser Leu Asn His Tyr Leu Leu Pro Pro Asp Ser	

Leu Gly Pro Leu Leu Asn Pro Tyr Leu Glu His Leu Ala Lys Leu Tyr
 195 200 205

Val Ala Trp Ser Gly Ser Ile Glu Val Arg Phe Ser Ile Ser Gly Ser
 210 215 220

Gly Val Phe Gly Gly Lys Leu Ala Ala Ile Val Val Pro Pro Gly Val
 225 230 235 240

Asp Pro Val Gln Ser Thr Ser Met Leu Gln Tyr Pro His Val Leu Phe
 245 250 255

Asp Ala Arg Gln Val Glu Pro Val Ile Phe Cys Leu Pro Asp Leu Arg
 260 265 270

Ser Thr Leu Tyr His Leu Met Ser Asp Thr Asp Thr Thr Ser Leu Val
 275 280 285

Ile Met Val Tyr Asn Asp Leu Ile Asn Pro Tyr Ala Asn Asp Ala Asn
 290 295 300

Ser Ser Gly Cys Ile Val Thr Val Glu Thr Lys Pro Gly Pro Asp Phe
 305 310 315 320

Lys Phe His Leu Leu Lys Pro Pro Gly Ser Met Leu Thr His Gly Ser
 325 330 335

Ile Pro Ser Asp Leu Ile Pro Lys Thr Ser Ser Leu Trp Ile Gly Asn
 340 345 350

Arg Tyr Trp Ser Asp Ile Thr Asp Phe Val Ile Arg Pro Phe Val Phe
 355 360 365

Gln Ala Asn Arg His Phe Asp Phe Asn Gln Glu Thr Ala Gly Trp Ser
 370 375 380

Thr Pro Arg Phe Arg Pro Ile Ser Val Thr Ile Thr Glu Gln Asn Gly
 385 390 395 400

Ala Lys Leu Gly Ile Gly Val Ala Thr Asp Tyr Ile Val Pro Gly Ile
 405 410 415

Pro Asp Gly Trp Pro Asp Thr Thr Ile Pro Gly Glu Leu Ile Pro Ala
 420 425 430

Gly Asp Tyr Ala Ile Thr Asn Gly Thr Gly Asn Asp Ile Thr Thr Ala
 435 440 445

Thr Gly Tyr Asp Thr Ala Asp Ile Ile Lys Asn Asn Thr Asn Phe Arg
 450 455 460

Gly Met Tyr Ile Cys Gly Ser Leu Gln Arg Ala Trp Gly Asp Lys Lys
 465 470 475 480

Ile Ser Asn Thr Ala Phe Ile Thr Thr Ala Thr Leu Asp Gly Asp Asn
 485 490 495

Asn Asn Lys Ile Asn Pro Cys Asn Thr Ile Asp Gln Ser Lys Ile Val
 500 505 510

Val Phe Gln Asp Asn His Val Gly Lys Lys Ala Gln Thr Ser Asp Asp

515		520		525
Thr Leu Ala Leu Leu Gly Tyr Thr Gly Ile Gly Glu Gln Ala Ile Gly				
530		535		540
Ser Asp Arg Asp Arg Val Val Arg Ile Ser Thr Leu Pro Glu Thr Gly				
545		550		555
Ala Arg Gly Gly Asn His Pro Ile Phe Tyr Lys Asn Ser Ile Lys Leu				
		565		570
Gly Tyr Val Ile Arg Ser Ile Asp Val Phe Asn Ser Gln Ile Leu His				
		580		585
Thr Ser Arg Gln Leu Ser Leu Asn His Tyr Leu Leu Pro Pro Asp Ser				
		595		600
Phe Ala Val Tyr Arg Ile Ile Asp Ser Asn Gly Ser Trp Phe Asp Ile				
610		615		620
Gly Ile Asp Ser Asp Gly Phe Ser Phe Val Gly Val Ser Gly Phe Gly				
625		630		635
Lys Leu Glu Phe Pro Leu Ser Ala Ser Tyr Met Gly Ile Gln Leu Ala				
		645		650
Lys Ile Arg Leu Ala Ser Asn Ile Arg Ser Pro Met Thr Lys Leu				
		660		665
				670

<210> 3
 <211> 1641
 <212> DNA
 <213> Feline calicivirus

<220>
 <221> CDS
 <222> (1)..(1641)

<400> 3

gcg gat gac ggg tca atc aca gca ccc gag caa gga aca atg gtt ggc	48
Ala Asp Asp Gly Ser Ile Thr Ala Pro Glu Gln Gly Thr Met Val Gly	
1 5 10 15	
ggc gtc atc gct gaa ccc agc gcc cag atg tca aca gct gct gat atg	96
Gly Val Ile Ala Glu Pro Ser Ala Gln Met Ser Thr Ala Ala Asp Met	
20 25 30	
gcc acc ggg aaa agc gtt gat tot gag tgg gag gca ttc ttc tcc ttt	144
Ala Thr Gly Lys Ser Val Asp Ser Glu Trp Glu Ala Phe Phe Ser Phe	
35 40 45	
cac acc agc gtc aat tgg agt aca tct gaa acc caa gga aag att ctc	192
His Thr Ser Val Asn Trp Ser Thr Ser Glu Thr Gln Gly Lys Ile Leu	
50 55 60	
ttc aaa caa tcc tta ggc cct ttg ctc aac cca tat cta gaa cac ctt	240
Phe Lys Gln Ser Leu Gly Pro Leu Leu Asn Pro Tyr Leu Glu His Leu	
65 70 75 80	

gct aag cta tat gtt gcg tgg tct ggg tcg att gag gtt agg ttc tct 288
 Ala Lys Leu Tyr Val Ala Trp Ser Gly Ser Ile Glu Val Arg Phe Ser
 85 90 95

atc tct ggc tct ggt gtc ttt ggt ggg aag ctc gca gct att gtt gta 336
 Ile Ser Gly Ser Gly Val Phe Gly Gly Lys Leu Ala Ala Ile Val Val
 100 105 110

cct cct ggg gtt gat cca gtg cag agt act tcg atg cta caa tac ccc 384
 Pro Pro Gly Val Asp Pro Val Gln Ser Thr Ser Met Leu Gln Tyr Pro
 115 120 125

cat gtt ttg ttt gat gct cgt cag gtg gaa cca gtt atc ttc tgt ctt 432
 His Val Leu Phe Asp Ala Arg Gln Val Glu Pro Val Ile Phe Cys Leu
 130 135 140

cct gat cta aga agc acc ctg tac cac ctt atg tct gac act gac act 480
 Pro Asp Leu Arg Ser Thr Leu Tyr His Leu Met Ser Asp Thr Asp Thr
 145 150 155 160

aca tcc ttg gtc att atg gtg tac aat gat ctc atc aat ccc tat gcc 528
 Thr Ser Leu Val Ile Met Val Tyr Asn Asp Leu Ile Asn Pro Tyr Ala
 165 170 175

aat gat gcc aac tct tct ggg tgt att gtc act gtc gag aca aaa cct 576
 Asn Asp Ala Asn Ser Ser Gly Cys Ile Val Thr Val Glu Thr Lys Pro
 180 185 190

ggc cct gac ttc aag ttt cac ctc ctt aag cca ccc gga tct atg cta 624
 Gly Pro Asp Phe Lys Phe His Leu Leu Lys Pro Pro Gly Ser Met Leu
 195 200 205

acc cat ggc tct atc cct tct gat tta att ccc aaa aca tct tcg ctc 672
 Thr His Gly Ser Ile Pro Ser Asp Leu Ile Pro Lys Thr Ser Ser Leu
 210 215 220

tgg atc ggt aac cgc tac tgg tca gac ata act gat ttt gtg att cgg 720
 Trp Ile Gly Asn Arg Tyr Trp Ser Asp Ile Thr Asp Phe Val Ile Arg
 225 230 235 240

ccg ttt gtc ttc caa gca aat cgt cat ttt gac ttt aat caa gag acc 768
 Pro Phe Val Phe Gln Ala Asn Arg His Phe Asp Phe Asn Gln Glu Thr
 245 250 255

gca ggg tgg agc aca cca cgg ttt cgg cct ata tct gtt acc att act 816
 Ala Gly Trp Ser Thr Pro Arg Phe Arg Pro Ile Ser Val Thr Ile Thr
 260 265 270

gaa cag aac gga gca aaa ttg ggc att ggg gtg gca aca gat tac ata 864
 Glu Gln Asn Gly Ala Lys Leu Gly Ile Gly Val Ala Thr Asp Tyr Ile
 275 280 285

gtg cct gga atc cct gat ggc tgg cct gac acc aca att cct ggg gag 912
 Val Pro Gly Ile Pro Asp Gly Trp Pro Asp Thr Thr Ile Pro Gly Glu
 290 295 300

ttg ata cca gct ggt gat tac gca atc acc aat ggt act ggc aat gac 960
 Leu Ile Pro Ala Gly Asp Tyr Ala Ile Thr Asn Gly Thr Gly Asn Asp
 305 310 315 320

atc acc acg gct aca gga tat gac act gct gat ata att aag aac aat 1008

Ile Thr Thr Ala Thr Gly Tyr Asp Thr Ala Asp Ile Ile Lys Asn Asn
 325 330 335

acc aac ttt agg ggc atg tac ata tgt ggt tcg ctc cag cgt gcc tgg 1056
 Thr Asn Phe Arg Gly Met Tyr Ile Cys Gly Ser Leu Gln Arg Ala Trp
 340 345 350

ggt gat aag aaa att tcc aac act gcc ttt atc acc act gcc acc cta 1104
 Gly Asp Lys Lys Ile Ser Asn Thr Ala Phe Ile Thr Thr Ala Thr Leu
 355 360 365

gat ggt gac aac aac aac aag atc aat ccc tgt aat acc ata gac cag 1152
 Asp Gly Asp Asn Asn Asn Lys Ile Asn Pro Cys Asn Thr Ile Asp Gln
 370 375 380

tca aag atc gtc gtg ttt caa gac aac cat gtt gga aag aaa gcg caa 1200
 Ser Lys Ile Val Val Phe Gln Asp Asn His Val Gly Lys Lys Ala Gln
 385 390 395 400

acc tca gac gat aca ttg gcc ctg ctt ggt tac act ggc att ggt gag 1248
 Thr Ser Asp Asp Thr Leu Ala Leu Leu Gly Tyr Thr Gly Ile Gly Glu
 405 410 415

cag gcc atc ggg tct gat agg gac cgg gtt gtg cgc atc agc act ctc 1296
 Gln Ala Ile Gly Ser Asp Arg Asp Arg Val Val Arg Ile Ser Thr Leu
 420 425 430

cct gaa act ggt gct cga ggc ggt aac cac cca att ttc tac aag aac 1344
 Pro Glu Thr Gly Ala Arg Gly Gly Asn His Pro Ile Phe Tyr Lys Asn
 435 440 445

tcc att aaa ttg gga tat gta att agg tct att gat gtc ttt aat tca 1392
 Ser Ile Lys Leu Gly Tyr Val Ile Arg Ser Ile Asp Val Phe Asn Ser
 450 455 460

caa atc ttg cac act tcc aga cag tta tcg cta aat cat tac cta ctc 1440
 Gln Ile Leu His Thr Ser Arg Gln Leu Ser Leu Asn His Tyr Leu Leu
 465 470 475 480

cca cct gat tct ttt gcc gtc tat aga ata att gac tca aat ggc tcg 1488
 Pro Pro Asp Ser Phe Ala Val Tyr Arg Ile Ile Asp Ser Asn Gly Ser
 485 490 495

tgg ttt gat att gga att gat agt gat ggg ttc tct ttt gtt ggt gtt 1536
 Trp Phe Asp Ile Gly Ile Asp Ser Asp Gly Phe Ser Phe Val Gly Val
 500 505 510

tct ggc ttt ggt aaa tta gaa ttt ccc ctt tct gcc tcc tac atg gga 1584
 Ser Gly Phe Gly Lys Leu Glu Phe Pro Leu Ser Ala Ser Tyr Met Gly
 515 520 525

ata caa ttg gca aag atc cgg ctt gcc tct aac att agg agt ccc atg 1632
 Ile Gln Leu Ala Lys Ile Arg Leu Ala Ser Asn Ile Arg Ser Pro Met
 530 535 540

act aag tta
 Thr Lys Leu 1641
 545

<210> 4

<211> 547
 <212> PRT
 <213> Feline calicivirus

<400> 4
 Ala Asp Asp Gly Ser Ile Thr Ala Pro Glu Gln Gly Thr Met Val Gly
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 Gly Val Ile Ala Glu Pro Ser Ala Gln Met Ser Thr Ala Ala Asp Met
 20 25 30
 Ala Thr Gly Lys Ser Val Asp Ser Glu Trp Glu Ala Phe Phe Ser Phe
 35 40 45
 His Thr Ser Val Asn Trp Ser Thr Ser Glu Thr Gln Gly Lys Ile Leu
 50 55 60
 Phe Lys Gln Ser Leu Gly Pro Leu Leu Asn Pro Tyr Leu Glu His Leu
 65 70 75 80
 Ala Lys Leu Tyr Val Ala Trp Ser Gly Ser Ile Glu Val Arg Phe Ser
 85 90 95
 Ile Ser Gly Ser Gly Val Phe Gly Gly Lys Leu Ala Ala Ile Val Val
 100 105 110
 Pro Pro Gly Val Asp Pro Val Gln Ser Thr Ser Met Leu Gln Tyr Pro
 115 120 125
 His Val Leu Phe Asp Ala Arg Gln Val Glu Pro Val Ile Phe Cys Leu
 130 135 140
 Pro Asp Leu Arg Ser Thr Leu Tyr His Leu Met Ser Asp Thr Asp Thr
 145 150 155 160
 Thr Ser Leu Val Ile Met Val Tyr Asn Asp Leu Ile Asn Pro Tyr Ala
 165 170 175
 Asn Asp Ala Asn Ser Ser Gly Cys Ile Val Thr Val Glu Thr Lys Pro
 180 185 190
 Gly Pro Asp Phe Lys Phe His Leu Leu Lys Pro Pro Gly Ser Met Leu
 195 200 205
 Thr His Gly Ser Ile Pro Ser Asp Leu Ile Pro Lys Thr Ser Ser Leu
 210 215 220
 Trp Ile Gly Asn Arg Tyr Trp Ser Asp Ile Thr Asp Phe Val Ile Arg
 225 230 235 240
 Pro Phe Val Phe Gln Ala Asn Arg His Phe Asp Phe Asn Gln Glu Thr
 245 250 255
 Ala Gly Trp Ser Thr Pro Arg Phe Arg Pro Ile Ser Val Thr Ile Thr
 260 265 270
 Glu Gln Asn Gly Ala Lys Leu Gly Ile Gly Val Ala Thr Asp Tyr Ile
 275 280 285
 Val Pro Gly Ile Pro Asp Gly Trp Pro Asp Thr Thr Ile Pro Gly Glu
 290 295 300

Leu Ile Pro Ala Gly Asp Tyr Ala Ile Thr Asn Gly Thr Gly Asn Asp
 305 310 315 320
 Ile Thr Thr Ala Thr Gly Tyr Asp Thr Ala Asp Ile Ile Lys Asn Asn
 325 330 335
 Thr Asn Phe Arg Gly Met Tyr Ile Cys Gly Ser Leu Gln Arg Ala Trp
 340 345 350
 Gly Asp Lys Lys Ile Ser Asn Thr Ala Phe Ile Thr Thr Ala Thr Leu
 355 360 365
 Asp Gly Asp Asn Asn Asn Lys Ile Asn Pro Cys Asn Thr Ile Asp Gln
 370 375 380
 Ser Lys Ile Val Val Phe Gln Asp Asn His Val Gly Lys Lys Ala Gln
 385 390 395 400
 Thr Ser Asp Asp Thr Leu Ala Leu Leu Gly Tyr Thr Gly Ile Gly Glu
 405 410 415
 Gln Ala Ile Gly Ser Asp Arg Asp Arg Val Val Arg Ile Ser Thr Leu
 420 425 430
 Pro Glu Thr Gly Ala Arg Gly Gly Asn His Pro Ile Phe Tyr Lys Asn
 435 440 445
 Ser Ile Lys Leu Gly Tyr Val Ile Arg Ser Ile Asp Val Phe Asn Ser
 450 455 460
 Gln Ile Leu His Thr Ser Arg Gln Leu Ser Leu Asn His Tyr Leu Leu
 465 470 475 480
 Pro Pro Asp Ser Phe Ala Val Tyr Arg Ile Ile Asp Ser Asn Gly Ser
 485 490 495
 Trp Phe Asp Ile Gly Ile Asp Ser Asp Gly Phe Ser Phe Val Gly Val
 500 505 510
 Ser Gly Phe Gly Lys Leu Glu Phe Pro Leu Ser Ala Ser Tyr Met Gly
 515 520 525
 Ile Gln Leu Ala Lys Ile Arg Leu Ala Ser Asn Ile Arg Ser Pro Met
 530 535 540
 Thr Lys Leu
 545

<210> 5
 <211> 1752
 <212> DNA
 <213> Feline parvovirus

<220>
 <221> CDS
 <222> (1)..(1752)

<400> 5

atg agt gat gga gca gtt caa cca gac ggt ggt caa cct gct gtc aga 48
 Met Ser Asp Gly Ala Val Gln Pro Asp Gly Gly Gln Pro Ala Val Arg
 1 5 10 15

aat gaa aga gct aca gga tct ggg aac ggg tct gga ggc ggg ggt ggt 96
 Asn Glu Arg Ala Thr Gly Ser Gly Asn Gly Ser Gly Gly Gly Gly Gly
 20 25 30

ggt ggt tct ggg ggt gtg ggg att tct acg ggt act ttc aat aat cag 144
 Gly Gly Ser Gly Gly Val Gly Ile Ser Thr Gly Thr Phe Asn Asn Gln
 35 40 45

acg gaa ttt aaa ttt ttg gaa aac ggg tgg gtg gaa atc aca gca aac 192
 Thr Glu Phe Lys Phe Leu Glu Asn Gly Trp Val Glu Ile Thr Ala Asn
 50 55 60

tca agc aga ctt gta cat tta aat atg cca gaa agt gaa aat tat aaa 240
 Ser Ser Arg Leu Val His Leu Asn Met Pro Glu Ser Glu Asn Tyr Lys
 65 70 75 80

aga gta gtt gta aat aat atg gat aaa act gca gtt aaa gga aac atg 288
 Arg Val Val Val Asn Asn Met Asp Lys Thr Ala Val Lys Gly Asn Met
 85 90 95

gct tta gat gat att cat gta caa att gta aca cct tgg tca ttg gtt 336
 Ala Leu Asp Asp Ile His Val Gln Ile Val Thr Pro Trp Ser Leu Val
 100 105 110

gat gca aat gct tgg gga gtt tgg ttt aat cca gga gat tgg caa cta 384
 Asp Ala Asn Ala Trp Gly Val Trp Phe Asn Pro Gly Asp Trp Gln Leu
 115 120 125

att gtt aat act atg agt gag ttg cat tta gtt agt ttt gaa caa gaa 432
 Ile Val Asn Thr Met Ser Glu Leu His Leu Val Ser Phe Glu Gln Glu
 130 135 140

att ttt aat gtt gtt tta aag act gtt tca gaa tct gct act cag cca 480
 Ile Phe Asn Val Val Leu Lys Thr Val Ser Glu Ser Ala Thr Gln Pro
 145 150 155 160

cca act aaa gtt tat aat aat gat tta act gca tca ttg atg gtt gca 528
 Pro Thr Lys Val Tyr Asn Asn Asp Leu Thr Ala Ser Leu Met Val Ala
 165 170 175

tta gat agt aat aat act atg cca ttt act cca gca gct atg aga tct 576
 Leu Asp Ser Asn Asn Thr Met Pro Phe Thr Pro Ala Ala Met Arg Ser
 180 185 190

gag aca ttg ggt ttt tat cca tgg aaa cca acc ata cca act cca tgg 624
 Glu Thr Leu Gly Phe Tyr Pro Trp Lys Pro Thr Ile Pro Thr Pro Trp
 195 200 205

aga tat tat ttt caa tgg gat aga aca tta ata cca tct cat act gga 672
 Arg Tyr Tyr Phe Gln Trp Asp Arg Thr Leu Ile Pro Ser His Thr Gly
 210 215 220

act agt ggc aca cca aca aat gta tat cat ggt aca gat cca gat gat 720
 Thr Ser Gly Thr Pro Thr Asn Val Tyr His Gly Thr Asp Pro Asp Asp
 225 230 235 240

gtt caa ttt tat act att gaa aat tct gtg cca gta cac tta cta aga 768

Val	Gln	Phe	Tyr	Thr	Ile	Glu	Asn	Ser	Val	Pro	Val	His	Leu	Leu	Arg		
				245					250					255			
aca	ggt	gat	gaa	ttt	gct	aca	gga	aca	ttt	ttt	ttt	gat	tgt	aaa	cca	816	
Thr	Gly	Asp	Glu	Phe	Ala	Thr	Gly	Thr	Phe	Phe	Phe	Asp	Cys	Lys	Pro		
			260					265					270				
tgt	aga	tta	aca	cat	aca	tgg	caa	aca	aat	aga	gca	ttg	ggc	tta	cca	864	
Cys	Arg	Leu	Thr	His	Thr	Trp	Gln	Thr	Asn	Arg	Ala	Leu	Gly	Leu	Pro		
		275					280					285					
cca	ttt	tta	aat	tct	ttg	cct	caa	tct	gaa	gga	gct	act	aac	ttt	ggt	912	
Pro	Phe	Leu	Asn	Ser	Leu	Pro	Gln	Ser	Glu	Gly	Ala	Thr	Asn	Phe	Gly		
	290					295					300						
gat	ata	gga	ggt	caa	caa	gat	aaa	aga	cgt	ggt	gta	act	caa	atg	gga	960	
Asp	Ile	Gly	Val	Gln	Gln	Asp	Lys	Arg	Arg	Gly	Val	Thr	Gln	Met	Gly		
305				310						315					320		
aat	aca	gac	tat	att	act	gaa	gct	act	att	atg	aga	cca	gct	gag	ggt	1008	
Asn	Thr	Asp	Tyr	Ile	Thr	Glu	Ala	Thr	Ile	Met	Arg	Pro	Ala	Glu	Val		
			325						330					335			
ggt	tat	agt	gca	cca	tat	tat	tct	ttt	gaa	gcg	tct	aca	caa	ggg	cca	1056	
Gly	Tyr	Ser	Ala	Pro	Tyr	Tyr	Ser	Phe	Glu	Ala	Ser	Thr	Gln	Gly	Pro		
			340					345					350				
ttt	aaa	aca	cct	att	gca	gca	gga	cgg	ggg	gga	gcg	caa	aca	gat	gaa	1104	
Phe	Lys	Thr	Pro	Ile	Ala	Ala	Gly	Arg	Gly	Gly	Ala	Gln	Thr	Asp	Glu		
		355					360					365					
aat	caa	gca	gca	gat	ggt	gat	cca	aga	tat	gca	ttt	ggt	aga	caa	cat	1152	
Asn	Gln	Ala	Ala	Asp	Gly	Asp	Pro	Arg	Tyr	Ala	Phe	Gly	Arg	Gln	His		
	370					375						380					
ggt	caa	aaa	act	act	aca	aca	gga	gaa	aca	cct	gag	aga	ttt	aca	tat	1200	
Gly	Gln	Lys	Thr	Thr	Thr	Thr	Gly	Glu	Thr	Pro	Glu	Arg	Phe	Thr	Tyr		
385					390					395					400		
ata	gca	cat	caa	gat	aca	gga	aga	tat	cca	gaa	gga	gat	tgg	att	caa	1248	
Ile	Ala	His	Gln	Asp	Thr	Gly	Arg	Tyr	Pro	Glu	Gly	Asp	Trp	Ile	Gln		
			405					410						415			
aat	att	aac	ttt	aac	ctt	cct	gta	aca	aat	gat	aat	gta	ttg	cta	cca	1296	
Asn	Ile	Asn	Phe	Asn	Leu	Pro	Val	Thr	Asn	Asp	Asn	Val	Leu	Leu	Pro		
			420					425					430				
aca	gat	cca	att	ggg	ggt	aaa	aca	gga	att	aac	tat	act	aat	ata	ttt	1344	
Thr	Asp	Pro	Ile	Gly	Gly	Lys	Thr	Gly	Ile	Asn	Tyr	Thr	Asn	Ile	Phe		
		435					440					445					
aat	act	tat	ggt	cct	tta	act	gca	tta	aat	aat	gta	cca	cca	ggt	tat	1392	
Asn	Thr	Tyr	Gly	Pro	Leu	Thr	Ala	Leu	Asn	Asn	Val	Pro	Pro	Val	Tyr		
	450					455					460						
cca	aat	ggt	caa	att	tgg	gat	aaa	gaa	ttt	gat	act	gac	tta	aaa	cca	1440	
Pro	Asn	Gly	Gln	Ile	Trp	Asp	Lys	Glu	Phe	Asp	Thr	Asp	Leu	Lys	Pro		
465					470					475					480		
aga	ctt	cat	gta	aat	gca	cca	ttt	ggt	tgt	caa	aat	aat	tgt	cct	ggt	1488	
Arg	Leu	His	Val	Asn	Ala	Pro	Phe	Val	Cys	Gln	Asn	Asn	Cys	Pro	Gly		

	485	490	495	
caa tta ttt gta aaa gtt gcg cct aat tta acg aat gaa tat gat cct				1536
Gln Leu Phe Val Lys Val Ala Pro Asn Leu Thr Asn Glu Tyr Asp Pro				
	500	505	510	
gat gca tct gct aat atg tca aga att gta act tat tca gat ttt tgg				1584
Asp Ala Ser Ala Asn Met Ser Arg Ile Val Thr Tyr Ser Asp Phe Trp				
	515	520	525	
tgg aaa ggt aaa tta gta ttt aaa gct aaa cta aga gca tct cat act				1632
Trp Lys Gly Lys Leu Val Phe Lys Ala Lys Leu Arg Ala Ser His Thr				
	530	535	540	
tgg aat cca att caa caa atg agc att aat gta gat aac caa ttt aac				1680
Trp Asn Pro Ile Gln Gln Met Ser Ile Asn Val Asp Asn Gln Phe Asn				
	545	550	555	560
tat gta cca aat aat att gga gct atg aaa att gta tat gaa aaa tct				1728
Tyr Val Pro Asn Asn Ile Gly Ala Met Lys Ile Val Tyr Glu Lys Ser				
	565	570	575	
caa cta gca cct aga aaa tta tat				1752
Gln Leu Ala Pro Arg Lys Leu Tyr				
	580			

<210> 6
 <211> 584
 <212> PRT
 <213> Feline parvovirus

<400> 6
 Met Ser Asp Gly Ala Val Gln Pro Asp Gly Gly Gln Pro Ala Val Arg
 1 5 10 15
 Asn Glu Arg Ala Thr Gly Ser Gly Asn Gly Ser Gly Gly Gly Gly Gly
 20 25 30
 Gly Gly Ser Gly Gly Val Gly Ile Ser Thr Gly Thr Phe Asn Asn Gln
 35 40 45
 Thr Glu Phe Lys Phe Leu Glu Asn Gly Trp Val Glu Ile Thr Ala Asn
 50 55 60
 Ser Ser Arg Leu Val His Leu Asn Met Pro Glu Ser Glu Asn Tyr Lys
 65 70 75 80
 Arg Val Val Val Asn Asn Met Asp Lys Thr Ala Val Lys Gly Asn Met
 85 90 95
 Ala Leu Asp Asp Ile His Val Gln Ile Val Thr Pro Trp Ser Leu Val
 100 105 110
 Asp Ala Asn Ala Trp Gly Val Trp Phe Asn Pro Gly Asp Trp Gln Leu
 115 120 125
 Ile Val Asn Thr Met Ser Glu Leu His Leu Val Ser Phe Glu Gln Glu
 130 135 140
 Ile Phe Asn Val Val Leu Lys Thr Val Ser Glu Ser Ala Thr Gln Pro

Arg Leu His Val Asn Ala Pro Phe Val Cys Gln Asn Asn Cys Pro Gly
 485 490 495

Gln Leu Phe Val Lys Val Ala Pro Asn Leu Thr Asn Glu Tyr Asp Pro
 500 505 510

Asp Ala Ser Ala Asn Met Ser Arg Ile Val Thr Tyr Ser Asp Phe Trp
 515 520 525

Trp Lys Gly Lys Leu Val Phe Lys Ala Lys Leu Arg Ala Ser His Thr
 530 535 540

Trp Asn Pro Ile Gln Gln Met Ser Ile Asn Val Asp Asn Gln Phe Asn
 545 550 555 560

Tyr Val Pro Asn Asn Ile Gly Ala Met Lys Ile Val Tyr Glu Lys Ser
 565 570 575

Gln Leu Ala Pro Arg Lys Leu Tyr
 580

<210> 7
 <211> 729
 <212> DNA
 <213> Feline parvovirus

<220>
 <221> CDS
 <222> (1)..(729)

<400> 7
 ggt aca gat cca gat gat gtt caa ttt tat act att gaa aat tct gtg 48
 Gly Thr Asp Pro Asp Asp Val Gln Phe Tyr Thr Ile Glu Asn Ser Val
 1 5 10 15

cca gta cac tta cta aga aca ggt gat gaa ttt gct aca gga aca ttt 96
 Pro Val His Leu Leu Arg Thr Gly Asp Glu Phe Ala Thr Gly Thr Phe
 20 25 30

ttt ttt gat tgt aaa cca tgt aga tta aca cat aca tgg caa aca aat 144
 Phe Phe Asp Cys Lys Pro Cys Arg Leu Thr His Thr Trp Gln Thr Asn
 35 40 45

aga gca ttg ggc tta cca cca ttt tta aat tct ttg cct caa tct gaa 192
 Arg Ala Leu Gly Leu Pro Pro Phe Leu Asn Ser Leu Pro Gln Ser Glu
 50 55 60

gga gct act aac ttt ggt gat ata gga gtt caa caa gat aaa aga cgt 240
 Gly Ala Thr Asn Phe Gly Asp Ile Gly Val Gln Gln Asp Lys Arg Arg
 65 70 75 80

ggt gta act caa atg gga aat aca gac tat att act gaa gct act att 288
 Gly Val Thr Gln Met Gly Asn Thr Asp Tyr Ile Thr Glu Ala Thr Ile
 85 90 95

atg aga cca gct gag gtt ggt tat agt gca cca tat tat tct ttt gaa 336
 Met Arg Pro Ala Glu Val Gly Tyr Ser Ala Pro Tyr Tyr Ser Phe Glu
 100 105 110

gcg tct aca caa ggg cca ttt aaa aca cct att gca gca gga cgg ggg 384
 Ala Ser Thr Gln Gly Pro Phe Lys Thr Pro Ile Ala Ala Gly Arg Gly
 115 120 125

gga gcg caa aca gat gaa aat caa gca gca gat ggt gat cca aga tat 432
 Gly Ala Gln Thr Asp Glu Asn Gln Ala Ala Asp Gly Asp Pro Arg Tyr
 130 135 140

gca ttt ggt aga caa cat ggt caa aaa act act aca aca gga gaa aca 480
 Ala Phe Gly Arg Gln His Gly Gln Lys Thr Thr Thr Thr Gly Glu Thr
 145 150 155 160

cct gag aga ttt aca tat ata gca cat caa gat aca gga aga tat cca 528
 Pro Glu Arg Phe Thr Tyr Ile Ala His Gln Asp Thr Gly Arg Tyr Pro
 165 170 175

gaa gga gat tgg att caa aat att aac ttt aac ctt cct gta aca aat 576
 Glu Gly Asp Trp Ile Gln Asn Ile Asn Phe Asn Leu Pro Val Thr Asn
 180 185 190

gat aat gta ttg cta cca aca gat cca att ggg ggt aaa aca gga att 624
 Asp Asn Val Leu Leu Pro Thr Asp Pro Ile Gly Gly Lys Thr Gly Ile
 195 200 205

aac tat act aat ata ttt aat act tat ggt cct tta act gca tta aat 672
 Asn Tyr Thr Asn Ile Phe Asn Thr Tyr Gly Pro Leu Thr Ala Leu Asn
 210 215 220

aat gta cca cca gtt tat cca aat ggt caa att tgg gat aaa gaa ttt 720
 Asn Val Pro Pro Val Tyr Pro Asn Gly Gln Ile Trp Asp Lys Glu Phe
 225 230 235 240

gat act gac 729
 Asp Thr Asp

<210> 8
 <211> 243
 <212> PRT
 <213> Feline parvovirus

<400> 8
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 20 25 30
 Phe Phe Asp Cys Lys Pro Cys Arg Leu Thr His Thr Trp Gln Thr Asn
 35 40 45
 Arg Ala Leu Gly Leu Pro Pro Phe Leu Asn Ser Leu Pro Gln Ser Glu
 50 55 60
 Gly Ala Thr Asn Phe Gly Asp Ile Gly Val Gln Gln Asp Lys Arg Arg
 65 70 75 80
 Gly Val Thr Gln Met Gly Asn Thr Asp Tyr Ile Thr Glu Ala Thr Ile
 85 90 95

Met Arg Pro Ala Glu Val Gly Tyr Ser Ala Pro Tyr Tyr Ser Phe Glu
 100 105 110

Ala Ser Thr Gln Gly Pro Phe Lys Thr Pro Ile Ala Ala Gly Arg Gly
 115 120 125

Gly Ala Gln Thr Asp Glu Asn Gln Ala Ala Asp Gly Asp Pro Arg Tyr
 130 135 140

Ala Phe Gly Arg Gln His Gly Gln Lys Thr Thr Thr Thr Gly Glu Thr
 145 150 155 160

Pro Glu Arg Phe Thr Tyr Ile Ala His Gln Asp Thr Gly Arg Tyr Pro
 165 170 175

Glu Gly Asp Trp Ile Gln Asn Ile Asn Phe Asn Leu Pro Val Thr Asn
 180 185 190

Asp Asn Val Leu Leu Pro Thr Asp Pro Ile Gly Gly Lys Thr Gly Ile
 195 200 205

Asn Tyr Thr Asn Ile Phe Asn Thr Tyr Gly Pro Leu Thr Ala Leu Asn
 210 215 220

Asn Val Pro Pro Val Tyr Pro Asn Gly Gln Ile Trp Asp Lys Glu Phe
 225 230 235 240

Asp Thr Asp

<210> 9
 <211> 1860
 <212> DNA
 <213> Feline parvovirus

<220>
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 <222> (1)..(1860)

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 Tyr Lys Tyr Leu Gly Pro Gly Asn Ser Leu Asp Gln Gly Glu Pro Thr
 20 25 30

aac cct tct gac gcc gct gca aaa gaa cac gac gaa gct tac gct gct 144
 Asn Pro Ser Asp Ala Ala Ala Lys Glu His Asp Glu Ala Tyr Ala Ala
 35 40 45

tat ctt cgc tct ggt aaa aac cca tac tta tat ttc tcg cca gca gat 192
 Tyr Leu Arg Ser Gly Lys Asn Pro Tyr Leu Tyr Phe Ser Pro Ala Asp
 50 55 60

caa cgc ttt ata gat caa act aag gac gct aca gat tgg ggg ggg aaa 240
 Gln Arg Phe Ile Asp Gln Thr Lys Asp Ala Thr Asp Trp Gly Gly Lys
 65 70 75 80

ata gga cat tat ttt ttt aga gct aaa aaa gca att gct cca gta tta	288
Ile Gly His Tyr Phe Phe Arg Ala Lys Lys Ala Ile Ala Pro Val Leu	
85 90 95	
act gat aca cca gat cat cca tca aca tca aga cca aca aaa cca act	336
Thr Asp Thr Pro Asp His Pro Ser Thr Ser Arg Pro Thr Lys Pro Thr	
100 105 110	
aaa aga agt aaa cca cca cct cat att ttc atc aat ctt gca aaa aaa	384
Lys Arg Ser Lys Pro Pro Pro His Ile Phe Ile Asn Leu Ala Lys Lys	
115 120 125	
aaa aaa gcc ggt gca gga caa gta aaa aga gac aat caa gca cca atg	432
Lys Lys Ala Gly Ala Gly Gln Val Lys Arg Asp Asn Gln Ala Pro Met	
130 135 140	
agt gat gga gca gtt caa cca gac ggt ggt caa cct gct gtc aga aat	480
Ser Asp Gly Ala Val Gln Pro Asp Gly Gly Gln Pro Ala Val Arg Asn	
145 150 155 160	
gaa aga gct aca gga tct ggg aac ggg tct gga ggc ggg ggt ggt ggt	528
Glu Arg Ala Thr Gly Ser Gly Asn Gly Ser Gly Gly Gly Gly Gly Gly	
165 170 175	
ggt tct ggg ggt gtg ggg att tct acg ggt act ttc aat aat cag acg	576
Gly Ser Gly Gly Val Gly Ile Ser Thr Gly Thr Phe Asn Asn Gln Thr	
180 185 190	
gaa ttt aaa ttt ttg gaa aac gga tgg gtg gaa atc aca gca aac tca	624
Glu Phe Lys Phe Leu Glu Asn Gly Trp Val Glu Ile Thr Ala Asn Ser	
195 200 205	
agc aga ctt gta cat tta aat atg cca gaa agt gaa aat tat aaa aga	672
Ser Arg Leu Val His Leu Asn Met Pro Glu Ser Glu Asn Tyr Lys Arg	
210 215 220	
gta gtt gta aat aat atg gat aaa act gca gtt aaa gga aac atg gct	720
Val Val Val Asn Asn Met Asp Lys Thr Ala Val Lys Gly Asn Met Ala	
225 230 235 240	
tta gat gac act cat gta caa att gta aca cct tgg tca ttg gtt gat	768
Leu Asp Asp Thr His Val Gln Ile Val Thr Pro Trp Ser Leu Val Asp	
245 250 255	
gca aat gct tgg gga gtt tgg ttt aat cca gga gat tgg caa cta att	816
Ala Asn Ala Trp Gly Val Trp Phe Asn Pro Gly Asp Trp Gln Leu Ile	
260 265 270	
gtt aat act atg agt gag ttg cat tta gtt agt ttt gaa caa gaa att	864
Val Asn Thr Met Ser Glu Leu His Leu Val Ser Phe Glu Gln Glu Ile	
275 280 285	
ttt aat gtt gtt tta aag act gtt tca gaa tct gct act cag cca cca	912
Phe Asn Val Val Leu Lys Thr Val Ser Glu Ser Ala Thr Gln Pro Pro	
290 295 300	
act aaa gtt tat aat aat gat tta act gca tca ttg atg gtt gca tta	960
Thr Lys Val Tyr Asn Asn Asp Leu Thr Ala Ser Leu Met Val Ala Leu	
305 310 315 320	

gat agt aat aat act atg cca ttt act cca gca gct atg aga tct gag	1008
Asp Ser Asn Asn Thr Met Pro Phe Thr Pro Ala Ala Met Arg Ser Glu	
325 330 335	
aca ttg ggt ttt tat cca tgg aaa cca acc ata cca act cca tgg aga	1056
Thr Leu Gly Phe Tyr Pro Trp Lys Pro Thr Ile Pro Thr Pro Trp Arg	
340 345 350	
tat tat ttt caa tgg gat aga aca tta ata cca tct cat act gga act	1104
Tyr Tyr Phe Gln Trp Asp Arg Thr Leu Ile Pro Ser His Thr Gly Thr	
355 360 365	
agt ggc aca cca aca aat ata tat cat ggt aca gat cca gat gat gtt	1152
Ser Gly Thr Pro Thr Asn Ile Tyr His Gly Thr Asp Pro Asp Asp Val	
370 375 380	
caa ttt tat act att gaa aat tct gtg cca gta cac tta cta aga aca	1200
Gln Phe Tyr Thr Ile Glu Asn Ser Val Pro Val His Leu Leu Arg Thr	
385 390 395 400	
ggt gat gaa ttt gct aca gga aca ttt ttt ttt gat tgt aaa cca tgt	1248
Gly Asp Glu Phe Ala Thr Gly Thr Phe Phe Phe Asp Cys Lys Pro Cys	
405 410 415	
aga cta aca cat aca tgg caa aca aac aga gca ttg ggc tta cca cca	1296
Arg Leu Thr His Thr Trp Gln Thr Asn Arg Ala Leu Gly Leu Pro Pro	
420 425 430	
ttt cta aat tct ttg cct caa tct gaa gga gct act aac ttt ggt gat	1344
Phe Leu Asn Ser Leu Pro Gln Ser Glu Gly Ala Thr Asn Phe Gly Asp	
435 440 445	
ata gga gtt caa caa gat aaa aga cgt ggt gta act caa atg gga aat	1392
Ile Gly Val Gln Gln Asp Lys Arg Arg Gly Val Thr Gln Met Gly Asn	
450 455 460	
aca gac tat att act gaa gct act att atg aga cca gct gag gtt ggt	1440
Thr Asp Tyr Ile Thr Glu Ala Thr Ile Met Arg Pro Ala Glu Val Gly	
465 470 475 480	
tat agt gca cca tat tat tct ttt gaa gcg tct aca caa ggg cca ttt	1488
Tyr Ser Ala Pro Tyr Tyr Ser Phe Glu Ala Ser Thr Gln Gly Pro Phe	
485 490 495	
aaa ata cct att gca gca gga cgg ggg gga gcg caa aca gat gaa aat	1536
Lys Ile Pro Ile Ala Ala Gly Arg Gly Gly Ala Gln Thr Asp Glu Asn	
500 505 510	
caa gca gca gat ggt gat cca aga tat gca ttt ggt aga caa cat ggt	1584
Gln Ala Ala Asp Gly Asp Pro Arg Tyr Ala Phe Gly Arg Gln His Gly	
515 520 525	
caa aaa act act aca aca gga gaa aca cct gag aga ttt aca tat ata	1632
Gln Lys Thr Thr Thr Thr Gly Glu Thr Pro Glu Arg Phe Thr Tyr Ile	
530 535 540	
gca cat caa gat aca gga aga tat cca gca gga gat tgg att caa aat	1680
Ala His Gln Asp Thr Gly Arg Tyr Pro Ala Gly Asp Trp Ile Gln Asn	
545 550 555 560	
att aac ttt aac ctt cct gta aca aat gat aat gta ttg cta cca aca	1728

Ile Asn Phe Asn Leu Pro Val Thr Asn Asp Asn Val Leu Leu Pro Thr
 565 570 575
 gat cca att gga ggt aaa aca gga atc aac tat act aat ata ttt aat 1776
 Asp Pro Ile Gly Gly Lys Thr Gly Ile Asn Tyr Thr Asn Ile Phe Asn
 580 585 590
 act tat ggt cct tta act gca tta aat aat gta cca cca gtt tat cca 1824
 Thr Tyr Gly Pro Leu Thr Ala Leu Asn Asn Val Pro Pro Val Tyr Pro
 595 600 605
 aat ggt caa att tgg gat aaa gaa ttt gat act gac 1860
 Asn Gly Gln Ile Trp Asp Lys Glu Phe Asp Thr Asp
 610 615 620

<210> 10
 <211> 620
 <212> PRT
 <213> Feline parvovirus

<400> 10
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 Tyr Lys Tyr Leu Gly Pro Gly Asn Ser Leu Asp Gln Gly Glu Pro Thr
 20 25 30
 Asn Pro Ser Asp Ala Ala Ala Lys Glu His Asp Glu Ala Tyr Ala Ala
 35 40 45
 Tyr Leu Arg Ser Gly Lys Asn Pro Tyr Leu Tyr Phe Ser Pro Ala Asp
 50 55 60
 Gln Arg Phe Ile Asp Gln Thr Lys Asp Ala Thr Asp Trp Gly Gly Lys
 65 70 75 80
 Ile Gly His Tyr Phe Phe Arg Ala Lys Lys Ala Ile Ala Pro Val Leu
 85 90 95
 Thr Asp Thr Pro Asp His Pro Ser Thr Ser Arg Pro Thr Lys Pro Thr
 100 105 110
 Lys Arg Ser Lys Pro Pro Pro His Ile Phe Ile Asn Leu Ala Lys Lys
 115 120 125
 Lys Lys Ala Gly Ala Gly Gln Val Lys Arg Asp Asn Gln Ala Pro Met
 130 135 140
 Ser Asp Gly Ala Val Gln Pro Asp Gly Gly Gln Pro Ala Val Arg Asn
 145 150 155 160
 Glu Arg Ala Thr Gly Ser Gly Asn Gly Ser Gly Gly Gly Gly Gly Gly
 165 170 175
 Gly Ser Gly Gly Val Gly Ile Ser Thr Gly Thr Phe Asn Asn Gln Thr
 180 185 190
 Glu Phe Lys Phe Leu Glu Asn Gly Trp Val Glu Ile Thr Ala Asn Ser
 195 200 205

Ser Arg Leu Val His Leu Asn Met Pro Glu Ser Glu Asn Tyr Lys Arg
 210 215 220

Val Val Val Asn Asn Met Asp Lys Thr Ala Val Lys Gly Asn Met Ala
 225 230 235 240

Leu Asp Asp Thr His Val Gln Ile Val Thr Pro Trp Ser Leu Val Asp
 245 250 255

Ala Asn Ala Trp Gly Val Trp Phe Asn Pro Gly Asp Trp Gln Leu Ile
 260 265 270

Val Asn Thr Met Ser Glu Leu His Leu Val Ser Phe Glu Gln Glu Ile
 275 280 285

Phe Asn Val Val Leu Lys Thr Val Ser Glu Ser Ala Thr Gln Pro Pro
 290 295 300

Thr Lys Val Tyr Asn Asn Asp Leu Thr Ala Ser Leu Met Val Ala Leu
 305 310 315 320

Asp Ser Asn Asn Thr Met Pro Phe Thr Pro Ala Ala Met Arg Ser Glu
 325 330 335

Thr Leu Gly Phe Tyr Pro Trp Lys Pro Thr Ile Pro Thr Pro Trp Arg
 340 345 350

Tyr Tyr Phe Gln Trp Asp Arg Thr Leu Ile Pro Ser His Thr Gly Thr
 355 360 365

Ser Gly Thr Pro Thr Asn Ile Tyr His Gly Thr Asp Pro Asp Asp Val
 370 375 380

Gln Phe Tyr Thr Ile Glu Asn Ser Val Pro Val His Leu Leu Arg Thr
 385 390 395 400

Gly Asp Glu Phe Ala Thr Gly Thr Phe Phe Phe Asp Cys Lys Pro Cys
 405 410 415

Arg Leu Thr His Thr Trp Gln Thr Asn Arg Ala Leu Gly Leu Pro Pro
 420 425 430

Phe Leu Asn Ser Leu Pro Gln Ser Glu Gly Ala Thr Asn Phe Gly Asp
 435 440 445

Ile Gly Val Gln Gln Asp Lys Arg Arg Gly Val Thr Gln Met Gly Asn
 450 455 460

Thr Asp Tyr Ile Thr Glu Ala Thr Ile Met Arg Pro Ala Glu Val Gly
 465 470 475 480

Tyr Ser Ala Pro Tyr Tyr Ser Phe Glu Ala Ser Thr Gln Gly Pro Phe
 485 490 495

Lys Ile Pro Ile Ala Ala Gly Arg Gly Gly Ala Gln Thr Asp Glu Asn
 500 505 510

Gln Ala Ala Asp Gly Asp Pro Arg Tyr Ala Phe Gly Arg Gln His Gly
 515 520 525

Gln Lys Thr Thr Thr Thr Gly Glu Thr Pro Glu Arg Phe Thr Tyr Ile

att gtt aat act atg agt gag ttg cat tta gtt agt ttt gaa caa gaa 432
 Ile Val Asn Thr Met Ser Glu Leu His Leu Val Ser Phe Glu Gln Glu
 130 135 140

att ttt aat gtt gtt tta aag act gtt tca gaa tct gct act cag cca 480
 Ile Phe Asn Val Val Leu Lys Thr Val Ser Glu Ser Ala Thr Gln Pro
 145 150 155 160

cca act aaa gtt tat aat aat gat tta act gca tca ttg atg gtt gca 528
 Pro Thr Lys Val Tyr Asn Asn Asp Leu Thr Ala Ser Leu Met Val Ala
 165 170 175

tta gat agt aat aat act atg cca ttt act cca gca gct atg aga tct 576
 Leu Asp Ser Asn Asn Thr Met Pro Phe Thr Pro Ala Ala Met Arg Ser
 180 185 190

gag aca ttg ggt ttt tat cca tgg aaa cca acc ata cca act cca tgg 624
 Glu Thr Leu Gly Phe Tyr Pro Trp Lys Pro Thr Ile Pro Thr Pro Trp
 195 200 205

aga tat tat ttt caa tgg gat aga aca tta ata cca tct cat act gga 672
 Arg Tyr Tyr Phe Gln Trp Asp Arg Thr Leu Ile Pro Ser His Thr Gly
 210 215 220

act agt ggc aca cca aca aat ata tat cat ggt aca gat cca gat gat 720
 Thr Ser Gly Thr Pro Thr Asn Ile Tyr His Gly Thr Asp Pro Asp Asp
 225 230 235 240

gtt caa ttt tat act att gaa aat tct gtg cca gta cac tta cta aga 768
 Val Gln Phe Tyr Thr Ile Glu Asn Ser Val Pro Val His Leu Leu Arg
 245 250 255

aca ggt gat gaa ttt gct aca gga aca ttt ttt ttt gat tgt aaa cca 816
 Thr Gly Asp Glu Phe Ala Thr Gly Thr Phe Phe Phe Asp Cys Lys Pro
 260 265 270

tgt aga cta aca cat aca tgg caa aca aac aga gca ttg ggc tta cca 864
 Cys Arg Leu Thr His Thr Trp Gln Thr Asn Arg Ala Leu Gly Leu Pro
 275 280 285

cca ttt cta aat tct ttg cct caa tct gaa gga gct act aac ttt ggt 912
 Pro Phe Leu Asn Ser Leu Pro Gln Ser Glu Gly Ala Thr Asn Phe Gly
 290 295 300

gat ata gga gtt caa caa gat aaa aga cgt ggt gta act caa atg gga 960
 Asp Ile Gly Val Gln Gln Asp Lys Arg Arg Gly Val Thr Gln Met Gly
 305 310 315 320

aat aca gac tat att act gaa gct act att atg aga cca gct gag gtt 1008
 Asn Thr Asp Tyr Ile Thr Glu Ala Thr Ile Met Arg Pro Ala Glu Val
 325 330 335

ggt tat agt gca cca tat tat tct ttt gaa gcg tct aca caa ggg cca 1056
 Gly Tyr Ser Ala Pro Tyr Tyr Ser Phe Glu Ala Ser Thr Gln Gly Pro
 340 345 350

ttt aaa ata cct att gca gca gga cgg ggg gga gcg caa aca gat gaa 1104
 Phe Lys Ile Pro Ile Ala Ala Gly Arg Gly Gly Ala Gln Thr Asp Glu
 355 360 365

aat caa gca gca gat ggt gat cca aga tat gca ttt ggt aga caa cat 1152

Asn Gln Ala Ala Asp Gly Asp Pro Arg Tyr Ala Phe Gly Arg Gln His
 370 375 380

ggt caa aaa act act aca aca gga gaa aca cct gag aga ttt aca tat 1200
 Gly Gln Lys Thr Thr Thr Thr Gly Glu Thr Pro Glu Arg Phe Thr Tyr
 385 390 395 400

ata gca cat caa gat aca gga aga tat cca gca gga gat tgg att caa 1248
 Ile Ala His Gln Asp Thr Gly Arg Tyr Pro Ala Gly Asp Trp Ile Gln
 405 410 415

aat att aac ttt aac ctt cct gta aca aat gat aat gta ttg cta cca 1296
 Asn Ile Asn Phe Asn Leu Pro Val Thr Asn Asp Asn Val Leu Leu Pro
 420 425 430

aca gat cca att gga ggt aaa aca gga atc aac tat act aat ata ttt 1344
 Thr Asp Pro Ile Gly Gly Lys Thr Gly Ile Asn Tyr Thr Asn Ile Phe
 435 440 445

aat act tat ggt cct tta act gca tta aat aat gta cca cca gtt tat 1392
 Asn Thr Tyr Gly Pro Leu Thr Ala Leu Asn Asn Val Pro Pro Val Tyr
 450 455 460

cca aat ggt caa att tgg gat aaa gaa ttt gat act gac 1431
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 465 470 475

<210> 12
 <211> 477
 <212> PRT
 <213> Feline parvovirus

<400> 12
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Asn Glu Arg Ala Thr Gly Ser Gly Asn Gly Ser Gly Gly Gly Gly Gly
 20 25 30

Gly Gly Ser Gly Gly Val Gly Ile Ser Thr Gly Thr Phe Asn Asn Gln
 35 40 45

Thr Glu Phe Lys Phe Leu Glu Asn Gly Trp Val Glu Ile Thr Ala Asn
 50 55 60

Ser Ser Arg Leu Val His Leu Asn Met Pro Glu Ser Glu Asn Tyr Lys
 65 70 75 80

Arg Val Val Val Asn Asn Met Asp Lys Thr Ala Val Lys Gly Asn Met
 85 90 95

Ala Leu Asp Asp Thr His Val Gln Ile Val Thr Pro Trp Ser Leu Val
 100 105 110

Asp Ala Asn Ala Trp Gly Val Trp Phe Asn Pro Gly Asp Trp Gln Leu
 115 120 125

Ile Val Asn Thr Met Ser Glu Leu His Leu Val Ser Phe Glu Gln Glu
 130 135 140

Ile Phe Asn Val Val Leu Lys Thr Val Ser Glu Ser Ala Thr Gln Pro
 145 150 155 160

Pro Thr Lys Val Tyr Asn Asn Asp Leu Thr Ala Ser Leu Met Val Ala
 165 170 175

Leu Asp Ser Asn Asn Thr Met Pro Phe Thr Pro Ala Ala Met Arg Ser
 180 185 190

Glu Thr Leu Gly Phe Tyr Pro Trp Lys Pro Thr Ile Pro Thr Pro Trp
 195 200 205

Arg Tyr Tyr Phe Gln Trp Asp Arg Thr Leu Ile Pro Ser His Thr Gly
 210 215 220

Thr Ser Gly Thr Pro Thr Asn Ile Tyr His Gly Thr Asp Pro Asp Asp
 225 230 235 240

Val Gln Phe Tyr Thr Ile Glu Asn Ser Val Pro Val His Leu Leu Arg
 245 250 255

Thr Gly Asp Glu Phe Ala Thr Gly Thr Phe Phe Phe Asp Cys Lys Pro
 260 265 270

Cys Arg Leu Thr His Thr Trp Gln Thr Asn Arg Ala Leu Gly Leu Pro
 275 280 285

Pro Phe Leu Asn Ser Leu Pro Gln Ser Glu Gly Ala Thr Asn Phe Gly
 290 295 300

Asp Ile Gly Val Gln Gln Asp Lys Arg Arg Gly Val Thr Gln Met Gly
 305 310 315 320

Asn Thr Asp Tyr Ile Thr Glu Ala Thr Ile Met Arg Pro Ala Glu Val
 325 330 335

Gly Tyr Ser Ala Pro Tyr Tyr Ser Phe Glu Ala Ser Thr Gln Gly Pro
 340 345 350

Phe Lys Ile Pro Ile Ala Ala Gly Arg Gly Gly Ala Gln Thr Asp Glu
 355 360 365

Asn Gln Ala Ala Asp Gly Asp Pro Arg Tyr Ala Phe Gly Arg Gln His
 370 375 380

Gly Gln Lys Thr Thr Thr Thr Gly Glu Thr Pro Glu Arg Phe Thr Tyr
 385 390 395 400

Ile Ala His Gln Asp Thr Gly Arg Tyr Pro Ala Gly Asp Trp Ile Gln
 405 410 415

Asn Ile Asn Phe Asn Leu Pro Val Thr Asn Asp Asn Val Leu Leu Pro
 420 425 430

Thr Asp Pro Ile Gly Gly Lys Thr Gly Ile Asn Tyr Thr Asn Ile Phe
 435 440 445

Asn Thr Tyr Gly Pro Leu Thr Ala Leu Asn Asn Val Pro Pro Val Tyr
 450 455 460

Pro Asn Gly Gln Ile Trp Asp Lys Glu Phe Asp Thr Asp

465

470

475

<210> 13
 <211> 2829
 <212> DNA
 <213> Feline herpesvirus 1

<220>
 <221> CDS
 <222> (1)..(2829)

<400> 13

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cag gga cac agt ggc tat ttt cga cag aga tgt ttt ttc cct tct cta 96
Gln Gly His Ser Gly Tyr Phe Arg Gln Arg Cys Phe Phe Pro Ser Leu
                    20                    25                    30

ctc ggt att gca gcg act ggc tcc aga cat ggt aac gga tcg tcg gga 144
Leu Gly Ile Ala Ala Thr Gly Ser Arg His Gly Asn Gly Ser Ser Gly
                    35                    40                    45

tta acc aga cta gct aga tat gtt tca ttt atc tgg atc gta cta ttc 192
Leu Thr Arg Leu Ala Arg Tyr Val Ser Phe Ile Trp Ile Val Leu Phe
                    50                    55                    60

tta gtc ggt ccc cgt cca gta gag ggt caa tct gga agc aca tcg gaa 240
Leu Val Gly Pro Arg Pro Val Glu Gly Gln Ser Gly Ser Thr Ser Glu
  65                    70                    75                    80

caa ccc cgg cgg act gta gct acc cct gag gta ggg gta cac cac caa 288
Gln Pro Arg Arg Thr Val Ala Thr Pro Glu Val Gly Val His His Gln
                    85                    90                    95

aac caa cta cag atc cca ccg ata tgt cga tat gag gaa gct ctc cgt 336
Asn Gln Leu Gln Ile Pro Pro Ile Cys Arg Tyr Glu Glu Ala Leu Arg
                    100                    105                    110

gcg tcc caa ata gag gct aac gga cca tcg act ttt tat atg tgt cca 384
Ala Ser Gln Ile Glu Ala Asn Gly Pro Ser Thr Phe Tyr Met Cys Pro
                    115                    120                    125

cca cct tca gga tct act gtc gtg cgt tta gag cca cca cgg gcc tgt 432
Pro Pro Ser Gly Ser Thr Val Val Arg Leu Glu Pro Pro Arg Ala Cys
  130                    135                    140

cca gat tat aaa cta ggg aaa aat ttt acc gag ggt ata gct gta ata 480
Pro Asp Tyr Lys Leu Gly Lys Asn Phe Thr Glu Gly Ile Ala Val Ile
  145                    150                    155                    160

ttt aaa gaa aat ata gcg cca tat aaa ttc aag gca aat ata tac tat 528
Phe Lys Glu Asn Ile Ala Pro Tyr Lys Phe Lys Ala Asn Ile Tyr Tyr
                    165                    170                    175

aaa aac att att atg aca acg gta tgg tct ggg agt tcc tat gcc gtt 576
Lys Asn Ile Ile Met Thr Thr Val Trp Ser Gly Ser Ser Tyr Ala Val
                    180                    185                    190
    
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aca acc aac cga tat aca gac agg gtt ccc gtg aaa gtt caa gag att	624
Thr Thr Asn Arg Tyr Thr Asp Arg Val Pro Val Lys Val Gln Glu Ile	
195 200 205	
aca gat ctc ata gat aga cgg ggt atg tgc ctc tcg aaa gct gat tac	672
Thr Asp Leu Ile Asp Arg Arg Gly Met Cys Leu Ser Lys Ala Asp Tyr	
210 215 220	
gtt cgt aac aat tat caa ttt acg gcc ttt gat cga gac gag gat ccc	720
Val Arg Asn Asn Tyr Gln Phe Thr Ala Phe Asp Arg Asp Glu Asp Pro	
225 230 235 240	
aga gaa ctg cct ctg aaa cct cca agt tca aca ctc tcc aga gtc cgt	768
Arg Glu Leu Pro Leu Lys Pro Pro Ser Ser Thr Leu Ser Arg Val Arg	
245 250 255	
gga tgg cac acc aat gaa aca tac aca aag atc gtg ctg ctg gat ttc	816
Gly Trp His Thr Asn Glu Thr Tyr Thr Lys Ile Val Leu Leu Asp Phe	
260 265 270	
cac cac tct ggg acc tct gta aat tgc atc gta gag gaa gtg gat gca	864
His His Ser Gly Thr Ser Val Asn Cys Ile Val Glu Glu Val Asp Ala	
275 280 285	
aga tct gta tat cca tat gac tca ttt gct atc tcc act ggt gac gtg	912
Arg Ser Val Tyr Pro Tyr Asp Ser Phe Ala Ile Ser Thr Gly Asp Val	
290 295 300	
att cac atg tct cca ttc ttt ggg ctg agg gat gga gcc cat gta gaa	960
Ile His Met Ser Pro Phe Phe Gly Leu Arg Asp Gly Ala His Val Glu	
305 310 315 320	
cat act agt tat tct tca gac aga ttt caa caa atc gag gga tac tat	1008
His Thr Ser Tyr Ser Ser Asp Arg Phe Gln Gln Ile Glu Gly Tyr Tyr	
325 330 335	
cca ata gac ttg gat acc gat tac act ggg gca cca gtt tct cgc aat	1056
Pro Ile Asp Leu Asp Thr Asp Tyr Thr Gly Ala Pro Val Ser Arg Asn	
340 345 350	
ttt ttg gaa act ccg cat gtg aca gtg gcc tgg aac tgg acc cca aag	1104
Phe Leu Glu Thr Pro His Val Thr Val Ala Trp Asn Trp Thr Pro Lys	
355 360 365	
tct ggt cgg gta tgt acc tta gcc aaa tgg agg gaa ata gat gaa atg	1152
Ser Gly Arg Val Cys Thr Leu Ala Lys Trp Arg Glu Ile Asp Glu Met	
370 375 380	
cta ccg atg aat ata ggc tcc tat aga ttt aca gcc aag acc ata tcc	1200
Leu Pro Met Asn Ile Gly Ser Tyr Arg Phe Thr Ala Lys Thr Ile Ser	
385 390 395 400	
gct act ttc atc tcc aat act tca caa ttt gaa atc aat cgt atc cgt	1248
Ala Thr Phe Ile Ser Asn Thr Ser Gln Phe Glu Ile Asn Arg Ile Arg	
405 410 415	
ttg ggg gac tgt gcc acc aag gag gca gcc gaa gcc ata gac cgg att	1296
Leu Gly Asp Cys Ala Thr Lys Glu Ala Ala Glu Ala Ile Asp Arg Ile	
420 425 430	

tat aag agt aaa tat agt aaa act cat att cag act gga acc ctg gag	1344
Tyr Lys Ser Lys Tyr Ser Lys Thr His Ile Gln Thr Gly Thr Leu Glu	
435 440 445	
acc tac cta gcc cgt ggg gga ttt cta ata gct ttc cgt ccc atg atc	1392
Thr Tyr Leu Ala Arg Gly Gly Phe Leu Ile Ala Phe Arg Pro Met Ile	
450 455 460	
agc aac gaa cta gca aag tta tat atc aat gaa tta gca cgt tcc aat	1440
Ser Asn Glu Leu Ala Lys Leu Tyr Ile Asn Glu Leu Ala Arg Ser Asn	
465 470 475 480	
cgc acg gta gtg gat ctc agt gca ctc ctc aat cca tct ggg gaa aca	1488
Arg Thr Val Val Asp Leu Ser Ala Leu Leu Asn Pro Ser Gly Glu Thr	
485 490 495	
gta caa cga act aga aga tcg gtc cca tct aat caa cat cat agg tcg	1536
Val Gln Arg Thr Arg Arg Ser Val Pro Ser Asn Gln His His Arg Ser	
500 505 510	
cgg cgc agc aca ata gag ggg ggt ata gaa acc gtg aac aat gca tca	1584
Arg Arg Ser Thr Ile Glu Gly Gly Ile Glu Thr Val Asn Asn Ala Ser	
515 520 525	
ctc ctc aag acc acc tca tct gtg gaa ttc gca atg cta caa ttt gcc	1632
Leu Leu Lys Thr Thr Ser Ser Val Glu Phe Ala Met Leu Gln Phe Ala	
530 535 540	
tat gac tac ata caa gcc cat gta aat gaa atg ttg agt cgg ata gcc	1680
Tyr Asp Tyr Ile Gln Ala His Val Asn Glu Met Leu Ser Arg Ile Ala	
545 550 555 560	
act gcc tgg tgt aca ctt cag aac cgc gaa cat gtg ctg tgg aca gag	1728
Thr Ala Trp Cys Thr Leu Gln Asn Arg Glu His Val Leu Trp Thr Glu	
565 570 575	
acc cta aaa ctc aat ccc ggt ggg gtg gtc tcg atg gcc cta gaa cgt	1776
Thr Leu Lys Leu Asn Pro Gly Gly Val Val Ser Met Ala Leu Glu Arg	
580 585 590	
cgt gta tcc gcg cgc cta ctt gga gat gcc gtc gcc gta aca caa tgt	1824
Arg Val Ser Ala Arg Leu Leu Gly Asp Ala Val Ala Val Thr Gln Cys	
595 600 605	
gtt aac att tct agc gga cat gtc tat atc caa aat tct atg cgg gtg	1872
Val Asn Ile Ser Ser Gly His Val Tyr Ile Gln Asn Ser Met Arg Val	
610 615 620	
acg ggt tca tca acg aca tgt tac agc cgc cct ctt gtt tcc ttc cgt	1920
Thr Gly Ser Ser Thr Thr Cys Tyr Ser Arg Pro Leu Val Ser Phe Arg	
625 630 635 640	
gcc ctc aat gac tcc gaa tac ata gaa gga caa cta ggg gaa aac aat	1968
Ala Leu Asn Asp Ser Glu Tyr Ile Glu Gly Gln Leu Gly Glu Asn Asn	
645 650 655	
gaa ctt ctc gtg gaa cga aaa cta att gag cct tgc act gtc aat aat	2016
Glu Leu Leu Val Glu Arg Lys Leu Ile Glu Pro Cys Thr Val Asn Asn	
660 665 670	
aag cgg tat ttt aag ttt ggg gca gat tat gta tat ttt gag gat tat	2064

Lys Arg Tyr Phe Lys Phe Gly Ala Asp Tyr Val Tyr Phe Glu Asp Tyr
 675 680 685

gcg tat gtc cgt aaa gtc ccg cta tcg gag ata gaa ctg ata agt gcg 2112
 Ala Tyr Val Arg Lys Val Pro Leu Ser Glu Ile Glu Leu Ile Ser Ala
 690 695 700

tat gtg att aaa tct act ctc cta gag gat cgt gaa ttt ctc cac tca 2160
 Tyr Val Ile Lys Ser Thr Leu Leu Glu Asp Arg Glu Phe Leu His Ser
 705 710 715 720

agt tat aca cga gct gag ctg gaa gat acc ggc cct ttt gac tac agc 2208
 Ser Tyr Thr Arg Ala Glu Leu Glu Asp Thr Gly Pro Phe Asp Tyr Ser
 725 730 735

gag att caa cgc cgc aac caa ctc cac gcc tta aaa ttt tat gat ata 2256
 Glu Ile Gln Arg Arg Asn Gln Leu His Ala Leu Lys Phe Tyr Asp Ile
 740 745 750

gac agc ata gtc aga gtg gat aat aat ctt gtc atc atg cgt ggt atg 2304
 Asp Ser Ile Val Arg Val Asp Asn Asn Leu Val Ile Met Arg Gly Met
 755 760 765

gca aat ttt ttt cag gga ctc ggg gat gtg ggg gct ggt ttc ggc aag 2352
 Ala Asn Phe Phe Gln Gly Leu Gly Asp Val Gly Ala Gly Phe Gly Lys
 770 775 780

gtg gtc tta ggg gct gcg agt gcg gta atc tca aca gta tca ggc gta 2400
 Val Val Leu Gly Ala Ala Ser Ala Val Ile Ser Thr Val Ser Gly Val
 785 790 795 800

tca tca ttt cta aac aac cca ttt gga gca ttg gcc gtg gga ctg tta 2448
 Ser Ser Phe Leu Asn Asn Pro Phe Gly Ala Leu Ala Val Gly Leu Leu
 805 810 815

ata tta gct ggc atc gtc gca gca ttc ctg gca tat cgc tat ata tct 2496
 Ile Leu Ala Gly Ile Val Ala Ala Phe Leu Ala Tyr Arg Tyr Ile Ser
 820 825 830

aga tta cgt gca aat cca atg aaa gcc tta tat cct gtg acg act agg 2544
 Arg Leu Arg Ala Asn Pro Met Lys Ala Leu Tyr Pro Val Thr Thr Arg
 835 840 845

aat ttg aaa cag acg gct aag agc ccc gcc tca acg gct ggt ggg gat 2592
 Asn Leu Lys Gln Thr Ala Lys Ser Pro Ala Ser Thr Ala Gly Gly Asp
 850 855 860

agc gac ccg gga gtc gat gac ttc gat gag gaa aag cta atg cag gca 2640
 Ser Asp Pro Gly Val Asp Asp Phe Asp Glu Glu Lys Leu Met Gln Ala
 865 870 875 880

agg gag atg ata aaa tat atg tcc ctc gta tcg gct atg gag caa caa 2688
 Arg Glu Met Ile Lys Tyr Met Ser Leu Val Ser Ala Met Glu Gln Gln
 885 890 895

gaa cat aag gcg atg aaa aag aat aag ggc cca gcg atc cta acg agt 2736
 Glu His Lys Ala Met Lys Lys Asn Lys Gly Pro Ala Ile Leu Thr Ser
 900 905 910

cat ctc act aac atg gcc ctc cgt cgc cgt gga cct aaa tac caa cgc 2784
 His Leu Thr Asn Met Ala Leu Arg Arg Gly Pro Lys Tyr Gln Arg

915 920 925 2829

ctc aat aat ctt gat agc ggt gat gat act gaa aca aat ctt gtc
 Leu Asn Asn Leu Asp Ser Gly Asp Asp Thr Glu Thr Asn Leu Val
 930 935 940

<210> 14
 <211> 943
 <212> PRT
 <213> Feline herpesvirus 1

<400> 14

Met Ser Thr Arg Gly Asp Leu Gly Lys Arg Arg Arg Gly Ser Arg Trp
 1 5 10 15

Gln Gly His Ser Gly Tyr Phe Arg Gln Arg Cys Phe Phe Pro Ser Leu
 20 25 30

Leu Gly Ile Ala Ala Thr Gly Ser Arg His Gly Asn Gly Ser Ser Gly
 35 40 45

Leu Thr Arg Leu Ala Arg Tyr Val Ser Phe Ile Trp Ile Val Leu Phe
 50 55 60

Leu Val Gly Pro Arg Pro Val Glu Gly Gln Ser Gly Ser Thr Ser Glu
 65 70 75 80

Gln Pro Arg Arg Thr Val Ala Thr Pro Glu Val Gly Val His His Gln
 85 90 95

Asn Gln Leu Gln Ile Pro Pro Ile Cys Arg Tyr Glu Glu Ala Leu Arg
 100 105 110

Ala Ser Gln Ile Glu Ala Asn Gly Pro Ser Thr Phe Tyr Met Cys Pro
 115 120 125

Pro Pro Ser Gly Ser Thr Val Val Arg Leu Glu Pro Pro Arg Ala Cys
 130 135 140

Pro Asp Tyr Lys Leu Gly Lys Asn Phe Thr Glu Gly Ile Ala Val Ile
 145 150 155 160

Phe Lys Glu Asn Ile Ala Pro Tyr Lys Phe Lys Ala Asn Ile Tyr Tyr
 165 170 175

Lys Asn Ile Ile Met Thr Thr Val Trp Ser Gly Ser Ser Tyr Ala Val
 180 185 190

Thr Thr Asn Arg Tyr Thr Asp Arg Val Pro Val Lys Val Gln Glu Ile
 195 200 205

Thr Asp Leu Ile Asp Arg Arg Gly Met Cys Leu Ser Lys Ala Asp Tyr
 210 215 220

Val Arg Asn Asn Tyr Gln Phe Thr Ala Phe Asp Arg Asp Glu Asp Pro
 225 230 235 240

Arg Glu Leu Pro Leu Lys Pro Pro Ser Ser Thr Leu Ser Arg Val Arg
 245 250 255

Gly Trp His Thr Asn Glu Thr Tyr Thr Lys Ile Val Leu Leu Asp Phe
 260 265 270

His His Ser Gly Thr Ser Val Asn Cys Ile Val Glu Glu Val Asp Ala
 275 280 285

Arg Ser Val Tyr Pro Tyr Asp Ser Phe Ala Ile Ser Thr Gly Asp Val
 290 295 300

Ile His Met Ser Pro Phe Phe Gly Leu Arg Asp Gly Ala His Val Glu
 305 310 315 320

His Thr Ser Tyr Ser Ser Asp Arg Phe Gln Gln Ile Glu Gly Tyr Tyr
 325 330 335

Pro Ile Asp Leu Asp Thr Asp Tyr Thr Gly Ala Pro Val Ser Arg Asn
 340 345 350

Phe Leu Glu Thr Pro His Val Thr Val Ala Trp Asn Trp Thr Pro Lys
 355 360 365

Ser Gly Arg Val Cys Thr Leu Ala Lys Trp Arg Glu Ile Asp Glu Met
 370 375 380

Leu Pro Met Asn Ile Gly Ser Tyr Arg Phe Thr Ala Lys Thr Ile Ser
 385 390 395 400

Ala Thr Phe Ile Ser Asn Thr Ser Gln Phe Glu Ile Asn Arg Ile Arg
 405 410 415

Leu Gly Asp Cys Ala Thr Lys Glu Ala Ala Glu Ala Ile Asp Arg Ile
 420 425 430

Tyr Lys Ser Lys Tyr Ser Lys Thr His Ile Gln Thr Gly Thr Leu Glu
 435 440 445

Thr Tyr Leu Ala Arg Gly Gly Phe Leu Ile Ala Phe Arg Pro Met Ile
 450 455 460

Ser Asn Glu Leu Ala Lys Leu Tyr Ile Asn Glu Leu Ala Arg Ser Asn
 465 470 475 480

Arg Thr Val Val Asp Leu Ser Ala Leu Leu Asn Pro Ser Gly Glu Thr
 485 490 495

Val Gln Arg Thr Arg Arg Ser Val Pro Ser Asn Gln His His Arg Ser
 500 505 510

Arg Arg Ser Thr Ile Glu Gly Gly Ile Glu Thr Val Asn Asn Ala Ser
 515 520 525

Leu Leu Lys Thr Thr Ser Ser Val Glu Phe Ala Met Leu Gln Phe Ala
 530 535 540

Tyr Asp Tyr Ile Gln Ala His Val Asn Glu Met Leu Ser Arg Ile Ala
 545 550 555 560

Thr Ala Trp Cys Thr Leu Gln Asn Arg Glu His Val Leu Trp Thr Glu
 565 570 575

Thr Leu Lys Leu Asn Pro Gly Gly Val Val Ser Met Ala Leu Glu Arg

			580					585					590			
Arg	Val	Ser	Ala	Arg	Leu	Leu	Gly	Asp	Ala	Val	Ala	Val	Thr	Gln	Cys	
		595					600						605			
Val	Asn	Ile	Ser	Ser	Gly	His	Val	Tyr	Ile	Gln	Asn	Ser	Met	Arg	Val	
	610					615					620					
Thr	Gly	Ser	Ser	Thr	Thr	Cys	Tyr	Ser	Arg	Pro	Leu	Val	Ser	Phe	Arg	
625					630					635					640	
Ala	Leu	Asn	Asp	Ser	Glu	Tyr	Ile	Glu	Gly	Gln	Leu	Gly	Glu	Asn	Asn	
				645					650					655		
Glu	Leu	Leu	Val	Glu	Arg	Lys	Leu	Ile	Glu	Pro	Cys	Thr	Val	Asn	Asn	
			660					665					670			
Lys	Arg	Tyr	Phe	Lys	Phe	Gly	Ala	Asp	Tyr	Val	Tyr	Phe	Glu	Asp	Tyr	
		675					680					685				
Ala	Tyr	Val	Arg	Lys	Val	Pro	Leu	Ser	Glu	Ile	Glu	Leu	Ile	Ser	Ala	
	690					695					700					
Tyr	Val	Ile	Lys	Ser	Thr	Leu	Leu	Glu	Asp	Arg	Glu	Phe	Leu	His	Ser	
705					710					715					720	
Ser	Tyr	Thr	Arg	Ala	Glu	Leu	Glu	Asp	Thr	Gly	Pro	Phe	Asp	Tyr	Ser	
				725					730					735		
Glu	Ile	Gln	Arg	Arg	Asn	Gln	Leu	His	Ala	Leu	Lys	Phe	Tyr	Asp	Ile	
			740					745					750			
Asp	Ser	Ile	Val	Arg	Val	Asp	Asn	Asn	Leu	Val	Ile	Met	Arg	Gly	Met	
		755					760					765				
Ala	Asn	Phe	Phe	Gln	Gly	Leu	Gly	Asp	Val	Gly	Ala	Gly	Phe	Gly	Lys	
	770					775					780					
Val	Val	Leu	Gly	Ala	Ala	Ser	Ala	Val	Ile	Ser	Thr	Val	Ser	Gly	Val	
785					790					795					800	
Ser	Ser	Phe	Leu	Asn	Asn	Pro	Phe	Gly	Ala	Leu	Ala	Val	Gly	Leu	Leu	
				805					810					815		
Ile	Leu	Ala	Gly	Ile	Val	Ala	Ala	Phe	Leu	Ala	Tyr	Arg	Tyr	Ile	Ser	
			820					825					830			
Arg	Leu	Arg	Ala	Asn	Pro	Met	Lys	Ala	Leu	Tyr	Pro	Val	Thr	Thr	Arg	
		835					840						845			
Asn	Leu	Lys	Gln	Thr	Ala	Lys	Ser	Pro	Ala	Ser	Thr	Ala	Gly	Gly	Asp	
	850					855					860					
Ser	Asp	Pro	Gly	Val	Asp	Asp	Phe	Asp	Glu	Glu	Lys	Leu	Met	Gln	Ala	
865					870					875					880	
Arg	Glu	Met	Ile	Lys	Tyr	Met	Ser	Leu	Val	Ser	Ala	Met	Glu	Gln	Gln	
				885					890					895		
Glu	His	Lys	Ala	Met	Lys	Lys	Asn	Lys	Gly	Pro	Ala	Ile	Leu	Thr	Ser	
			900					905					910			

His Leu Thr Asn Met Ala Leu Arg Arg Arg Gly Pro Lys Tyr Gln Arg
 915 920 925

Leu Asn Asn Leu Asp Ser Gly Asp Asp Thr Glu Thr Asn Leu Val
 930 935 940

<210> 15
 <211> 750
 <212> DNA
 <213> Feline herpesvirus 1

<220>
 <221> CDS
 <222> (1)..(750)

<400> 15
 atg tcc act cgt ggc gat ctt ggg aag cgg cga cga ggg agt cgt tgg 48
 Met Ser Thr Arg Gly Asp Leu Gly Lys Arg Arg Arg Gly Ser Arg Trp
 1 5 10 15

cag gga cac agt ggc tat ttt cga cag aga tgt ttt ttc cct tct cta 96
 Gln Gly His Ser Gly Tyr Phe Arg Gln Arg Cys Phe Phe Pro Ser Leu
 20 25 30

ctc ggt att gca gcg act ggc tcc aga cat ggt aac gga tcg tcg gga 144
 Leu Gly Ile Ala Ala Thr Gly Ser Arg His Gly Asn Gly Ser Ser Gly
 35 40 45

tta acc aga cta gct aga tat gtt tca ttt atc tgg atc gta cta ttc 192
 Leu Thr Arg Leu Ala Arg Tyr Val Ser Phe Ile Trp Ile Val Leu Phe
 50 55 60

tta gtc ggt ccc cgt cca gta gag ggt caa tct gga agc aca tcg gaa 240
 Leu Val Gly Pro Arg Pro Val Glu Gly Gln Ser Gly Ser Thr Ser Glu
 65 70 75 80

caa ccc cgg cgg act gta gct acc cct gag gta ggg gta cac cac caa 288
 Gln Pro Arg Arg Thr Val Ala Thr Pro Glu Val Gly Val His His Gln
 85 90 95

aac caa cta cag atc cca ccg ata tgt cga tat gag gaa gct ctc cgt 336
 Asn Gln Leu Gln Ile Pro Pro Ile Cys Arg Tyr Glu Glu Ala Leu Arg
 100 105 110

gcg tcc caa ata gag gct aac gga cca tcg act ttt tat atg tgt cca 384
 Ala Ser Gln Ile Glu Ala Asn Gly Pro Ser Thr Phe Tyr Met Cys Pro
 115 120 125

cca cct tca gga tct act gtc gtg cgt tta gag cca cca cgg gcc tgt 432
 Pro Pro Ser Gly Ser Thr Val Val Arg Leu Glu Pro Pro Arg Ala Cys
 130 135 140

cca gat tat aaa cta ggg aaa aat ttt acc gag ggt ata gct gta ata 480
 Pro Asp Tyr Lys Leu Gly Lys Asn Phe Thr Glu Gly Ile Ala Val Ile
 145 150 155 160

ttt aaa gaa aat ata gcg cca tat aaa ttc aag gca aat ata tac tat 528
 Phe Lys Glu Asn Ile Ala Pro Tyr Lys Phe Lys Ala Asn Ile Tyr Tyr

	165		170		175	
aaa aac att att atg aca acg gta tgg tct ggg agt tcc tat gcc gtt						576
Lys Asn Ile Ile Met Thr Thr Val Trp Ser Gly Ser Ser Tyr Ala Val						
	180		185		190	
aca acc aac cga tat aca gac agg gtt ccc gtg aaa gtt caa gag att						624
Thr Thr Asn Arg Tyr Thr Asp Arg Val Pro Val Lys Val Gln Glu Ile						
	195		200		205	
aca gat ctc ata gat aga cgg ggt atg tgc ctc tcg aaa gct gat tac						672
Thr Asp Leu Ile Asp Arg Arg Gly Met Cys Leu Ser Lys Ala Asp Tyr						
	210		215		220	
gtt cgt aac aat tat caa ttt acg gcc ttt gat cga gac gag gat ccc						720
Val Arg Asn Asn Tyr Gln Phe Thr Ala Phe Asp Arg Asp Glu Asp Pro						
	225		230		235	240
aga gaa ctg cct ctg aaa cct cca agt tca						750
Arg Glu Leu Pro Leu Lys Pro Pro Ser Ser						
	245		250			

<210> 16
 <211> 250
 <212> PRT
 <213> Feline herpesvirus 1

<400> 16
 Met Ser Thr Arg Gly Asp Leu Gly Lys Arg Arg Arg Gly Ser Arg Trp
 1 5 10 15
 Gln Gly His Ser Gly Tyr Phe Arg Gln Arg Cys Phe Phe Pro Ser Leu
 20 25 30
 Leu Gly Ile Ala Ala Thr Gly Ser Arg His Gly Asn Gly Ser Ser Gly
 35 40 45
 Leu Thr Arg Leu Ala Arg Tyr Val Ser Phe Ile Trp Ile Val Leu Phe
 50 55 60
 Leu Val Gly Pro Arg Pro Val Glu Gly Gln Ser Gly Ser Thr Ser Glu
 65 70 75 80
 Gln Pro Arg Arg Thr Val Ala Thr Pro Glu Val Gly Val His His Gln
 85 90 95
 Asn Gln Leu Gln Ile Pro Pro Ile Cys Arg Tyr Glu Glu Ala Leu Arg
 100 105 110
 Ala Ser Gln Ile Glu Ala Asn Gly Pro Ser Thr Phe Tyr Met Cys Pro
 115 120 125
 Pro Pro Ser Gly Ser Thr Val Val Arg Leu Glu Pro Pro Arg Ala Cys
 130 135 140
 Pro Asp Tyr Lys Leu Gly Lys Asn Phe Thr Glu Gly Ile Ala Val Ile
 145 150 155 160
 Phe Lys Glu Asn Ile Ala Pro Tyr Lys Phe Lys Ala Asn Ile Tyr Tyr
 165 170 175

Lys Asn Ile Ile Met Thr Thr Val Trp Ser Gly Ser Ser Tyr Ala Val
 180 185 190

Thr Thr Asn Arg Tyr Thr Asp Arg Val Pro Val Lys Val Gln Glu Ile
 195 200 205

Thr Asp Leu Ile Asp Arg Arg Gly Met Cys Leu Ser Lys Ala Asp Tyr
 210 215 220

Val Arg Asn Asn Tyr Gln Phe Thr Ala Phe Asp Arg Asp Glu Asp Pro
 225 230 235 240

Arg Glu Leu Pro Leu Lys Pro Pro Ser Ser
 245 250

<210> 17
 <211> 1602
 <212> DNA
 <213> Feline herpesvirus 1

<220>
 <221> CDS
 <222> (1)..(1602)

<400> 17
 atg aga cga tat agg atg gga cgc gga atc tac ctt ctc tat atc tgt 48
 Met Arg Arg Tyr Arg Met Gly Arg Gly Ile Tyr Leu Leu Tyr Ile Cys
 1 5 10 15

ctg tta tat aca tat ctc cag ttt ggt act tcg tcg aca acc gcg gtc 96
 Leu Leu Tyr Thr Tyr Leu Gln Phe Gly Thr Ser Ser Thr Thr Ala Val
 20 25 30

agt att gaa aat agt gat aat agt act gcg gag atg tta tca tct acc 144
 Ser Ile Glu Asn Ser Asp Asn Ser Thr Ala Glu Met Leu Ser Ser Thr
 35 40 45

agc atg tcc gct acc acc ccg ata tcc cag cca aca tct cca ttc act 192
 Ser Met Ser Ala Thr Thr Pro Ile Ser Gln Pro Thr Ser Pro Phe Thr
 50 55 60

act cca act aga aga tct aca aat ata gct aca agt tcg agt acc acc 240
 Thr Pro Thr Arg Arg Ser Thr Asn Ile Ala Thr Ser Ser Ser Thr Thr
 65 70 75 80

cag gca tcc cag cca aca tct aca tta act act cta act aga agc tcg 288
 Gln Ala Ser Gln Pro Thr Ser Thr Leu Thr Thr Leu Thr Arg Ser Ser
 85 90 95

aca act ata gct aca agt ccg agt acc acc cag gca gcc aca ttc ata 336
 Thr Thr Ile Ala Thr Ser Pro Ser Thr Thr Gln Ala Ala Thr Phe Ile
 100 105 110

gga tca tct acc gat tcc aat acc act tta ctc aaa aca aca aaa aaa 384
 Gly Ser Ser Thr Asp Ser Asn Thr Thr Leu Leu Lys Thr Thr Lys Lys
 115 120 125

cca aag cgt aaa aag aat aag aat aac ggg gcc aga ttt aaa tta tat 432

Pro Lys Arg Lys Lys Asn Lys Asn Asn Gly Ala Arg Phe Lys Leu Tyr
 130 135 140

tgt gga tat aag ggg gtt atc tac aga ccg tat ttt agc cct ctt cag 480
 Cys Gly Tyr Lys Gly Val Ile Tyr Arg Pro Tyr Phe Ser Pro Leu Gln
 145 150 155 160

cta aac tgt act cta ccc aca gaa cct cat att acc aac cct att gac 528
 Leu Asn Cys Thr Leu Pro Thr Glu Pro His Ile Thr Asn Pro Ile Asp
 165 170 175

ttc gag atc tgg ttt aaa cca cgc acc aga ttt ggg gat ttt ctt ggg 576
 Phe Glu Ile Trp Phe Lys Pro Arg Thr Arg Phe Gly Asp Phe Leu Gly
 180 185 190

gat aaa gaa gac ttc gta ggg aat cat acc cgc acc agc ata tta cta 624
 Asp Lys Glu Asp Phe Val Gly Asn His Thr Arg Thr Ser Ile Leu Leu
 195 200 205

ttt agc agc cgt aat ggg agt gtt aat tcc atg gat ctt ggg gac gcg 672
 Phe Ser Ser Arg Asn Gly Ser Val Asn Ser Met Asp Leu Gly Asp Ala
 210 215 220

aca ctc ggg atc cta caa tct agg ata cca gat tac aca tta tat aat 720
 Thr Leu Gly Ile Leu Gln Ser Arg Ile Pro Asp Tyr Thr Leu Tyr Asn
 225 230 235 240

att ccc ata caa cat acc gaa gcg atg tca ttg gga atc aaa tct gtg 768
 Ile Pro Ile Gln His Thr Glu Ala Met Ser Leu Gly Ile Lys Ser Val
 245 250 255

gaa tct gcc acg tcc ggt gtt tat aca tgg cgg gtc tat ggt gga gat 816
 Glu Ser Ala Thr Ser Gly Val Tyr Thr Trp Arg Val Tyr Gly Gly Asp
 260 265 270

gta cta aat aaa aca gtg cta gga cag gta aat gta tct gta gtg gca 864
 Val Leu Asn Lys Thr Val Leu Gly Gln Val Asn Val Ser Val Val Ala
 275 280 285

tat cac ccc ccg agc gta aat ctt aca cca cgc gcc agt cta ttt aat 912
 Tyr His Pro Pro Ser Val Asn Leu Thr Pro Arg Ala Ser Leu Phe Asn
 290 295 300

aag acc ttt gag gcg gta tgt gca gtg gcg aat tac ttc ccc ccg cga 960
 Lys Thr Phe Glu Ala Val Cys Ala Val Ala Asn Tyr Phe Pro Pro Arg
 305 310 315 320

tcc acg aaa cta aca tgg tat ctt gac ggg aag cca ata gaa agg caa 1008
 Ser Thr Lys Leu Thr Trp Tyr Leu Asp Gly Lys Pro Ile Glu Arg Gln
 325 330 335

tac att tca gat acg gca agt gta tgg ata gat gga ctc atc acc aga 1056
 Tyr Ile Ser Asp Thr Ala Ser Val Trp Ile Asp Gly Leu Ile Thr Arg
 340 345 350

agt tct gtg ttg gct att ccg aca act gaa aca gat tcc gag aaa cca 1104
 Ser Ser Val Leu Ala Ile Pro Thr Thr Glu Thr Asp Ser Glu Lys Pro
 355 360 365

gat ata cga tgt gat ttg gaa tgg cat gaa agt cct gtg tcc tat aag 1152
 Asp Ile Arg Cys Asp Leu Glu Trp His Glu Ser Pro Val Ser Tyr Lys

370	375	380	
aga ttc acg aaa agt gta gcc ccg gac gtc tat tac cca cct act gtg			1200
Arg Phe Thr Lys Ser Val Ala Pro Asp Val Tyr Tyr Pro Pro Thr Val			
385	390	395	400
tct gtt acc ttc gct gat aca cgg gct ata tgt gat gtt aaa tgt gta			1248
Ser Val Thr Phe Ala Asp Thr Arg Ala Ile Cys Asp Val Lys Cys Val			
	405	410	415
cca cgg gac ggg ata tcc ttg atg tgg aaa att ggt aac tac cat cta			1296
Pro Arg Asp Gly Ile Ser Leu Met Trp Lys Ile Gly Asn Tyr His Leu			
	420	425	430
cca aaa gca atg agt gct gat ata ctg atc aca ggt ccg tgt ata gaa			1344
Pro Lys Ala Met Ser Ala Asp Ile Leu Ile Thr Gly Pro Cys Ile Glu			
	435	440	445
cg t cca ggt ttg gtc aac att cag agt atg tgt gat ata tca gaa acg			1392
Arg Pro Gly Leu Val Asn Ile Gln Ser Met Cys Asp Ile Ser Glu Thr			
	450	455	460
gat gga ccc gtg agt tat acc tgt cag acc atc gga tac cca cca att			1440
Asp Gly Pro Val Ser Tyr Thr Cys Gln Thr Ile Gly Tyr Pro Pro Ile			
	465	470	475
cta ccg gga ttt tac gac aca caa gtc tac gac gcg tcc cct gaa atc			1488
Leu Pro Gly Phe Tyr Asp Thr Gln Val Tyr Asp Ala Ser Pro Glu Ile			
	485	490	495
gtc agt gaa tca atg ttg gtt agt gtc gtt gct gta ata cta gga gct			1536
Val Ser Glu Ser Met Leu Val Ser Val Val Ala Val Ile Leu Gly Ala			
	500	505	510
gtt ctc atc aca gtc ttt atc ttt att acg gca tta tgt tta tat tat			1584
Val Leu Ile Thr Val Phe Ile Phe Ile Thr Ala Leu Cys Leu Tyr Tyr			
	515	520	525
tct cat ccc cgg cga tta			1602
Ser His Pro Arg Arg Leu			
	530		

<210> 18
 <211> 534
 <212> PRT
 <213> Feline herpesvirus 1

<400> 18
 Met Arg Arg Tyr Arg Met Gly Arg Gly Ile Tyr Leu Leu Tyr Ile Cys
 1 5 10 15
 Leu Leu Tyr Thr Tyr Leu Gln Phe Gly Thr Ser Ser Thr Thr Ala Val
 20 25 30
 Ser Ile Glu Asn Ser Asp Asn Ser Thr Ala Glu Met Leu Ser Ser Thr
 35 40 45
 Ser Met Ser Ala Thr Thr Pro Ile Ser Gln Pro Thr Ser Pro Phe Thr
 50 55 60

Thr Pro Thr Arg Arg Ser Thr Asn Ile Ala Thr Ser Ser Ser Thr Thr
 65 70 75 80

Gln Ala Ser Gln Pro Thr Ser Thr Leu Thr Thr Leu Thr Arg Ser Ser
 85 90 95

Thr Thr Ile Ala Thr Ser Pro Ser Thr Thr Gln Ala Ala Thr Phe Ile
 100 105 110

Gly Ser Ser Thr Asp Ser Asn Thr Thr Leu Leu Lys Thr Thr Lys Lys
 115 120 125

Pro Lys Arg Lys Lys Asn Lys Asn Asn Gly Ala Arg Phe Lys Leu Tyr
 130 135 140

Cys Gly Tyr Lys Gly Val Ile Tyr Arg Pro Tyr Phe Ser Pro Leu Gln
 145 150 155 160

Leu Asn Cys Thr Leu Pro Thr Glu Pro His Ile Thr Asn Pro Ile Asp
 165 170 175

Phe Glu Ile Trp Phe Lys Pro Arg Thr Arg Phe Gly Asp Phe Leu Gly
 180 185 190

Asp Lys Glu Asp Phe Val Gly Asn His Thr Arg Thr Ser Ile Leu Leu
 195 200 205

Phe Ser Ser Arg Asn Gly Ser Val Asn Ser Met Asp Leu Gly Asp Ala
 210 215 220

Thr Leu Gly Ile Leu Gln Ser Arg Ile Pro Asp Tyr Thr Leu Tyr Asn
 225 230 235 240

Ile Pro Ile Gln His Thr Glu Ala Met Ser Leu Gly Ile Lys Ser Val
 245 250 255

Glu Ser Ala Thr Ser Gly Val Tyr Thr Trp Arg Val Tyr Gly Gly Asp
 260 265 270

Val Leu Asn Lys Thr Val Leu Gly Gln Val Asn Val Ser Val Val Ala
 275 280 285

Tyr His Pro Pro Ser Val Asn Leu Thr Pro Arg Ala Ser Leu Phe Asn
 290 295 300

Lys Thr Phe Glu Ala Val Cys Ala Val Ala Asn Tyr Phe Pro Pro Arg
 305 310 315 320

Ser Thr Lys Leu Thr Trp Tyr Leu Asp Gly Lys Pro Ile Glu Arg Gln
 325 330 335

Tyr Ile Ser Asp Thr Ala Ser Val Trp Ile Asp Gly Leu Ile Thr Arg
 340 345 350

Ser Ser Val Leu Ala Ile Pro Thr Thr Glu Thr Asp Ser Glu Lys Pro
 355 360 365

Asp Ile Arg Cys Asp Leu Glu Trp His Glu Ser Pro Val Ser Tyr Lys
 370 375 380

Arg Phe Thr Lys Ser Val Ala Pro Asp Val Tyr Tyr Pro Pro Thr Val

gga tca tct acc gat tcc aat acc act tta ctc aaa aca aca aaa aaa 288
 Gly Ser Ser Thr Asp Ser Asn Thr Thr Leu Leu Lys Thr Thr Lys Lys
 85 90 95

cca aag cgt aaa aag aat aag aat aac ggg gcc aga ttt aaa tta tat 336
 Pro Lys Arg Lys Lys Asn Lys Asn Asn Gly Ala Arg Phe Lys Leu Tyr
 100 105 110

tgt gga tat aag ggg gtt atc tac aga ccg tat ttt agc cct ctt cag 384
 Cys Gly Tyr Lys Gly Val Ile Tyr Arg Pro Tyr Phe Ser Pro Leu Gln
 115 120 125

cta aac tgt act cta ccc aca gaa cct cat att acc aac cct att gac 432
 Leu Asn Cys Thr Leu Pro Thr Glu Pro His Ile Thr Asn Pro Ile Asp
 130 135 140

ttc gag atc tgg ttt aaa cca cgc acc aga ttt ggg gat ttt ctt ggg 480
 Phe Glu Ile Trp Phe Lys Pro Arg Thr Arg Phe Gly Asp Phe Leu Gly
 145 150 155 160

gat aaa gaa gac ttc gta ggg aat cat acc cgc acc agc ata tta cta 528
 Asp Lys Glu Asp Phe Val Gly Asn His Thr Arg Thr Ser Ile Leu Leu
 165 170 175

ttt agc agc cgt aat ggg agt gtt aat tcc atg gat ctt ggg gac gcg 576
 Phe Ser Ser Arg Asn Gly Ser Val Asn Ser Met Asp Leu Gly Asp Ala
 180 185 190

aca ctc ggg atc cta caa tct agg ata cca gat tac aca tta tat aat 624
 Thr Leu Gly Ile Leu Gln Ser Arg Ile Pro Asp Tyr Thr Leu Tyr Asn
 195 200 205

att ccc ata caa cat acc gaa gcg atg tca ttg gga atc aaa tct gtg 672
 Ile Pro Ile Gln His Thr Glu Ala Met Ser Leu Gly Ile Lys Ser Val
 210 215 220

gaa tct gcc acg tcc ggt gtt tat aca tgg cgg gtc tat ggt gga gat 720
 Glu Ser Ala Thr Ser Gly Val Tyr Thr Trp Arg Val Tyr Gly Gly Asp
 225 230 235 240

gta cta aat aaa aca gtg cta gga cag gta aat gta tct gta gtg gca 768
 Val Leu Asn Lys Thr Val Leu Gly Gln Val Asn Val Ser Val Val Ala
 245 250 255

tat cac ccc ccg agc gta aat ctt aca cca cgc gcc agt cta ttt aat 816
 Tyr His Pro Pro Ser Val Asn Leu Thr Pro Arg Ala Ser Leu Phe Asn
 260 265 270

aag acc ttt gag gcg gta tgt gca gtg gcg aat tac ttc ccc ccg cga 864
 Lys Thr Phe Glu Ala Val Cys Ala Val Ala Asn Tyr Phe Pro Pro Arg
 275 280 285

tcc acg aaa cta aca tgg tat ctt gac ggg aag cca ata gaa agg caa 912
 Ser Thr Lys Leu Thr Trp Tyr Leu Asp Gly Lys Pro Ile Glu Arg Gln
 290 295 300

tac att tca gat acg gca agt gta tgg ata gat gga ctc atc acc aga 960
 Tyr Ile Ser Asp Thr Ala Ser Val Trp Ile Asp Gly Leu Ile Thr Arg
 305 310 315 320

agt tct gtg ttg gct att ccg aca act gaa aca gat tcc gag aaa cca 1008

Ser Ser Val Leu Ala Ile Pro Thr Thr Glu Thr Asp Ser Glu Lys Pro
 325 330 335

gat ata cga tgt gat ttg gaa tgg cat gaa agt cct gtg tcc tat aag 1056
 Asp Ile Arg Cys Asp Leu Glu Trp His Glu Ser Pro Val Ser Tyr Lys
 340 345 350

aga ttc acg aaa agt gta gcc ccg gac gtc tat tac cca cct act gtg 1104
 Arg Phe Thr Lys Ser Val Ala Pro Asp Val Tyr Tyr Pro Pro Thr Val
 355 360 365

tct gtt acc ttc gct gat aca cgg gct ata tgt gat gtt aaa tgt gta 1152
 Ser Val Thr Phe Ala Asp Thr Arg Ala Ile Cys Asp Val Lys Cys Val
 370 375 380

cca cgg gac ggg ata tcc ttg atg tgg aaa att ggt aac tac cat cta 1200
 Pro Arg Asp Gly Ile Ser Leu Met Trp Lys Ile Gly Asn Tyr His Leu
 385 390 395 400

cca aaa gca atg agt gct gat ata ctg atc aca ggt ccg tgt ata gaa 1248
 Pro Lys Ala Met Ser Ala Asp Ile Leu Ile Thr Gly Pro Cys Ile Glu
 405 410 415

cgt cca ggt ttg gtc aac att cag agt atg tgt gat ata tca gaa acg 1296
 Arg Pro Gly Leu Val Asn Ile Gln Ser Met Cys Asp Ile Ser Glu Thr
 420 425 430

gat gga ccc gtg agt tat acc tgt cag acc atc gga tac cca cca att 1344
 Asp Gly Pro Val Ser Tyr Thr Cys Gln Thr Ile Gly Tyr Pro Pro Ile
 435 440 445

cta ccg gga ttt tac gac aca caa gtc tac gac gcg tcc cct gaa atc 1392
 Leu Pro Gly Phe Tyr Asp Thr Gln Val Tyr Asp Ala Ser Pro Glu Ile
 450 455 460

gtc agt gaa 1401
 Val Ser Glu
 465

<210> 20
 <211> 467
 <212> PRT
 <213> Feline herpesvirus 1

<400> 20
 Ser Ile Glu Asn Ser Asp Asn Ser Thr Ala Glu Met Leu Ser Ser Thr
 1 5 10 15

Ser Met Ser Ala Thr Thr Pro Ile Ser Gln Pro Thr Ser Pro Phe Thr
 20 25 30

Thr Pro Thr Arg Arg Ser Thr Asn Ile Ala Thr Ser Ser Ser Thr Thr
 35 40 45

Gln Ala Ser Gln Pro Thr Ser Thr Leu Thr Thr Leu Thr Arg Ser Ser
 50 55 60

Thr Thr Ile Ala Thr Ser Pro Ser Thr Thr Gln Ala Ala Thr Phe Ile
 65 70 75 80

Gly Ser Ser Thr Asp Ser Asn Thr Thr Leu Leu Lys Thr Thr Lys Lys
 85 90 95

Pro Lys Arg Lys Lys Asn Lys Asn Asn Gly Ala Arg Phe Lys Leu Tyr
 100 105 110

Cys Gly Tyr Lys Gly Val Ile Tyr Arg Pro Tyr Phe Ser Pro Leu Gln
 115 120 125

Leu Asn Cys Thr Leu Pro Thr Glu Pro His Ile Thr Asn Pro Ile Asp
 130 135 140

Phe Glu Ile Trp Phe Lys Pro Arg Thr Arg Phe Gly Asp Phe Leu Gly
 145 150 155 160

Asp Lys Glu Asp Phe Val Gly Asn His Thr Arg Thr Ser Ile Leu Leu
 165 170 175

Phe Ser Ser Arg Asn Gly Ser Val Asn Ser Met Asp Leu Gly Asp Ala
 180 185 190

Thr Leu Gly Ile Leu Gln Ser Arg Ile Pro Asp Tyr Thr Leu Tyr Asn
 195 200 205

Ile Pro Ile Gln His Thr Glu Ala Met Ser Leu Gly Ile Lys Ser Val
 210 215 220

Glu Ser Ala Thr Ser Gly Val Tyr Thr Trp Arg Val Tyr Gly Gly Asp
 225 230 235 240

Val Leu Asn Lys Thr Val Leu Gly Gln Val Asn Val Ser Val Val Ala
 245 250 255

Tyr His Pro Pro Ser Val Asn Leu Thr Pro Arg Ala Ser Leu Phe Asn
 260 265 270

Lys Thr Phe Glu Ala Val Cys Ala Val Ala Asn Tyr Phe Pro Pro Arg
 275 280 285

Ser Thr Lys Leu Thr Trp Tyr Leu Asp Gly Lys Pro Ile Glu Arg Gln
 290 295 300

Tyr Ile Ser Asp Thr Ala Ser Val Trp Ile Asp Gly Leu Ile Thr Arg
 305 310 315 320

Ser Ser Val Leu Ala Ile Pro Thr Thr Glu Thr Asp Ser Glu Lys Pro
 325 330 335

Asp Ile Arg Cys Asp Leu Glu Trp His Glu Ser Pro Val Ser Tyr Lys
 340 345 350

Arg Phe Thr Lys Ser Val Ala Pro Asp Val Tyr Tyr Pro Pro Thr Val
 355 360 365

Ser Val Thr Phe Ala Asp Thr Arg Ala Ile Cys Asp Val Lys Cys Val
 370 375 380

Pro Arg Asp Gly Ile Ser Leu Met Trp Lys Ile Gly Asn Tyr His Leu
 385 390 395 400

Pro Lys Ala Met Ser Ala Asp Ile Leu Ile Thr Gly Pro Cys Ile Glu

405 410 415
 Arg Pro Gly Leu Val Asn Ile Gln Ser Met Cys Asp Ile Ser Glu Thr
 420 425 430
 Asp Gly Pro Val Ser Tyr Thr Cys Gln Thr Ile Gly Tyr Pro Pro Ile
 435 440 445
 Leu Pro Gly Phe Tyr Asp Thr Gln Val Tyr Asp Ala Ser Pro Glu Ile
 450 455 460
 Val Ser Glu
 465

<210> 21
 <211> 1401
 <212> DNA
 <213> Feline herpesvirus 1

<220>
 <221> CDS
 <222> (1)..(1401)

<400> 21
 atg tcc atc gaa aac agc gat aat agt act gcg gag atg tta tca tct 48
 Met Ser Ile Glu Asn Ser Asp Asn Ser Thr Ala Glu Met Leu Ser Ser
 1 5 10 15
 acc agc atg tcc gct acc acc ccg ata tcc cag cca aca tct cca ttc 96
 Thr Ser Met Ser Ala Thr Thr Pro Ile Ser Gln Pro Thr Ser Pro Phe
 20 25 30
 act act cca act cgt cgc tct aca aat ata gct aca tcc tct tcc acc 144
 Thr Thr Pro Thr Arg Arg Ser Thr Asn Ile Ala Thr Ser Ser Ser Thr
 35 40 45
 acc cag gca tcc cag cca aca tct aca tta act act cta act aga agc 192
 Thr Gln Ala Ser Gln Pro Thr Ser Thr Leu Thr Thr Leu Thr Arg Ser
 50 55 60
 tcg aca act ata gct aca agt ccg agt acc acc cag gca gcc aca ttc 240
 Ser Thr Thr Ile Ala Thr Ser Pro Ser Thr Thr Gln Ala Ala Thr Phe
 65 70 75 80
 ata gga tca tct acc gat tcc aat acc act tta ctc aaa aca aca aaa 288
 Ile Gly Ser Ser Thr Asp Ser Asn Thr Thr Leu Leu Lys Thr Thr Lys
 85 90 95
 aaa cca aag cgt aaa aag aat aag aat aac ggg gcc aga ttt aaa tta 336
 Lys Pro Lys Arg Lys Lys Asn Lys Asn Asn Gly Ala Arg Phe Lys Leu
 100 105 110
 gat tgt gga tat aag ggg gtt atc tac aga ccg tat ttt agc cct ctt 384
 Asp Cys Gly Tyr Lys Gly Val Ile Tyr Arg Pro Tyr Phe Ser Pro Leu
 115 120 125
 cag cta aac tgt act cta ccc aca gaa cct cat att acc aac cct att 432
 Gln Leu Asn Cys Thr Leu Pro Thr Glu Pro His Ile Thr Asn Pro Ile
 130 135 140

gac ttc gag atc tgg ttt aaa cca cgc acc aga ttt ggg gat ttt ctt 480
 Asp Phe Glu Ile Trp Phe Lys Pro Arg Thr Arg Phe Gly Asp Phe Leu
 145 150 155 160

ggg gat aaa gaa gac ttc gta ggg aat cat acc cgc acc agc ata tta 528
 Gly Asp Lys Glu Asp Phe Val Gly Asn His Thr Arg Thr Ser Ile Leu
 165 170 175

cta ttt agc agc cgt aat ggg agt gtt aat tcc atg gat ctt ggg gac 576
 Leu Phe Ser Ser Arg Asn Gly Ser Val Asn Ser Met Asp Leu Gly Asp
 180 185 190

gcg aca ctc ggg atc cta caa tct agg ata cca gat tac aca tta tat 624
 Ala Thr Leu Gly Ile Leu Gln Ser Arg Ile Pro Asp Tyr Thr Leu Tyr
 195 200 205

aat att ccc ata caa cat acc gaa gcg atg tca ttg gga atc aaa tct 672
 Asn Ile Pro Ile Gln His Thr Glu Ala Met Ser Leu Gly Ile Lys Ser
 210 215 220

gtg gaa tct gcc act tct ggt gtt tat aca tgg cgt gtc tat ggt gga 720
 Val Glu Ser Ala Thr Ser Gly Val Tyr Thr Trp Arg Val Tyr Gly Gly
 225 230 235 240

gat ggt ctg aac aaa aca gtg ctg ggt cag gta aat gta tct gta gtg 768
 Asp Gly Leu Asn Lys Thr Val Leu Gly Gln Val Asn Val Ser Val Val
 245 250 255

gca tat cac ccc ccg agc gta aat ctt aca cca cgc gcc agt cta ttt 816
 Ala Tyr His Pro Pro Ser Val Asn Leu Thr Pro Arg Ala Ser Leu Phe
 260 265 270

aat aag acc ttt gag gcg gta tgt gca gtg gcg aat tac ttc ccc ccg 864
 Asn Lys Thr Phe Glu Ala Val Cys Ala Val Ala Asn Tyr Phe Pro Pro
 275 280 285

cga tcc acg aaa cta aca tgg tat ctt gac ggg aag cca ata gaa agg 912
 Arg Ser Thr Lys Leu Thr Trp Tyr Leu Asp Gly Lys Pro Ile Glu Arg
 290 295 300

caa tac att tca gat acg gca agt gta tgg ata gat gga ctc atc acc 960
 Gln Tyr Ile Ser Asp Thr Ala Ser Val Trp Ile Asp Gly Leu Ile Thr
 305 310 315 320

aga agt tct gtg ttg gct att ccg aca act gaa aca gat tcc gag aaa 1008
 Arg Ser Ser Val Leu Ala Ile Pro Thr Thr Glu Thr Asp Ser Glu Lys
 325 330 335

cca gat ata cga tgt gat ttg gaa tgg cat gaa agt cct gtg tcc tat 1056
 Pro Asp Ile Arg Cys Asp Leu Glu Trp His Glu Ser Pro Val Ser Tyr
 340 345 350

aag aga ttc acg aaa agt gta gcc ccg gac gtc tat tac cca cct act 1104
 Lys Arg Phe Thr Lys Ser Val Ala Pro Asp Val Tyr Tyr Pro Pro Thr
 355 360 365

gtg tct gtt acc ttc gct gat aca cgg gct ata tgt gat gtt aaa tgt 1152
 Val Ser Val Thr Phe Ala Asp Thr Arg Ala Ile Cys Asp Val Lys Cys
 370 375 380

gta cca cgg gac ggg ata tcc ttg atg tgg aaa att ggt aac tac cat 1200
 Val Pro Arg Asp Gly Ile Ser Leu Met Trp Lys Ile Gly Asn Tyr His
 385 390 395 400

cta cca aaa gca atg agt gct gat ata ctg atc aca ggt ccg tgt ata 1248
 Leu Pro Lys Ala Met Ser Ala Asp Ile Leu Ile Thr Gly Pro Cys Ile
 405 410 415

gaa cgt cca ggt ttg gtc aac att cag agt atg tgt gat ata tca gaa 1296
 Glu Arg Pro Gly Leu Val Asn Ile Gln Ser Met Cys Asp Ile Ser Glu
 420 425 430

acg gat gga ccc gtg agt tat acc tgt cag acc atc gga tac cca cca 1344
 Thr Asp Gly Pro Val Ser Tyr Thr Cys Gln Thr Ile Gly Tyr Pro Pro
 435 440 445

att cta ccg gga ttt tac gac aca caa gtc tac gac gcg tcc cct gaa 1392
 Ile Leu Pro Gly Phe Tyr Asp Thr Gln Val Tyr Asp Ala Ser Pro Glu
 450 455 460

atc gtc tcc 1401
 Ile Val Ser
 465

<210> 22
 <211> 467
 <212> PRT
 <213> Feline herpesvirus 1

<400> 22
 Met Ser Ile Glu Asn Ser Asp Asn Ser Thr Ala Glu Met Leu Ser Ser
 1 5 10 15

Thr Ser Met Ser Ala Thr Thr Pro Ile Ser Gln Pro Thr Ser Pro Phe
 20 25 30

Thr Thr Pro Thr Arg Arg Ser Thr Asn Ile Ala Thr Ser Ser Ser Thr
 35 40 45

Thr Gln Ala Ser Gln Pro Thr Ser Thr Leu Thr Thr Leu Thr Arg Ser
 50 55 60

Ser Thr Thr Ile Ala Thr Ser Pro Ser Thr Thr Gln Ala Ala Thr Phe
 65 70 75 80

Ile Gly Ser Ser Thr Asp Ser Asn Thr Thr Leu Leu Lys Thr Thr Lys
 85 90 95

Lys Pro Lys Arg Lys Lys Asn Lys Asn Asn Gly Ala Arg Phe Lys Leu
 100 105 110

Asp Cys Gly Tyr Lys Gly Val Ile Tyr Arg Pro Tyr Phe Ser Pro Leu
 115 120 125

Gln Leu Asn Cys Thr Leu Pro Thr Glu Pro His Ile Thr Asn Pro Ile
 130 135 140

Asp Phe Glu Ile Trp Phe Lys Pro Arg Thr Arg Phe Gly Asp Phe Leu
 145 150 155 160

Gly Asp Lys Glu Asp Phe Val Gly Asn His Thr Arg Thr Ser Ile Leu
 165 170 175

Leu Phe Ser Ser Arg Asn Gly Ser Val Asn Ser Met Asp Leu Gly Asp
 180 185 190

Ala Thr Leu Gly Ile Leu Gln Ser Arg Ile Pro Asp Tyr Thr Leu Tyr
 195 200 205

Asn Ile Pro Ile Gln His Thr Glu Ala Met Ser Leu Gly Ile Lys Ser
 210 215 220

Val Glu Ser Ala Thr Ser Gly Val Tyr Thr Trp Arg Val Tyr Gly Gly
 225 230 235 240

Asp Gly Leu Asn Lys Thr Val Leu Gly Gln Val Asn Val Ser Val Val
 245 250 255

Ala Tyr His Pro Pro Ser Val Asn Leu Thr Pro Arg Ala Ser Leu Phe
 260 265 270

Asn Lys Thr Phe Glu Ala Val Cys Ala Val Ala Asn Tyr Phe Pro Pro
 275 280 285

Arg Ser Thr Lys Leu Thr Trp Tyr Leu Asp Gly Lys Pro Ile Glu Arg
 290 295 300

Gln Tyr Ile Ser Asp Thr Ala Ser Val Trp Ile Asp Gly Leu Ile Thr
 305 310 315 320

Arg Ser Ser Val Leu Ala Ile Pro Thr Thr Glu Thr Asp Ser Glu Lys
 325 330 335

Pro Asp Ile Arg Cys Asp Leu Glu Trp His Glu Ser Pro Val Ser Tyr
 340 345 350

Lys Arg Phe Thr Lys Ser Val Ala Pro Asp Val Tyr Tyr Pro Pro Thr
 355 360 365

Val Ser Val Thr Phe Ala Asp Thr Arg Ala Ile Cys Asp Val Lys Cys
 370 375 380

Val Pro Arg Asp Gly Ile Ser Leu Met Trp Lys Ile Gly Asn Tyr His
 385 390 395 400

Leu Pro Lys Ala Met Ser Ala Asp Ile Leu Ile Thr Gly Pro Cys Ile
 405 410 415

Glu Arg Pro Gly Leu Val Asn Ile Gln Ser Met Cys Asp Ile Ser Glu
 420 425 430

Thr Asp Gly Pro Val Ser Tyr Thr Cys Gln Thr Ile Gly Tyr Pro Pro
 435 440 445

Ile Leu Pro Gly Phe Tyr Asp Thr Gln Val Tyr Asp Ala Ser Pro Glu
 450 455 460

Ile Val Ser
 465

<210> 23
 <211> 1122
 <212> DNA
 <213> Feline herpesvirus 1

<220>
 <221> CDS
 <222> (1)..(1122)

<400> 23

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atg atg aca cgt cta cat ttt tgg tgg tgt gga atc ttt gcg gtc ctg 48
Met Met Thr Arg Leu His Phe Trp Trp Cys Gly Ile Phe Ala Val Leu
    1                    5                    10                    15

aaa tat ctg gta tgt act tca agc ctt acg acc acg cca aaa aca act 96
Lys Tyr Leu Val Cys Thr Ser Ser Leu Thr Thr Thr Pro Lys Thr Thr
                20                    25                    30

acg gtt tat gtg aag gga ttt aat ata cct cca cta cgc tac aat tat 144
Thr Val Tyr Val Lys Gly Phe Asn Ile Pro Pro Leu Arg Tyr Asn Tyr
                35                    40                    45

act caa gcc aga atc gtg cca aaa att ccc cag gcg atg gat ccg aag 192
Thr Gln Ala Arg Ile Val Pro Lys Ile Pro Gln Ala Met Asp Pro Lys
    50                    55                    60

ata aca gct gaa gta cgt tat gta aca tca atg gat tca tgt ggg atg 240
Ile Thr Ala Glu Val Arg Tyr Val Thr Ser Met Asp Ser Cys Gly Met
    65                    70                    75                    80

gtg gca ttg ata tca gag ccg gat ata gac gct act att cga acc ata 288
Val Ala Leu Ile Ser Glu Pro Asp Ile Asp Ala Thr Ile Arg Thr Ile
                85                    90                    95

caa cta tct caa aaa aaa aca tat aac gcg act ata agt tgg ttt aag 336
Gln Leu Ser Gln Lys Lys Thr Tyr Asn Ala Thr Ile Ser Trp Phe Lys
                100                    105                    110

gta acc cag ggt tgt gaa tac cct atg ttt ctt atg gat atg aga ctt 384
Val Thr Gln Gly Cys Glu Tyr Pro Met Phe Leu Met Asp Met Arg Leu
                115                    120                    125

tgt gat cct aaa cgg gaa ttt gga ata tgt gct tta cgg tcg cct tca 432
Cys Asp Pro Lys Arg Glu Phe Gly Ile Cys Ala Leu Arg Ser Pro Ser
    130                    135                    140

tat tgg ttg gaa cct tta aca aag tat atg ttc cta aca gac gat gaa 480
Tyr Trp Leu Glu Pro Leu Thr Lys Tyr Met Phe Leu Thr Asp Asp Glu
    145                    150                    155                    160

ctg ggt ttg att atg atg gcc ccg gcc caa ttt aat caa gga caa tat 528
Leu Gly Leu Ile Met Met Ala Pro Ala Gln Phe Asn Gln Gly Gln Tyr
                165                    170                    175

cga aga gtt ata acc atc gat ggt tcc atg ttt tat aca gat ttt atg 576
Arg Arg Val Ile Thr Ile Asp Gly Ser Met Phe Tyr Thr Asp Phe Met
                180                    185                    190

gta caa cta tct cca acg cca tgt tgg ttc gca aaa ccc gat aga tac 624
Val Gln Leu Ser Pro Thr Pro Cys Trp Phe Ala Lys Pro Asp Arg Tyr
    
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195	200	205	
gaa gag att cta cat gaa tgg tgt cga aat gtt aaa act att ggc ctt			672
Glu Glu Ile Leu His Glu Trp Cys Arg Asn Val Lys Thr Ile Gly Leu			
210	215	220	
gat gga gct cgt gat tac cac tat tat tgg gta ccc tat aac cca caa			720
Asp Gly Ala Arg Asp Tyr His Tyr Tyr Trp Val Pro Tyr Asn Pro Gln			
225	230	235	240
cct cac cat aaa gcc gta ctc tta tat tgg tat cgg act cat ggc cga			768
Pro His His Lys Ala Val Leu Leu Tyr Trp Tyr Arg Thr His Gly Arg			
245	250	255	
gaa ccc cca gta aga ttc caa gag gcc att cga tat gat cgt ccc gcc			816
Glu Pro Pro Val Arg Phe Gln Glu Ala Ile Arg Tyr Asp Arg Pro Ala			
260	265	270	
ata ccg tct ggg agt gag gat tcg aaa cgg tcc aac gac tct aga gga			864
Ile Pro Ser Gly Ser Glu Asp Ser Lys Arg Ser Asn Asp Ser Arg Gly			
275	280	285	
gaa tcg agt gga ccc aat tgg ata gac att gaa aat tac act cct aaa			912
Glu Ser Ser Gly Pro Asn Trp Ile Asp Ile Glu Asn Tyr Thr Pro Lys			
290	295	300	
aat aat gtg cct att ata ata tct gac gat gac gtt cct aca gcc cct			960
Asn Asn Val Pro Ile Ile Ile Ser Asp Asp Asp Val Pro Thr Ala Pro			
305	310	315	320
ccc aag ggc atg aat aat cag tca gta gtg ata ccc gca atc gta cta			1008
Pro Lys Gly Met Asn Asn Gln Ser Val Val Ile Pro Ala Ile Val Leu			
325	330	335	
agt tgt ctt ata ata gca ctg att cta gga gtg ata tat tat att ttg			1056
Ser Cys Leu Ile Ile Ala Leu Ile Leu Gly Val Ile Tyr Tyr Ile Leu			
340	345	350	
agg gta aag agg tct cga tca act gca tat caa caa ctt cct ata ata			1104
Arg Val Lys Arg Ser Arg Ser Thr Ala Tyr Gln Gln Leu Pro Ile Ile			
355	360	365	
cat aca act cac cat cct			1122
His Thr Thr His His Pro			
370			

<210> 24
 <211> 374
 <212> PRT
 <213> Feline herpesvirus 1

<400> 24
 Met Met Thr Arg Leu His Phe Trp Trp Cys Gly Ile Phe Ala Val Leu
 1 5 10 15
 Lys Tyr Leu Val Cys Thr Ser Ser Leu Thr Thr Thr Pro Lys Thr Thr
 20 25 30
 Thr Val Tyr Val Lys Gly Phe Asn Ile Pro Pro Leu Arg Tyr Asn Tyr
 35 40 45

Thr Gln Ala Arg Ile Val Pro Lys Ile Pro Gln Ala Met Asp Pro Lys
 50 55 60
 Ile Thr Ala Glu Val Arg Tyr Val Thr Ser Met Asp Ser Cys Gly Met
 65 70 75 80
 Val Ala Leu Ile Ser Glu Pro Asp Ile Asp Ala Thr Ile Arg Thr Ile
 85 90 95
 Gln Leu Ser Gln Lys Lys Thr Tyr Asn Ala Thr Ile Ser Trp Phe Lys
 100 105 110
 Val Thr Gln Gly Cys Glu Tyr Pro Met Phe Leu Met Asp Met Arg Leu
 115 120 125
 Cys Asp Pro Lys Arg Glu Phe Gly Ile Cys Ala Leu Arg Ser Pro Ser
 130 135 140
 Tyr Trp Leu Glu Pro Leu Thr Lys Tyr Met Phe Leu Thr Asp Asp Glu
 145 150 155 160
 Leu Gly Leu Ile Met Met Ala Pro Ala Gln Phe Asn Gln Gly Gln Tyr
 165 170 175
 Arg Arg Val Ile Thr Ile Asp Gly Ser Met Phe Tyr Thr Asp Phe Met
 180 185 190
 Val Gln Leu Ser Pro Thr Pro Cys Trp Phe Ala Lys Pro Asp Arg Tyr
 195 200 205
 Glu Glu Ile Leu His Glu Trp Cys Arg Asn Val Lys Thr Ile Gly Leu
 210 215 220
 Asp Gly Ala Arg Asp Tyr His Tyr Tyr Trp Val Pro Tyr Asn Pro Gln
 225 230 235 240
 Pro His His Lys Ala Val Leu Leu Tyr Trp Tyr Arg Thr His Gly Arg
 245 250 255
 Glu Pro Pro Val Arg Phe Gln Glu Ala Ile Arg Tyr Asp Arg Pro Ala
 260 265 270
 Ile Pro Ser Gly Ser Glu Asp Ser Lys Arg Ser Asn Asp Ser Arg Gly
 275 280 285
 Glu Ser Ser Gly Pro Asn Trp Ile Asp Ile Glu Asn Tyr Thr Pro Lys
 290 295 300
 Asn Asn Val Pro Ile Ile Ile Ser Asp Asp Asp Val Pro Thr Ala Pro
 305 310 315 320
 Pro Lys Gly Met Asn Asn Gln Ser Val Val Ile Pro Ala Ile Val Leu
 325 330 335
 Ser Cys Leu Ile Ile Ala Leu Ile Leu Gly Val Ile Tyr Tyr Ile Leu
 340 345 350
 Arg Val Lys Arg Ser Arg Ser Thr Ala Tyr Gln Gln Leu Pro Ile Ile
 355 360 365

His Thr Thr His His Pro
370.

<210> 25
<211> 900
<212> DNA
<213> Feline herpesvirus 1

<220>
<221> CDS
<222> (1)..(900)

<400> 25
cca aaa aca act acg gtt tat gtg aag gga ttt aat ata cct cca cta 48
Pro Lys Thr Thr Thr Val Tyr Val Lys Gly Phe Asn Ile Pro Pro Leu
1 5 10 15
cgc tac aat tat act caa gcc aga atc gtg cca aaa att ccc cag gcg 96
Arg Tyr Asn Tyr Thr Gln Ala Arg Ile Val Pro Lys Ile Pro Gln Ala
20 25 30
atg gat ccg aag ata aca gct gaa gta cgt tat gta aca tca atg gat 144
Met Asp Pro Lys Ile Thr Ala Glu Val Arg Tyr Val Thr Ser Met Asp
35 40 45
tca tgt ggg atg gtg gca ttg ata tca gag ccg gat ata gac gct act 192
Ser Cys Gly Met Val Ala Leu Ile Ser Glu Pro Asp Ile Asp Ala Thr
50 55 60
att cga acc ata caa cta tct caa aaa aaa aca tat aac gcg act ata 240
Ile Arg Thr Ile Gln Leu Ser Gln Lys Lys Thr Tyr Asn Ala Thr Ile
65 70 75 80
agt tgg ttt aag gta acc cag ggt tgt gaa tac cct atg ttt ctt atg 288
Ser Trp Phe Lys Val Thr Gln Gly Cys Glu Tyr Pro Met Phe Leu Met
85 90 95
gat atg aga ctt tgt gat cct aaa cgg gaa ttt gga ata tgt gct tta 336
Asp Met Arg Leu Cys Asp Pro Lys Arg Glu Phe Gly Ile Cys Ala Leu
100 105 110
cgg tcg cct tca tat tgg ttg gaa cct tta aca aag tat atg ttc cta 384
Arg Ser Pro Ser Tyr Trp Leu Glu Pro Leu Thr Lys Tyr Met Phe Leu
115 120 125
aca gac gat gaa ctg ggt ttg att atg atg gcc ccg gcc caa ttt aat 432
Thr Asp Asp Glu Leu Gly Leu Ile Met Met Ala Pro Ala Gln Phe Asn
130 135 140
caa gga caa tat cga aga gtt ata acc atc gat ggt tcc atg ttt tat 480
Gln Gly Gln Tyr Arg Arg Val Ile Thr Ile Asp Gly Ser Met Phe Tyr
145 150 155 160
aca gat ttt atg gta caa cta tct cca acg cca tgt tgg ttc gca aaa 528
Thr Asp Phe Met Val Gln Leu Ser Pro Thr Pro Cys Trp Phe Ala Lys
165 170 175
ccc gat aga tac gaa gag att cta cat gaa tgg tgt cga aat gtt aaa 576
Pro Asp Arg Tyr Glu Glu Ile Leu His Glu Trp Cys Arg Asn Val Lys

	180		185		190	
act att ggc ctt gat gga gct cgt gat tac cac tat tat tgg gta ccc						624
Thr Ile Gly Leu Asp Gly Ala Arg Asp Tyr His Tyr Tyr Trp Val Pro						
	195		200		205	
tat aac cca caa cct cac cat aaa gcc gta ctc tta tat tgg tat cgg						672
Tyr Asn Pro Gln Pro His His Lys Ala Val Leu Leu Tyr Trp Tyr Arg						
	210		215		220	
act cat ggc cga gaa ccc cca gta aga ttc caa gag gcc att cga tat						720
Thr His Gly Arg Glu Pro Pro Val Arg Phe Gln Glu Ala Ile Arg Tyr						
	225		230		235	240
gat cgt ccc gcc ata ccg tct ggg agt gag gat tcg aaa cgg tcc aac						768
Asp Arg Pro Ala Ile Pro Ser Gly Ser Glu Asp Ser Lys Arg Ser Asn						
	245		250		255	
gac tct aga gga gaa tcg agt gga ccc aat tgg ata gac att gaa aat						816
Asp Ser Arg Gly Glu Ser Ser Gly Pro Asn Trp Ile Asp Ile Glu Asn						
	260		265		270	
tac act cct aaa aat aat gtg cct att ata ata tct gac gat gac gtt						864
Tyr Thr Pro Lys Asn Asn Val Pro Ile Ile Ile Ser Asp Asp Asp Val						
	275		280		285	
cct aca gcc cct ccc aag ggc atg aat aat cag tca						900
Pro Thr Ala Pro Pro Lys Gly Met Asn Asn Gln Ser						
	290		295		300	

<210> 26
 <211> 300
 <212> PRT
 <213> Feline herpesvirus 1

<400> 26
 Pro Lys Thr Thr Thr Val Tyr Val Lys Gly Phe Asn Ile Pro Pro Leu
 1 5 10 15
 Arg Tyr Asn Tyr Thr Gln Ala Arg Ile Val Pro Lys Ile Pro Gln Ala
 20 25 30
 Met Asp Pro Lys Ile Thr Ala Glu Val Arg Tyr Val Thr Ser Met Asp
 35 40 45
 Ser Cys Gly Met Val Ala Leu Ile Ser Glu Pro Asp Ile Asp Ala Thr
 50 55 60
 Ile Arg Thr Ile Gln Leu Ser Gln Lys Lys Thr Tyr Asn Ala Thr Ile
 65 70 75 80
 Ser Trp Phe Lys Val Thr Gln Gly Cys Glu Tyr Pro Met Phe Leu Met
 85 90 95
 Asp Met Arg Leu Cys Asp Pro Lys Arg Glu Phe Gly Ile Cys Ala Leu
 100 105 110
 Arg Ser Pro Ser Tyr Trp Leu Glu Pro Leu Thr Lys Tyr Met Phe Leu
 115 120 125

Thr Asp Asp Glu Leu Gly Leu Ile Met Met Ala Pro Ala Gln Phe Asn
 130 135 140

Gln Gly Gln Tyr Arg Arg Val Ile Thr Ile Asp Gly Ser Met Phe Tyr
 145 150 155 160

Thr Asp Phe Met Val Gln Leu Ser Pro Thr Pro Cys Trp Phe Ala Lys
 165 170 175

Pro Asp Arg Tyr Glu Glu Ile Leu His Glu Trp Cys Arg Asn Val Lys
 180 185 190

Thr Ile Gly Leu Asp Gly Ala Arg Asp Tyr His Tyr Tyr Trp Val Pro
 195 200 205

Tyr Asn Pro Gln Pro His His Lys Ala Val Leu Leu Tyr Trp Tyr Arg
 210 215 220

Thr His Gly Arg Glu Pro Pro Val Arg Phe Gln Glu Ala Ile Arg Tyr
 225 230 235 240

Asp Arg Pro Ala Ile Pro Ser Gly Ser Glu Asp Ser Lys Arg Ser Asn
 245 250 255

Asp Ser Arg Gly Glu Ser Ser Gly Pro Asn Trp Ile Asp Ile Glu Asn
 260 265 270

Tyr Thr Pro Lys Asn Asn Val Pro Ile Ile Ile Ser Asp Asp Asp Val
 275 280 285

Pro Thr Ala Pro Pro Lys Gly Met Asn Asn Gln Ser
 290 295 300

<210> 27
 <211> 759
 <212> DNA
 <213> Feline leukemia virus

<220>
 <221> CDS
 <222> (1)..(759)

<400> 27
 atg ccg ctg cgt gaa ggt ccg aac aac cgt ccc cag tat tgg cca ttc 48
 Met Pro Leu Arg Glu Gly Pro Asn Asn Arg Pro Gln Tyr Trp Pro Phe
 1 5 10 15

tca gct tca gac ctg tat aac tgg aag tcg cat aac ccc cct ttc tcc 96
 Ser Ala Ser Asp Leu Tyr Asn Trp Lys Ser His Asn Pro Pro Phe Ser
 20 25 30

caa gac ccc gtg gcc cta act aac cta att gag tcc att tta gtg acg 144
 Gln Asp Pro Val Ala Leu Thr Asn Leu Ile Glu Ser Ile Leu Val Thr
 35 40 45

cat caa cca acc tgg gac gac tgc cag caa ctc ttg cag gca ctc ctg 192
 His Gln Pro Thr Trp Asp Asp Cys Gln Gln Leu Leu Gln Ala Leu Leu
 50 55 60

aca ggc gaa gaa agg caa agg gtc ctt ctt gag gcc cga aag cag gtt 240
 Thr Gly Glu Glu Arg Gln Arg Val Leu Leu Glu Ala Arg Lys Gln Val
 65 70 75 80

cca ggc gag gac gga cgg cca acc cag ctg ccc aat gtc att gac gaa 288
 Pro Gly Glu Asp Gly Arg Pro Thr Gln Leu Pro Asn Val Ile Asp Glu
 85 90 95

gct ttc ccc ttg acc cgt ccc aac tgg gat ttt gct acg ccg gca ggt 336
 Ala Phe Pro Leu Thr Arg Pro Asn Trp Asp Phe Ala Thr Pro Ala Gly
 100 105 110

agg gag cac cta cgc ctt tat cgc cag ttg ctg tta gcg ggt ctc cgc 384
 Arg Glu His Leu Arg Leu Tyr Arg Gln Leu Leu Leu Ala Gly Leu Arg
 115 120 125

ggg gct gca aga cgc ccc act aat ttg gca cag gta aag caa gtt gta 432
 Gly Ala Ala Arg Arg Pro Thr Asn Leu Ala Gln Val Lys Gln Val Val
 130 135 140

caa ggg aaa gag gaa acg cca gcc tca ttc tta gaa aga tta aaa gag 480
 Gln Gly Lys Glu Glu Thr Pro Ala Ser Phe Leu Glu Arg Leu Lys Glu
 145 150 155 160

gct tac aga atg tat act ccc tat gac cct gag gac cca ggg cag gct 528
 Ala Tyr Arg Met Tyr Thr Pro Tyr Asp Pro Glu Asp Pro Gly Gln Ala
 165 170 175

gct agt gtt atc ctg tcc ttt atc tac cag tct agc ccg gac ata aga 576
 Ala Ser Val Ile Leu Ser Phe Ile Tyr Gln Ser Ser Pro Asp Ile Arg
 180 185 190

aat aag tta caa agg cta gaa ggc cta cag ggg ttc aca ctg tct gat 624
 Asn Lys Leu Gln Arg Leu Glu Gly Leu Gln Gly Phe Thr Leu Ser Asp
 195 200 205

ttg cta aaa gag gca gaa aag ata tac aac aaa agg gag acc cca gag 672
 Leu Leu Lys Glu Ala Glu Lys Ile Tyr Asn Lys Arg Glu Thr Pro Glu
 210 215 220

gaa agg gaa gaa aga tta tgg cag cgg cag gaa gaa aga gat aaa aag 720
 Glu Arg Glu Glu Arg Leu Trp Gln Arg Gln Glu Glu Arg Asp Lys Lys
 225 230 235 240

cgc cat aag gag atg act aag gtc tgt gag aat tct agc 759
 Arg His Lys Glu Met Thr Lys Val Cys Glu Asn Ser Ser
 245 250

<210> 28
 <211> 253
 <212> PRT
 <213> Feline leukemia virus

<400> 28
 Met Pro Leu Arg Glu Gly Pro Asn Asn Arg Pro Gln Tyr Trp Pro Phe
 1 5 10 15
 Ser Ala Ser Asp Leu Tyr Asn Trp Lys Ser His Asn Pro Pro Phe Ser
 20 25 30

Gln Asp Pro Val Ala Leu Thr Asn Leu Ile Glu Ser Ile Leu Val Thr
 35 40 45

His Gln Pro Thr Trp Asp Asp Cys Gln Gln Leu Leu Gln Ala Leu Leu
 50 55 60

Thr Gly Glu Glu Arg Gln Arg Val Leu Leu Glu Ala Arg Lys Gln Val
 65 70 75 80

Pro Gly Glu Asp Gly Arg Pro Thr Gln Leu Pro Asn Val Ile Asp Glu
 85 90 95

Ala Phe Pro Leu Thr Arg Pro Asn Trp Asp Phe Ala Thr Pro Ala Gly
 100 105 110

Arg Glu His Leu Arg Leu Tyr Arg Gln Leu Leu Leu Ala Gly Leu Arg
 115 120 125

Gly Ala Ala Arg Arg Pro Thr Asn Leu Ala Gln Val Lys Gln Val Val
 130 135 140

Gln Gly Lys Glu Glu Thr Pro Ala Ser Phe Leu Glu Arg Leu Lys Glu
 145 150 155 160

Ala Tyr Arg Met Tyr Thr Pro Tyr Asp Pro Glu Asp Pro Gly Gln Ala
 165 170 175

Ala Ser Val Ile Leu Ser Phe Ile Tyr Gln Ser Ser Pro Asp Ile Arg
 180 185 190

Asn Lys Leu Gln Arg Leu Glu Gly Leu Gln Gly Phe Thr Leu Ser Asp
 195 200 205

Leu Leu Lys Glu Ala Glu Lys Ile Tyr Asn Lys Arg Glu Thr Pro Glu
 210 215 220

Glu Arg Glu Glu Arg Leu Trp Gln Arg Gln Glu Glu Arg Asp Lys Lys
 225 230 235 240

Arg His Lys Glu Met Thr Lys Val Cys Glu Asn Ser Ser
 245 250

<210> 29
 <211> 1830
 <212> DNA
 <213> Feline leukemia virus

<220>
 <221> CDS
 <222> (1)..(1830)

<400> 29
 atg gcc aat cct agt cca ccc caa atg tat aat gta act tgg gta ata 48
 Met Ala Asn Pro Ser Pro Pro Gln Met Tyr Asn Val Thr Trp Val Ile
 1 5 10 15

acc aat gta caa acc aac acc caa gct aat gcc acc tct atg tta gga 96
 Thr Asn Val Gln Thr Asn Thr Gln Ala Asn Ala Thr Ser Met Leu Gly
 20 25 30

gac tgt tgg ctc tgc ctg gtt tct cga cca ccc tat tac gaa ggg att 864
 Asp Cys Trp Leu Cys Leu Val Ser Arg Pro Pro Tyr Tyr Glu Gly Ile
 275 280 285

gca atc tta ggt aac tac agc aac caa aca aac cct ccc cca tcc tgc 912
 Ala Ile Leu Gly Asn Tyr Ser Asn Gln Thr Asn Pro Pro Pro Ser Cys
 290 295 300

cta tct att ccg cca cac aag ctg acc ata tct aaa gta tca ggg caa 960
 Leu Ser Ile Pro Pro His Lys Leu Thr Ile Ser Lys Val Ser Gly Gln
 305 310 315 320

gga ctg tgc ata ggg act gtt cct aag acc cac cag gct ttg tgc aat 1008
 Gly Leu Cys Ile Gly Thr Val Pro Lys Thr His Gln Ala Leu Cys Asn
 325 330 335

aag acg cac cag gga cat aca ggg gcg gac tat cga gcc gcc ccg cgg 1056
 Lys Thr His Gln Gly His Thr Gly Ala Asp Tyr Arg Ala Ala Pro Arg
 340 345 350

tat cta gcc gcc ccc aat ggc acc tat tgg gcc tgt aac act gga ctc 1104
 Tyr Leu Ala Ala Pro Asn Gly Thr Tyr Trp Ala Cys Asn Thr Gly Leu
 355 360 365

acc cca tgc att tcc atg gcg gtg ctc aat ttg acc tct gat ttt tgt 1152
 Thr Pro Cys Ile Ser Met Ala Val Leu Asn Leu Thr Ser Asp Phe Cys
 370 375 380

gtc tta atc gaa tta tgg ccc aga gtg act tac cat caa ccc gaa tat 1200
 Val Leu Ile Glu Leu Trp Pro Arg Val Thr Tyr His Gln Pro Glu Tyr
 385 390 395 400

gtg tac aca cat ttt gcc aaa gct ggc agg ttc cga aga gaa cca ata 1248
 Val Tyr Thr His Phe Ala Lys Ala Gly Arg Phe Arg Arg Glu Pro Ile
 405 410 415

tca cta act gtt gcc ctc atg ttg gga gga ctc act gta ggg ggc ata 1296
 Ser Leu Thr Val Ala Leu Met Leu Gly Gly Leu Thr Val Gly Gly Ile
 420 425 430

gcc gcg ggg gtc gga aca ggg act aaa gcc ctc ctt gaa aca gcc cag 1344
 Ala Ala Gly Val Gly Thr Gly Thr Lys Ala Leu Leu Glu Thr Ala Gln
 435 440 445

ttc aga caa cta caa atg gcc atg cac aca gac atc cag gcc cta gaa 1392
 Phe Arg Gln Leu Gln Met Ala Met His Thr Asp Ile Gln Ala Leu Glu
 450 455 460

gag tca att agt gcc tta gaa aag tcc ctg acc tcc ctt tct gaa gta 1440
 Glu Ser Ile Ser Ala Leu Glu Lys Ser Leu Thr Ser Leu Ser Glu Val
 465 470 475 480

gtc tta caa aac aga cgg ggc cta gat att cta ttc cta caa gag gga 1488
 Val Leu Gln Asn Arg Arg Gly Leu Asp Ile Leu Phe Leu Gln Glu Gly
 485 490 495

ggg ctc tgt gcc gca tta aaa gaa gaa tgt tgc ttc tat gcg gat cac 1536
 Gly Leu Cys Ala Ala Leu Lys Glu Glu Cys Cys Phe Tyr Ala Asp His
 500 505 510

acc gga ctc gtc cga gac aat atg gct aaa tta aga gaa aga cta aaa 1584

Thr Gly Leu Val Arg Asp Asn Met Ala Lys Leu Arg Glu Arg Leu Lys
 515 520 525

cag cgg caa caa ctg ttt gac tcc caa cag gga tgg ttt gaa gga tgg 1632
 Gln Arg Gln Gln Leu Phe Asp Ser Gln Gln Gly Trp Phe Glu Gly Trp
 530 535 540

ttc aac agg tcc ccc tgg ttt aca acc cta att tcc tcc att atg ggc 1680
 Phe Asn Arg Ser Pro Trp Phe Thr Thr Leu Ile Ser Ser Ile Met Gly
 545 550 555 560

ccc tta cta atc cta ctc cta att ctc ctc ttc ggc cca tac atc ctt 1728
 Pro Leu Leu Ile Leu Leu Leu Ile Leu Leu Phe Gly Pro Tyr Ile Leu
 565 570 575

aac aga tta gta caa ttc gta aaa gac aga ata tct gtg gta caa gcc 1776
 Asn Arg Leu Val Gln Phe Val Lys Asp Arg Ile Ser Val Val Gln Ala
 580 585 590

tta att tta acc caa cag tac caa cag ata aag caa tac gat ccg gac 1824
 Leu Ile Leu Thr Gln Gln Tyr Gln Gln Ile Lys Gln Tyr Asp Pro Asp
 595 600 605

cga cca 1830
 Arg Pro
 610

<210> 30
 <211> 610
 <212> PRT
 <213> Feline leukemia virus

<400> 30
 Met Ala Asn Pro Ser Pro Pro Gln Met Tyr Asn Val Thr Trp Val Ile
 1 5 10 15

Thr Asn Val Gln Thr Asn Thr Gln Ala Asn Ala Thr Ser Met Leu Gly
 20 25 30

Thr Leu Thr Asp Val Tyr Pro Thr Leu His Val Asp Leu Cys Asp Leu
 35 40 45

Val Gly Asp Thr Trp Glu Pro Met Val Leu Ser Pro Thr Gly Tyr Pro
 50 55 60

Pro Ser Lys Tyr Gly Cys Lys Thr Thr Asp Arg Lys Lys Gln Gln Gln
 65 70 75 80

Thr Tyr Pro Phe Tyr Val Cys Pro Gly His Arg Pro Ser Leu Gly Pro
 85 90 95

Lys Gly Thr His Cys Gly Gly Ala Gln Asp Gly Phe Cys Ala Ala Trp
 100 105 110

Gly Cys Glu Thr Thr Gly Glu Ala Trp Trp Lys Pro Ser Ser Ser Trp
 115 120 125

Asp Tyr Ile Thr Val Lys Arg Gly Ser Ser Gln Asn Asn Asn Cys Glu
 130 135 140

Gly Lys Cys Asn Pro Leu Ile Leu Gln Phe Thr Gln Lys Gly Lys Gln
 145 150 155 160

Ala Ser Trp Asp Gly Pro Lys Met Trp Gly Leu Arg Leu Tyr Arg Thr
 165 170 175

Gly Tyr Asp Pro Ile Ala Leu Phe Thr Val Ser Arg Arg Val Ser Thr
 180 185 190

Ile Thr Pro Pro Gln Ala Met Gly Pro Asp Leu Val Leu Pro Asp Gln
 195 200 205

Lys Pro Pro Ser Arg Gln Ser Gln Thr Gly Ser Lys Val Ala Thr Gln
 210 215 220

Arg Pro Gln Thr Asn Glu Ser Ala Pro Arg Ser Val Ala Pro Thr Thr
 225 230 235 240

Val Gly Pro Lys Arg Ile Gly Thr Gly Asp Arg Leu Ile Asn Leu Val
 245 250 255

Gln Gly Ala Tyr Leu Ala Leu Asn Ala Thr Asp Pro Asn Lys Thr Lys
 260 265 270

Asp Cys Trp Leu Cys Leu Val Ser Arg Pro Pro Tyr Tyr Glu Gly Ile
 275 280 285

Ala Ile Leu Gly Asn Tyr Ser Asn Gln Thr Asn Pro Pro Pro Ser Cys
 290 295 300

Leu Ser Ile Pro Pro His Lys Leu Thr Ile Ser Lys Val Ser Gly Gln
 305 310 315 320

Gly Leu Cys Ile Gly Thr Val Pro Lys Thr His Gln Ala Leu Cys Asn
 325 330 335

Lys Thr His Gln Gly His Thr Gly Ala Asp Tyr Arg Ala Ala Pro Arg
 340 345 350

Tyr Leu Ala Ala Pro Asn Gly Thr Tyr Trp Ala Cys Asn Thr Gly Leu
 355 360 365

Thr Pro Cys Ile Ser Met Ala Val Leu Asn Leu Thr Ser Asp Phe Cys
 370 375 380

Val Leu Ile Glu Leu Trp Pro Arg Val Thr Tyr His Gln Pro Glu Tyr
 385 390 395 400

Val Tyr Thr His Phe Ala Lys Ala Gly Arg Phe Arg Arg Glu Pro Ile
 405 410 415

Ser Leu Thr Val Ala Leu Met Leu Gly Gly Leu Thr Val Gly Gly Ile
 420 425 430

Ala Ala Gly Val Gly Thr Gly Thr Lys Ala Leu Leu Glu Thr Ala Gln
 435 440 445

Phe Arg Gln Leu Gln Met Ala Met His Thr Asp Ile Gln Ala Leu Glu
 450 455 460

Glu Ser Ile Ser Ala Leu Glu Lys Ser Leu Thr Ser Leu Ser Glu Val

aat aag tta caa agg cta gaa ggc cta cag ggg ttc aca ctg tct gat	288
Asn Lys Leu Gln Arg Leu Glu Gly Leu Gln Gly Phe Thr Leu Ser Asp	
85 90 95	
ttg cta aaa gag gca gaa aag ata tac aac aaa agg gag acc cca gag	336
Leu Leu Lys Glu Ala Glu Lys Ile Tyr Asn Lys Arg Glu Thr Pro Glu	
100 105 110	
gaa agg gaa gaa aga tta tgg cag cgg cag gaa gaa aga gat aaa aag	384
Glu Arg Glu Glu Arg Leu Trp Gln Arg Gln Glu Glu Arg Asp Lys Lys	
115 120 125	
cgc cat aag gag atg act aaa gtt ctg gcc aca gta gtt gct cag aat	432
Arg His Lys Glu Met Thr Lys Val Leu Ala Thr Val Val Ala Gln Asn	
130 135 140	
aga gat aag gat aga gag gaa agt aaa ctg gga gat caa aga aaa ata	480
Arg Asp Lys Asp Arg Glu Glu Ser Lys Leu Gly Asp Gln Arg Lys Ile	
145 150 155 160	
cct ctg ggg aaa gac cag tgt gcc tat tgc aag gaa aag gga cat tgg	528
Pro Leu Gly Lys Asp Gln Cys Ala Tyr Cys Lys Glu Lys Gly His Trp	
165 170 175	
gtt cgc gat tgc ccc aac cgg ccc cgg aag aaa ccc gcc aac tcc act	576
Val Arg Asp Cys Pro Asn Arg Pro Arg Lys Lys Pro Ala Asn Ser Thr	
180 185 190	
ctc ctc aac tta gaa gat atg gcc aat cct agt cca ccc caa atg tat	624
Leu Leu Asn Leu Glu Asp Met Ala Asn Pro Ser Pro Pro Gln Met Tyr	
195 200 205	
aat gta act tgg gta ata acc aat gta caa acc aac acc caa gct aat	672
Asn Val Thr Trp Val Ile Thr Asn Val Gln Thr Asn Thr Gln Ala Asn	
210 215 220	
gcc acc tct atg tta gga acc tta acc gat gtc tac cct acc cta cat	720
Ala Thr Ser Met Leu Gly Thr Leu Thr Asp Val Tyr Pro Thr Leu His	
225 230 235 240	
gtt gac tta tgt gac cta gtg gga gac acc tgg gaa cct atg gtc cta	768
Val Asp Leu Cys Asp Leu Val Gly Asp Thr Trp Glu Pro Met Val Leu	
245 250 255	
agc cca acc ggg tac cct ccc tca aaa tat gga tgt aaa act aca gat	816
Ser Pro Thr Gly Tyr Pro Pro Ser Lys Tyr Gly Cys Lys Thr Thr Asp	
260 265 270	
aga aaa aaa cag caa cag aca tac ccc ttt tac gtc tgc ccc ggg cat	864
Arg Lys Lys Gln Gln Gln Thr Tyr Pro Phe Tyr Val Cys Pro Gly His	
275 280 285	
cgc ccc tcg ctg ggg cca aag gga aca cat tgt gga ggg gca caa gat	912
Arg Pro Ser Leu Gly Pro Lys Gly Thr His Cys Gly Gly Ala Gln Asp	
290 295 300	
ggg ttt tgt gcc gca tgg gga tgt gaa acc acc gga gaa gct tgg tgg	960
Gly Phe Cys Ala Ala Trp Gly Cys Glu Thr Thr Gly Glu Ala Trp Trp	
305 310 315 320	
aag ccc tcc tcc tca tgg gac tat atc aca gta aaa aga ggg agt agt	1008

Lys	Pro	Ser	Ser	Ser	Trp	Asp	Tyr	Ile	Thr	Val	Lys	Arg	Gly	Ser	Ser		
				325					330					335			
cag	aac	aat	aac	tgt	gag	gga	aaa	tgc	aac	ccc	ctg	att	ttg	cag	ttc	1056	
Gln	Asn	Asn	Asn	Cys	Glu	Gly	Lys	Cys	Asn	Pro	Leu	Ile	Leu	Gln	Phe		
			340					345					350				
acc	cag	aag	ggg	aaa	caa	gcc	tct	tgg	gac	gga	cct	aag	atg	tgg	gga	1104	
Thr	Gln	Lys	Gly	Lys	Gln	Ala	Ser	Trp	Asp	Gly	Pro	Lys	Met	Trp	Gly		
		355					360					365					
ttg	cgg	cta	tac	cgt	aca	gga	tat	gac	cct	atc	gcc	tta	ttc	acg	gta	1152	
Leu	Arg	Leu	Tyr	Arg	Thr	Gly	Tyr	Asp	Pro	Ile	Ala	Leu	Phe	Thr	Val		
	370					375					380						
tcc	cgg	cgg	gtg	tca	acc	att	acg	ccg	cct	cag	gca	atg	gga	cca	gac	1200	
Ser	Arg	Arg	Val	Ser	Thr	Ile	Thr	Pro	Pro	Gln	Ala	Met	Gly	Pro	Asp		
385					390					395					400		
cta	gtc	tta	cct	gat	caa	aaa	ccc	cca	tcc	cga	caa	tct	caa	aca	ggg	1248	
Leu	Val	Leu	Pro	Asp	Gln	Lys	Pro	Pro	Ser	Arg	Gln	Ser	Gln	Thr	Gly		
				405					410					415			
tcc	aaa	gtg	gcg	acc	cag	agg	ccc	caa	acg	aat	gaa	agc	gcc	cca	agg	1296	
Ser	Lys	Val	Ala	Thr	Gln	Arg	Pro	Gln	Thr	Asn	Glu	Ser	Ala	Pro	Arg		
			420					425					430				
tct	gtt	gcc	ccc	acc	acc	gtg	ggt	ccc	aaa	cgg	att	ggg	acc	gga	gat	1344	
Ser	Val	Ala	Pro	Thr	Thr	Val	Gly	Pro	Lys	Arg	Ile	Gly	Thr	Gly	Asp		
		435					440					445					
agg	tta	ata	aat	tta	gta	caa	ggg	gca	tac	cta	gcc	tta	aat	gcc	acc	1392	
Arg	Leu	Ile	Asn	Leu	Val	Gln	Gly	Ala	Tyr	Leu	Ala	Leu	Asn	Ala	Thr		
	450					455					460						
gac	ccc	aac	aaa	act	aaa	gac	tgt	tgg	ctc	tgc	ctg	gtt	tct	cga	cca	1440	
Asp	Pro	Asn	Lys	Thr	Lys	Asp	Cys	Trp	Leu	Cys	Leu	Val	Ser	Arg	Pro		
465					470					475					480		
ccc	tat	tac	gaa	ggg	att	gca	atc	tta	ggt	aac	tac	agc	aac	caa	aca	1488	
Pro	Tyr	Tyr	Glu	Gly	Ile	Ala	Ile	Leu	Gly	Asn	Tyr	Ser	Asn	Gln	Thr		
				485					490					495			
aac	cct	ccc	cca	tcc	tgc	cta	tct	att	ccg	cca	cac	aag	ctg	acc	ata	1536	
Asn	Pro	Pro	Pro	Ser	Cys	Leu	Ser	Ile	Pro	Pro	His	Lys	Leu	Thr	Ile		
			500					505					510				
tct	aaa	gta	tca	ggg	caa	gga	ctg	tgc	ata	ggg	act	gtt	cct	aag	acc	1584	
Ser	Lys	Val	Ser	Gly	Gln	Gly	Leu	Cys	Ile	Gly	Thr	Val	Pro	Lys	Thr		
		515					520					525					
cac	cag	gct	ttg	tgc	aat	aag	acg	cac	cag	gga	cat	aca	ggg	gcg	gac	1632	
His	Gln	Ala	Leu	Cys	Asn	Lys	Thr	His	Gln	Gly	His	Thr	Gly	Ala	Asp		
	530					535					540						
tat	cga	gcc	gcc	ccg	cgg	tat	cta	gcc	gcc	ccc	aat	ggc	acc	tat	tgg	1680	
Tyr	Arg	Ala	Ala	Pro	Arg	Tyr	Leu	Ala	Ala	Pro	Asn	Gly	Thr	Tyr	Trp		
545					550					555					560		
gcc	tgt	aac	act	gga	ctc	acc	cca	tgc	att	tcc	atg	gcg	gtg	ctc	aat	1728	
Ala	Cys	Asn	Thr	Gly	Leu	Thr	Pro	Cys	Ile	Ser	Met	Ala	Val	Leu	Asn		

	565		570		575		
ttg acc tct gat ttt tgt gtc tta atc gaa tta tgg ccc aga gtg act						1776	
Leu Thr Ser Asp Phe Cys Val Leu Ile Glu Leu Trp Pro Arg Val Thr							
	580		585		590		
tac cat caa ccc gaa tat gtg tac aca cat ttt gcc aaa gct ggc agg						1824	
Tyr His Gln Pro Glu Tyr Val Tyr Thr His Phe Ala Lys Ala Gly Arg							
	595		600		605		
ttc cga aga						1833	
Phe Arg Arg							
	610						

<210> 32
 <211> 611
 <212> PRT
 <213> Feline leukemia virus

<400> 32
 Met Glu His Leu Arg Leu Tyr Arg Gln Leu Leu Leu Ala Gly Leu Arg
 1 5 10 15
 Gly Ala Ala Arg His Pro Thr Asn Leu Ala Gln Val Lys Gln Phe Leu
 20 25 30
 Gln Gly Lys Glu Glu Thr Pro Ala Ser Phe Leu Glu Arg Leu Lys Glu
 35 40 45
 Ala Tyr Arg Met Tyr Thr Pro Tyr Asp Pro Glu Asp Pro Gly Gln Ala
 50 55 60
 Ala Ser Val Ile Leu Ser Phe Ile Tyr Gln Ser Ser Pro Asp Ile Arg
 65 70 75 80
 Asn Lys Leu Gln Arg Leu Glu Gly Leu Gln Gly Phe Thr Leu Ser Asp
 85 90 95
 Leu Leu Lys Glu Ala Glu Lys Ile Tyr Asn Lys Arg Glu Thr Pro Glu
 100 105 110
 Glu Arg Glu Glu Arg Leu Trp Gln Arg Gln Glu Glu Arg Asp Lys Lys
 115 120 125
 Arg His Lys Glu Met Thr Lys Val Leu Ala Thr Val Val Ala Gln Asn
 130 135 140
 Arg Asp Lys Asp Arg Glu Glu Ser Lys Leu Gly Asp Gln Arg Lys Ile
 145 150 155 160
 Pro Leu Gly Lys Asp Gln Cys Ala Tyr Cys Lys Glu Lys Gly His Trp
 165 170 175
 Val Arg Asp Cys Pro Asn Arg Pro Arg Lys Lys Pro Ala Asn Ser Thr
 180 185 190
 Leu Leu Asn Leu Glu Asp Met Ala Asn Pro Ser Pro Pro Gln Met Tyr
 195 200 205
 Asn Val Thr Trp Val Ile Thr Asn Val Gln Thr Asn Thr Gln Ala Asn

Tyr Arg Ala Ala Pro Arg Tyr Leu Ala Ala Pro Asn Gly Thr Tyr Trp
 545 550 555 560

Ala Cys Asn Thr Gly Leu Thr Pro Cys Ile Ser Met Ala Val Leu Asn
 565 570 575

Leu Thr Ser Asp Phe Cys Val Leu Ile Glu Leu Trp Pro Arg Val Thr
 580 585 590

Tyr His Gln Pro Glu Tyr Val Tyr Thr His Phe Ala Lys Ala Gly Arg
 595 600 605

Phe Arg Arg
 610

<210> 33
 <211> 1812
 <212> DNA
 <213> canine distemper virus

<220>
 <221> CDS
 <222> (1)..(1812)

<400> 33
 atg ctc ccc tac caa gac aag gtg ggt gcc ttc tac aag gat aat gca 48
 Met Leu Pro Tyr Gln Asp Lys Val Gly Ala Phe Tyr Lys Asp Asn Ala
 1 5 10 15

aga gcc aat tca acc aag ctg tcc tta gtg aca gaa gga cat ggg ggc 96
 Arg Ala Asn Ser Thr Lys Leu Ser Leu Val Thr Glu Gly His Gly Gly
 20 25 30

agg aga cca cct tat ttg ttg ttt gtc ctt ctc atc tta ttg gtt ggt 144
 Arg Arg Pro Pro Tyr Leu Leu Phe Val Leu Leu Ile Leu Leu Val Gly
 35 40 45

atc ctg gcc ttg ctt gct atc act gga gtt cga ttt cac caa gta tca 192
 Ile Leu Ala Leu Leu Ala Ile Thr Gly Val Arg Phe His Gln Val Ser
 50 55 60

act agt aat atg gaa ttt agc aga ttg ctg aaa gag gat atg gag aaa 240
 Thr Ser Asn Met Glu Phe Ser Arg Leu Leu Lys Glu Asp Met Glu Lys
 65 70 75 80

tca gag gcc gta cat cac caa gtc ata gat gtc ttg aca ccg ctc ttc 288
 Ser Glu Ala Val His His Gln Val Ile Asp Val Leu Thr Pro Leu Phe
 85 90 95

aag att att gga gat gag att ggg tta cgg ttg cca caa aag cta aac 336
 Lys Ile Ile Gly Asp Glu Ile Gly Leu Arg Leu Pro Gln Lys Leu Asn
 100 105 110

gag atc aaa caa ttt atc ctt caa aag aca aat ttc ttc aat ccg aac 384
 Glu Ile Lys Gln Phe Ile Leu Gln Lys Thr Asn Phe Phe Asn Pro Asn
 115 120 125

aga gaa ttc gac ttc cgc gat ctc cac tgg tgc att aac ccg cct agt 432

Arg	Glu	Phe	Asp	Phe	Arg	Asp	Leu	His	Trp	Cys	Ile	Asn	Pro	Pro	Ser		
	130					135					140						
acg	gtc	aag	gtg	aat	ttt	act	aat	tac	tgt	gag	tca	att	ggg	atc	aga	480	
Thr	Val	Lys	Val	Asn	Phe	Thr	Asn	Tyr	Cys	Glu	Ser	Ile	Gly	Ile	Arg		
	145				150					155					160		
aaa	gct	att	gca	tcg	gca	gca	aat	cct	atc	ctt	tta	tca	gcc	cta	tct	528	
Lys	Ala	Ile	Ala	Ser	Ala	Ala	Asn	Pro	Ile	Leu	Leu	Ser	Ala	Leu	Ser		
				165					170					175			
ggg	ggc	aga	ggg	gac	ata	ttc	cca	cca	cac	aga	tgc	agt	gga	gct	act	576	
Gly	Gly	Arg	Gly	Asp	Ile	Phe	Pro	Pro	His	Arg	Cys	Ser	Gly	Ala	Thr		
			180					185					190				
act	tca	gta	ggc	aaa	ggt	ttc	ccc	cta	tca	gtc	tca	tta	tcc	atg	tct	624	
Thr	Ser	Val	Gly	Lys	Val	Phe	Pro	Leu	Ser	Val	Ser	Leu	Ser	Met	Ser		
		195					200						205				
ttg	atc	tca	aga	acc	tca	gag	gta	atc	aat	atg	ctg	acc	gct	atc	tca	672	
Leu	Ile	Ser	Arg	Thr	Ser	Glu	Val	Ile	Asn	Met	Leu	Thr	Ala	Ile	Ser		
	210					215						220					
gac	ggc	gtg	tat	ggc	aaa	act	tac	ttg	cta	gtg	cct	gat	gat	ata	gaa	720	
Asp	Gly	Val	Tyr	Gly	Lys	Thr	Tyr	Leu	Leu	Val	Pro	Asp	Asp	Ile	Glu		
	225				230					235					240		
aga	gag	ttc	gac	act	cga	gag	att	cga	gtc	ttt	gaa	ata	ggg	ttc	atc	768	
Arg	Glu	Phe	Asp	Thr	Arg	Glu	Ile	Arg	Val	Phe	Glu	Ile	Gly	Phe	Ile		
				245					250					255			
aaa	agg	tgg	ctg	aat	gac	atg	cca	tta	ctc	caa	aca	acc	aac	tat	atg	816	
Lys	Arg	Trp	Leu	Asn	Asp	Met	Pro	Leu	Leu	Gln	Thr	Thr	Asn	Tyr	Met		
			260					265						270			
gta	ctc	ccg	aag	aat	tcc	aaa	gcc	aag	gta	tgt	act	ata	gca	gtg	ggg	864	
Val	Leu	Pro	Lys	Asn	Ser	Lys	Ala	Lys	Val	Cys	Thr	Ile	Ala	Val	Gly		
			275				280					285					
gag	ttg	aca	ctg	gct	tcc	ttg	tgt	gta	gaa	gag	agc	act	gta	tta	tta	912	
Glu	Leu	Thr	Leu	Ala	Ser	Leu	Cys	Val	Glu	Glu	Ser	Thr	Val	Leu	Leu		
	290					295					300						
tat	cat	gac	agc	agt	ggg	tca	caa	gat	ggg	att	cta	gta	gtg	aca	ctg	960	
Tyr	His	Asp	Ser	Ser	Gly	Ser	Gln	Asp	Gly	Ile	Leu	Val	Val	Thr	Leu		
	305				310					315					320		
ggg	ata	ttt	tgg	gca	aca	cct	atg	gat	cac	att	gag	gaa	gtg	ata	cct	1008	
Gly	Ile	Phe	Trp	Ala	Thr	Pro	Met	Asp	His	Ile	Glu	Glu	Val	Ile	Pro		
				325					330					335			
gtc	gct	cac	cca	tca	atg	aag	aaa	ata	cat	ata	aca	aac	cac	cgt	ggg	1056	
Val	Ala	His	Pro	Ser	Met	Lys	Lys	Ile	His	Ile	Thr	Asn	His	Arg	Gly		
			340					345					350				
ttt	ata	aaa	gat	tca	att	gca	acc	tgg	atg	gtg	cct	gcc	ctg	gcc	tct	1104	
Phe	Ile	Lys	Asp	Ser	Ile	Ala	Thr	Trp	Met	Val	Pro	Ala	Leu	Ala	Ser		
		355				360					365						
gag	aaa	caa	gaa	gaa	caa	aaa	ggg	tgt	ctg	gag	tca	gct	tgt	caa	aga	1152	
Glu	Lys	Gln	Glu	Glu	Gln	Lys	Gly	Cys	Leu	Glu	Ser	Ala	Cys	Gln	Arg		

370	375	380	
aaa acc tac ccc atg tgc aac caa gcg tca tgg gaa ccc ttc gga gga			1200
Lys Thr Tyr Pro Met Cys Asn Gln Ala Ser Trp Glu Pro Phe Gly Gly			
385	390	395	400
aga cag ttg cca tct tat ggg cgg ttg aca tta cct cta gat gca agt			1248
Arg Gln Leu Pro Ser Tyr Gly Arg Leu Thr Leu Pro Leu Asp Ala Ser			
	405	410	415
gtt gac ctt caa ctt aac ata tcg ttc aca tac ggt ccg gtt ata ctg			1296
Val Asp Leu Gln Leu Asn Ile Ser Phe Thr Tyr Gly Pro Val Ile Leu			
	420	425	430
aat gga gat ggt atg gat tat tat gaa agc cca ctt ttg aac tcc gga			1344
Asn Gly Asp Gly Met Asp Tyr Tyr Glu Ser Pro Leu Leu Asn Ser Gly			
	435	440	445
tgg ctt acc att ccc ccc aaa gac gga aca atc tct gga ttg ata aac			1392
Trp Leu Thr Ile Pro Pro Lys Asp Gly Thr Ile Ser Gly Leu Ile Asn			
	450	455	460
aaa gca ggt aga gga gac cag ttc act gta ctc ccc cat gtg tta aca			1440
Lys Ala Gly Arg Gly Asp Gln Phe Thr Val Leu Pro His Val Leu Thr			
	465	470	480
ttt gcg ccc agg gaa tca agt gga aat tgt tat tta cct att caa aca			1488
Phe Ala Pro Arg Glu Ser Ser Gly Asn Cys Tyr Leu Pro Ile Gln Thr			
	485	490	495
tct caa att aga gat aga gat gtc ctc att gag tcc aat ata gtg gtg			1536
Ser Gln Ile Arg Asp Arg Asp Val Leu Ile Glu Ser Asn Ile Val Val			
	500	505	510
ttg cct aca cag agt att aga tat gtc ata gca acg tat gac ata tca			1584
Leu Pro Thr Gln Ser Ile Arg Tyr Val Ile Ala Thr Tyr Asp Ile Ser			
	515	520	525
cga agt gat cat gct att gtt tat tat gtt tat gac cca atc cgg acg			1632
Arg Ser Asp His Ala Ile Val Tyr Tyr Val Tyr Asp Pro Ile Arg Thr			
	530	535	540
att tct tat acg cac cca ttt aga cta act acc aag ggt aga cct gat			1680
Ile Ser Tyr Thr His Pro Phe Arg Leu Thr Thr Lys Gly Arg Pro Asp			
	545	550	560
ttc cta agg att gaa tgt ttt gtg tgg gat gac aat ttg tgg tgt cac			1728
Phe Leu Arg Ile Glu Cys Phe Val Trp Asp Asp Asn Leu Trp Cys His			
	565	570	575
caa ttt tac aga ttc gag gct gac atc gcc aac tct aca acc agt gtt			1776
Gln Phe Tyr Arg Phe Glu Ala Asp Ile Ala Asn Ser Thr Thr Ser Val			
	580	585	590
gag aat tta gtc cgt ata aga ttc tca tgt aac cgt			1812
Glu Asn Leu Val Arg Ile Arg Phe Ser Cys Asn Arg			
	595	600	

<210> 34

<211> 604

<212> PRT

<213> canine distemper virus

<400> 34

Met Leu Pro Tyr Gln Asp Lys Val Gly Ala Phe Tyr Lys Asp Asn Ala
 1 5 10 15

Arg Ala Asn Ser Thr Lys Leu Ser Leu Val Thr Glu Gly His Gly Gly
 20 25 30

Arg Arg Pro Pro Tyr Leu Leu Phe Val Leu Leu Ile Leu Leu Val Gly
 35 40 45

Ile Leu Ala Leu Leu Ala Ile Thr Gly Val Arg Phe His Gln Val Ser
 50 55 60

Thr Ser Asn Met Glu Phe Ser Arg Leu Leu Lys Glu Asp Met Glu Lys
 65 70 75 80

Ser Glu Ala Val His His Gln Val Ile Asp Val Leu Thr Pro Leu Phe
 85 90 95

Lys Ile Ile Gly Asp Glu Ile Gly Leu Arg Leu Pro Gln Lys Leu Asn
 100 105 110

Glu Ile Lys Gln Phe Ile Leu Gln Lys Thr Asn Phe Phe Asn Pro Asn
 115 120 125

Arg Glu Phe Asp Phe Arg Asp Leu His Trp Cys Ile Asn Pro Pro Ser
 130 135 140

Thr Val Lys Val Asn Phe Thr Asn Tyr Cys Glu Ser Ile Gly Ile Arg
 145 150 155 160

Lys Ala Ile Ala Ser Ala Ala Asn Pro Ile Leu Leu Ser Ala Leu Ser
 165 170 175

Gly Gly Arg Gly Asp Ile Phe Pro Pro His Arg Cys Ser Gly Ala Thr
 180 185 190

Thr Ser Val Gly Lys Val Phe Pro Leu Ser Val Ser Leu Ser Met Ser
 195 200 205

Leu Ile Ser Arg Thr Ser Glu Val Ile Asn Met Leu Thr Ala Ile Ser
 210 215 220

Asp Gly Val Tyr Gly Lys Thr Tyr Leu Leu Val Pro Asp Asp Ile Glu
 225 230 235 240

Arg Glu Phe Asp Thr Arg Glu Ile Arg Val Phe Glu Ile Gly Phe Ile
 245 250 255

Lys Arg Trp Leu Asn Asp Met Pro Leu Leu Gln Thr Thr Asn Tyr Met
 260 265 270

Val Leu Pro Lys Asn Ser Lys Ala Lys Val Cys Thr Ile Ala Val Gly
 275 280 285

Glu Leu Thr Leu Ala Ser Leu Cys Val Glu Glu Ser Thr Val Leu Leu
 290 295 300

Tyr His Asp Ser Ser Gly Ser Gln Asp Gly Ile Leu Val Val Thr Leu
 305 310 315 320
 Gly Ile Phe Trp Ala Thr Pro Met Asp His Ile Glu Glu Val Ile Pro
 325 330 335
 Val Ala His Pro Ser Met Lys Lys Ile His Ile Thr Asn His Arg Gly
 340 345 350
 Phe Ile Lys Asp Ser Ile Ala Thr Trp Met Val Pro Ala Leu Ala Ser
 355 360 365
 Glu Lys Gln Glu Glu Gln Lys Gly Cys Leu Glu Ser Ala Cys Gln Arg
 370 375 380
 Lys Thr Tyr Pro Met Cys Asn Gln Ala Ser Trp Glu Pro Phe Gly Gly
 385 390 395 400
 Arg Gln Leu Pro Ser Tyr Gly Arg Leu Thr Leu Pro Leu Asp Ala Ser
 405 410 415
 Val Asp Leu Gln Leu Asn Ile Ser Phe Thr Tyr Gly Pro Val Ile Leu
 420 425 430
 Asn Gly Asp Gly Met Asp Tyr Tyr Glu Ser Pro Leu Leu Asn Ser Gly
 435 440 445
 Trp Leu Thr Ile Pro Pro Lys Asp Gly Thr Ile Ser Gly Leu Ile Asn
 450 455 460
 Lys Ala Gly Arg Gly Asp Gln Phe Thr Val Leu Pro His Val Leu Thr
 465 470 475 480
 Phe Ala Pro Arg Glu Ser Ser Gly Asn Cys Tyr Leu Pro Ile Gln Thr
 485 490 495
 Ser Gln Ile Arg Asp Arg Asp Val Leu Ile Glu Ser Asn Ile Val Val
 500 505 510
 Leu Pro Thr Gln Ser Ile Arg Tyr Val Ile Ala Thr Tyr Asp Ile Ser
 515 520 525
 Arg Ser Asp His Ala Ile Val Tyr Tyr Val Tyr Asp Pro Ile Arg Thr
 530 535 540
 Ile Ser Tyr Thr His Pro Phe Arg Leu Thr Thr Lys Gly Arg Pro Asp
 545 550 555 560
 Phe Leu Arg Ile Glu Cys Phe Val Trp Asp Asp Asn Leu Trp Cys His
 565 570 575
 Gln Phe Tyr Arg Phe Glu Ala Asp Ile Ala Asn Ser Thr Thr Ser Val
 580 585 590
 Glu Asn Leu Val Arg Ile Arg Phe Ser Cys Asn Arg
 595 600

<210> 35
 <211> 1986

<212> DNA
 <213> canine distemper virus

<220>
 <221> CDS
 <222> (1)..(1986)

<400> 35
 atg cac agg gga atc ccc aaa agc tcc aaa acc caa aca cat acc caa 48
 Met His Arg Gly Ile Pro Lys Ser Ser Lys Thr Gln Thr His Thr Gln
 1 5 10 15

caa gac cgc ccc cca caa ccc agc acc gaa ctc gaa gag acc agg acc 96
 Gln Asp Arg Pro Pro Gln Pro Ser Thr Glu Leu Glu Glu Thr Arg Thr
 20 25 30

tcc cga gca cga cac agc aca aca tca gct cag cga tcc acg cac tac 144
 Ser Arg Ala Arg His Ser Thr Thr Ser Ala Gln Arg Ser Thr His Tyr
 35 40 45

gat cct cga aca tcg gac aga ccc gtc tcc tac acc atg aac agg acc 192
 Asp Pro Arg Thr Ser Asp Arg Pro Val Ser Tyr Thr Met Asn Arg Thr
 50 55 60

agg tcc cgc aag caa acc agc cac aga ttg aag aac atc cca gtt cac 240
 Arg Ser Arg Lys Gln Thr Ser His Arg Leu Lys Asn Ile Pro Val His
 65 70 75 80

gga aac cac gag gcc acc atc cag cac ata cca gag agt gtc tca aaa 288
 Gly Asn His Glu Ala Thr Ile Gln His Ile Pro Glu Ser Val Ser Lys
 85 90 95

gga gcg aga tcc cag atc gaa agg cgg caa ccc aat gca atc aac tca 336
 Gly Ala Arg Ser Gln Ile Glu Arg Arg Gln Pro Asn Ala Ile Asn Ser
 100 105 110

ggc tct cat tgc acc tgg tta gtc ctg tgg tgc ctc gga atg gcc agt 384
 Gly Ser His Cys Thr Trp Leu Val Leu Trp Cys Leu Gly Met Ala Ser
 115 120 125

ctc ttt ctt tgt tcc aag gct cag ata cat tgg gat aat ttg tca act 432
 Leu Phe Leu Cys Ser Lys Ala Gln Ile His Trp Asp Asn Leu Ser Thr
 130 135 140

att ggg att atc ggg act gat aat gtc cat tac aag atc atg act agg 480
 Ile Gly Ile Ile Gly Thr Asp Asn Val His Tyr Lys Ile Met Thr Arg
 145 150 155 160

ccc agt cac cag tac ttg gtc ata aaa ttg atc cct aat gct tca ctt 528
 Pro Ser His Gln Tyr Leu Val Ile Lys Leu Ile Pro Asn Ala Ser Leu
 165 170 175

ata gag aat tgt acc aaa gca gaa tta ggt gag tat gag aaa tta ttg 576
 Ile Glu Asn Cys Thr Lys Ala Glu Leu Gly Glu Tyr Glu Lys Leu Leu
 180 185 190

aat tca gtc ctc gaa cca atc aac caa gct ttg act cta atg acc aag 624
 Asn Ser Val Leu Glu Pro Ile Asn Gln Ala Leu Thr Leu Met Thr Lys
 195 200 205

aat gtg aag ccc ctg cag tca tta ggg tca ggt agg aga caa agg cgt 672

Asn	Val	Lys	Pro	Leu	Gln	Ser	Leu	Gly	Ser	Gly	Arg	Arg	Gln	Arg	Arg		
210						215					220						
ttt	gca	gga	gtg	gta	ctt	gca	ggt	gta	gct	tta	gga	gtg	gct	aca	gct	720	
Phe	Ala	Gly	Val	Val	Leu	Ala	Gly	Val	Ala	Leu	Gly	Val	Ala	Thr	Ala		
225					230					235					240		
gca	caa	atc	act	gca	gga	ata	gct	tta	cat	caa	tcc	aac	ctc	aat	gct	768	
Ala	Gln	Ile	Thr	Ala	Gly	Ile	Ala	Leu	His	Gln	Ser	Asn	Leu	Asn	Ala		
				245					250						255		
caa	gca	atc	caa	tct	ctt	aga	acc	agc	ctt	gaa	cag	tct	aac	aaa	gct	816	
Gln	Ala	Ile	Gln	Ser	Leu	Arg	Thr	Ser	Leu	Glu	Gln	Ser	Asn	Lys	Ala		
			260						265						270		
ata	gaa	gaa	att	agg	gag	gct	acc	caa	gaa	acc	gtc	att	gcc	gtt	cag	864	
Ile	Glu	Glu	Ile	Arg	Glu	Ala	Thr	Gln	Glu	Thr	Val	Ile	Ala	Val	Gln		
		275						280							285		
gga	gtc	cag	gac	tac	gtc	aac	aac	gaa	ctc	gtc	cct	gcc	atg	caa	cat	912	
Gly	Val	Gln	Asp	Tyr	Val	Asn	Asn	Glu	Leu	Val	Pro	Ala	Met	Gln	His		
	290						295								300		
atg	tca	tgt	gaa	tta	gtt	ggg	cag	aga	tta	ggg	tta	aga	ctg	ctt	cgg	960	
Met	Ser	Cys	Glu	Leu	Val	Gly	Gln	Arg	Leu	Gly	Leu	Arg	Leu	Leu	Arg		
305					310						315				320		
tat	tat	act	gag	ttg	ttg	tca	ata	ttt	ggc	ccg	agt	tta	cgt	gac	cct	1008	
Tyr	Tyr	Thr	Glu	Leu	Leu	Ser	Ile	Phe	Gly	Pro	Ser	Leu	Arg	Asp	Pro		
				325						330					335		
att	tca	gcc	gag	ata	tca	att	cag	gca	ctg	att	tat	gct	ctt	gga	gga	1056	
Ile	Ser	Ala	Glu	Ile	Ser	Ile	Gln	Ala	Leu	Ile	Tyr	Ala	Leu	Gly	Gly		
			340						345						350		
gaa	att	cat	aag	ata	ctt	gag	aag	ttg	gga	tat	tct	gga	agt	gat	atg	1104	
Glu	Ile	His	Lys	Ile	Leu	Glu	Lys	Leu	Gly	Tyr	Ser	Gly	Ser	Asp	Met		
		355						360							365		
att	gca	atc	ttg	gag	agt	cgg	ggg	ata	aaa	aca	aaa	ata	act	cat	gtt	1152	
Ile	Ala	Ile	Leu	Glu	Ser	Arg	Gly	Ile	Lys	Thr	Lys	Ile	Thr	His	Val		
		370					375								380		
gat	ctt	ccc	ggg	aaa	ttc	atc	atc	cta	agt	atc	tca	tac	cca	act	tta	1200	
Asp	Leu	Pro	Gly	Lys	Phe	Ile	Ile	Leu	Ser	Ile	Ser	Tyr	Pro	Thr	Leu		
385					390						395				400		
tca	gaa	gtc	aag	ggg	gtt	ata	gtc	cac	aga	ctg	gaa	gca	gtt	tct	tac	1248	
Ser	Glu	Val	Lys	Gly	Val	Ile	Val	His	Arg	Leu	Glu	Ala	Val	Ser	Tyr		
				405						410					415		
aac	ata	gga	tca	caa	gag	tgg	tac	acc	act	gtc	ccg	agg	tat	att	gca	1296	
Asn	Ile	Gly	Ser	Gln	Glu	Trp	Tyr	Thr	Thr	Val	Pro	Arg	Tyr	Ile	Ala		
			420							425					430		
act	aat	ggt	tac	tta	ata	tct	aat	ttt	gat	gag	tca	tct	tgt	gta	ttc	1344	
Thr	Asn	Gly	Tyr	Leu	Ile	Ser	Asn	Phe	Asp	Glu	Ser	Ser	Cys	Val	Phe		
		435						440							445		
gtc	tca	gag	tca	gcc	att	tgt	agc	cag	aac	tcc	ctg	tat	ccc	atg	agc	1392	
Val	Ser	Glu	Ser	Ala	Ile	Cys	Ser	Gln	Asn	Ser	Leu	Tyr	Pro	Met	Ser		

450	455	460	
cca ctc tta caa caa tgt att agg ggc gac act tca tct tgt gct cgg			1440
Pro Leu Leu Gln Gln Cys Ile Arg Gly Asp Thr Ser Ser Cys Ala Arg			
465	470	475	480
acc ttg gta tct ggg act atg ggc aac aaa ttt att ctg tca aaa ggt			1488
Thr Leu Val Ser Gly Thr Met Gly Asn Lys Phe Ile Leu Ser Lys Gly			
	485	490	495
aat atc gtc gca aat tgt gct tct ata cta tgt aag tgt tat agc aca			1536
Asn Ile Val Ala Asn Cys Ala Ser Ile Leu Cys Lys Cys Tyr Ser Thr			
	500	505	510
agc aca att att aat cag agt cct gat aag ttg ctg aca ttc att gcc			1584
Ser Thr Ile Ile Asn Gln Ser Pro Asp Lys Leu Leu Thr Phe Ile Ala			
	515	520	525
tcc gat acc tgc cca ctg gtt gaa ata gat ggt gct act atc caa gtt			1632
Ser Asp Thr Cys Pro Leu Val Glu Ile Asp Gly Ala Thr Ile Gln Val			
	530	535	540
gga ggc agg caa tac cct gat atg gta tac gaa ggc aaa gtt gcc tta			1680
Gly Gly Arg Gln Tyr Pro Asp Met Val Tyr Glu Gly Lys Val Ala Leu			
	545	550	555
ggc cct gct ata tca ctt gat agg tta gat gta ggt aca aac tta ggg			1728
Gly Pro Ala Ile Ser Leu Asp Arg Leu Asp Val Gly Thr Asn Leu Gly			
	565	570	575
aac gcc ctt aag aaa ctg gat gat gct aag gta ctg ata gac tcc tct			1776
Asn Ala Leu Lys Lys Leu Asp Asp Ala Lys Val Leu Ile Asp Ser Ser			
	580	585	590
aac cag atc ctt gag acg gtt agg cgc tct tcc ttt aat ttt ggc agt			1824
Asn Gln Ile Leu Glu Thr Val Arg Arg Ser Ser Phe Asn Phe Gly Ser			
	595	600	605
ctc ctc agc gtt cct ata tta agt tgt aca gcc ctg gct ttg ttg ttg			1872
Leu Leu Ser Val Pro Ile Leu Ser Cys Thr Ala Leu Ala Leu Leu Leu			
	610	615	620
ctg att tac tgt tgt aaa aga cgc tac caa cag aca ctc aag cag cat			1920
Leu Ile Tyr Cys Cys Lys Arg Arg Tyr Gln Gln Thr Leu Lys Gln His			
	625	630	635
act aag gtc gat ccg gca ttt aaa cct gat cta act gga act tcg aaa			1968
Thr Lys Val Asp Pro Ala Phe Lys Pro Asp Leu Thr Gly Thr Ser Lys			
	645	650	655
tcc tat gtg aga tca ctc			1986
Ser Tyr Val Arg Ser Leu			
	660		

<210> 36
 <211> 662
 <212> PRT
 <213> canine distemper virus

<400> 36

Met His Arg Gly Ile Pro Lys Ser Ser Lys Thr Gln Thr His Thr Gln
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Gln Asp Arg Pro Pro Gln Pro Ser Thr Glu Leu Glu Glu Thr Arg Thr
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Ser Arg Ala Arg His Ser Thr Thr Ser Ala Gln Arg Ser Thr His Tyr
 35 40 45

Asp Pro Arg Thr Ser Asp Arg Pro Val Ser Tyr Thr Met Asn Arg Thr
 50 55 60

Arg Ser Arg Lys Gln Thr Ser His Arg Leu Lys Asn Ile Pro Val His
 65 70 75 80

Gly Asn His Glu Ala Thr Ile Gln His Ile Pro Glu Ser Val Ser Lys
 85 90 95

Gly Ala Arg Ser Gln Ile Glu Arg Arg Gln Pro Asn Ala Ile Asn Ser
 100 105 110

Gly Ser His Cys Thr Trp Leu Val Leu Trp Cys Leu Gly Met Ala Ser
 115 120 125

Leu Phe Leu Cys Ser Lys Ala Gln Ile His Trp Asp Asn Leu Ser Thr
 130 135 140

Ile Gly Ile Ile Gly Thr Asp Asn Val His Tyr Lys Ile Met Thr Arg
 145 150 155 160

Pro Ser His Gln Tyr Leu Val Ile Lys Leu Ile Pro Asn Ala Ser Leu
 165 170 175

Ile Glu Asn Cys Thr Lys Ala Glu Leu Gly Glu Tyr Glu Lys Leu Leu
 180 185 190

Asn Ser Val Leu Glu Pro Ile Asn Gln Ala Leu Thr Leu Met Thr Lys
 195 200 205

Asn Val Lys Pro Leu Gln Ser Leu Gly Ser Gly Arg Arg Gln Arg Arg
 210 215 220

Phe Ala Gly Val Val Leu Ala Gly Val Ala Leu Gly Val Ala Thr Ala
 225 230 235 240

Ala Gln Ile Thr Ala Gly Ile Ala Leu His Gln Ser Asn Leu Asn Ala
 245 250 255

Gln Ala Ile Gln Ser Leu Arg Thr Ser Leu Glu Gln Ser Asn Lys Ala
 260 265 270

Ile Glu Glu Ile Arg Glu Ala Thr Gln Glu Thr Val Ile Ala Val Gln
 275 280 285

Gly Val Gln Asp Tyr Val Asn Asn Glu Leu Val Pro Ala Met Gln His
 290 295 300

Met Ser Cys Glu Leu Val Gly Gln Arg Leu Gly Leu Arg Leu Leu Arg
 305 310 315 320

Tyr Tyr Thr Glu Leu Leu Ser Ile Phe Gly Pro Ser Leu Arg Asp Pro

				325					330					335			
Ile	Ser	Ala	Glu	Ile	Ser	Ile	Gln	Ala	Leu	Ile	Tyr	Ala	Leu	Gly	Gly		
			340					345					350				
Glu	Ile	His	Lys	Ile	Leu	Glu	Lys	Leu	Gly	Tyr	Ser	Gly	Ser	Asp	Met		
		355					360					365					
Ile	Ala	Ile	Leu	Glu	Ser	Arg	Gly	Ile	Lys	Thr	Lys	Ile	Thr	His	Val		
	370					375					380						
Asp	Leu	Pro	Gly	Lys	Phe	Ile	Ile	Leu	Ser	Ile	Ser	Tyr	Pro	Thr	Leu		
385					390					395					400		
Ser	Glu	Val	Lys	Gly	Val	Ile	Val	His	Arg	Leu	Glu	Ala	Val	Ser	Tyr		
			405						410					415			
Asn	Ile	Gly	Ser	Gln	Glu	Trp	Tyr	Thr	Thr	Val	Pro	Arg	Tyr	Ile	Ala		
			420					425					430				
Thr	Asn	Gly	Tyr	Leu	Ile	Ser	Asn	Phe	Asp	Glu	Ser	Ser	Cys	Val	Phe		
		435					440					445					
Val	Ser	Glu	Ser	Ala	Ile	Cys	Ser	Gln	Asn	Ser	Leu	Tyr	Pro	Met	Ser		
	450					455					460						
Pro	Leu	Leu	Gln	Gln	Cys	Ile	Arg	Gly	Asp	Thr	Ser	Ser	Cys	Ala	Arg		
465					470					475					480		
Thr	Leu	Val	Ser	Gly	Thr	Met	Gly	Asn	Lys	Phe	Ile	Leu	Ser	Lys	Gly		
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Asn	Ile	Val	Ala	Asn	Cys	Ala	Ser	Ile	Leu	Cys	Lys	Cys	Tyr	Ser	Thr		
			500					505					510				
Ser	Thr	Ile	Ile	Asn	Gln	Ser	Pro	Asp	Lys	Leu	Leu	Thr	Phe	Ile	Ala		
		515					520					525					
Ser	Asp	Thr	Cys	Pro	Leu	Val	Glu	Ile	Asp	Gly	Ala	Thr	Ile	Gln	Val		
	530					535					540						
Gly	Gly	Arg	Gln	Tyr	Pro	Asp	Met	Val	Tyr	Glu	Gly	Lys	Val	Ala	Leu		
545					550					555					560		
Gly	Pro	Ala	Ile	Ser	Leu	Asp	Arg	Leu	Asp	Val	Gly	Thr	Asn	Leu	Gly		
				565					570					575			
Asn	Ala	Leu	Lys	Lys	Leu	Asp	Asp	Ala	Lys	Val	Leu	Ile	Asp	Ser	Ser		
			580					585					590				
Asn	Gln	Ile	Leu	Glu	Thr	Val	Arg	Arg	Ser	Ser	Phe	Asn	Phe	Gly	Ser		
		595					600					605					
Leu	Leu	Ser	Val	Pro	Ile	Leu	Ser	Cys	Thr	Ala	Leu	Ala	Leu	Leu	Leu		
	610					615					620						
Leu	Ile	Tyr	Cys	Cys	Lys	Arg	Arg	Tyr	Gln	Gln	Thr	Leu	Lys	Gln	His		
625					630					635					640		
Thr	Lys	Val	Asp	Pro	Ala	Phe	Lys	Pro	Asp	Leu	Thr	Gly	Thr	Ser	Lys		
				645					650					655			

Ser Tyr Val Arg Ser Leu
660

专利名称(译)	使用重组抗原来确定动物的免疫状态		
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摘要(译)

本发明包括一种确定动物免疫状态的方法，该方法包括以下步骤：(a) 使动物的生物样本与重组感染因子抗原接触，所述重组感染因子抗原特异性地检测对该感染因子具有选择性的抗体，条件是适合于在重组抗原和抗体之间形成复合物，和(b) 检测复合物的存在或不存在，其中复合物的存在或不存在指示动物的免疫状态。优选地，这种方法表明动物是否应该接种疫苗。本发明还包括含有(a) 重组感染因子抗原的试验，该抗原特异性地检测对该感染因子具有选择性的抗体。(b) 检测选择性结合重组抗原的抗体的方法。本发明还包括重组抗原和编码这些抗原的核酸分子，以及产生和使用这种核酸分子和重组抗原的方法。