

TITLE

VLP BASED VACCINE DELIVERY SYSTEM

FIELD OF THE INVENTION

This invention relates to virus-like particles. More particularly, this invention
5 relates to engineered protein molecules for the production of chimeric polyoma virus-like particles.

BACKGROUND TO THE INVENTION

Not more so than in the modern era of global travel has the potential
catastrophic consequences of a pandemic arising from respiratory-borne pathogens
10 been so acute. As such there is a striking need for quick and efficient large-scale vaccine production. Influenza virus poses a particular threat because of its capacity to evade the adaptive immune response by mutation. Furthermore, the existence of a sizeable animal reservoir in birds of influenza increases the chance of rapid emergence.

15 Influenza viruses continuously undergo antigenic variation (antigenic drift and antigenic shift) to evade the immune system of the host. The antigenic variation of influenza viruses forms the primary basis for the occurrence of annual influenza epidemics and occasional pandemics and necessitates constant evolution of vaccine composition. Existing vaccine production methods for influenza rely upon either use
20 of embryonated eggs or cell culture, which are complex and time-consuming processes. Manufacture using these methods also requires specialized and costly infrastructure not widely available. In particular, the current lead time for initial delivery of even small amounts of influenza vaccine is several months following identification of a new pandemic strain. Clearly this amount of time is unacceptable

in view of the estimated 1.2 billion high-risk people that will need rapid vaccination with the new and possibly as-yet-unknown vaccine in the event of an influenza pandemic. Further, the ideal method of pandemic prevention is initial containment of outbreaks by rapid vaccination of the entire population in the geographical risk region, not only high-risk young and old. This must occur rapidly and certainly faster than is possible using current vaccine biomanufacturing technologies. The issues of speed and scale are daunting considering the complexity and slowness of existing influenza vaccine technologies, and the need for specialized infrastructure.

Virus-like particles (VLPs) provide a potentially powerful tool in a number of applications including as vaccines, as vehicles for delivery of small molecules and in gene therapy. The potential efficacy of VLP-based vaccines has been postulated for some time and has been demonstrated for cervical cancer vaccines. It is thought that the particulate nature of VLPs induces a more effective immune response than denatured or soluble proteins as immunogens.

VLPs have the added advantage that at no stage during biomanufacture is an infectious virus created. This is distinct to existing embryonated egg technologies and some cell-culture technologies where (i) the starting point of manufacture is the creation of an infectious virus, necessitating high biocontainment during manufacture, and (ii) the virus may be disassembled during processing to remove infectivity (i.e. to reduce the possibility that the vaccine itself might cause disease). This disassembly process has the disadvantage that the virus structure is destroyed and consequently that less-effective denatured or soluble immunogens are administered.

SUMMARY OF THE INVENTION

Due to increasing concern over the imminent threat of pandemic arising from respiratory-borne pathogens, there exists a need for broad-spectrum vaccines which can be rapidly and easily manufactured at large-scale and in swift response to disease
5 outbreak

In one broad form, the present invention is directed to a rapid response vaccine manufacturing technology against epidemic virus such as influenza but is not limited thereto. A preferred advantage of the present invention is an automated method using direct PCR ligation to create a multiplicity of antigenic VLPs
10 presenting different parts of a protein of interest.

In another broad form, the invention is directed to generation of a VP1-based VLP which has been engineered and/or modified to include a foreign protein, or a fragment thereof on the surface of said VLP.

In a first aspect, the invention provides an isolated protein comprising a
15 murine polyomavirus VP1 amino acid sequence wherein one or more exposed loops of said murine polyomavirus VP1 amino acid sequence has an insertion of an amino acid sequence of a virus protein other than murine polyomavirus VP1, or a fragment of said virus protein other than murine polyomavirus VP1.

It is contemplated that in particular embodiments that said one or more
20 exposed loops comprise an insertion site selected from the group consisting of site 1, site 3 and site 4.

Preferably, the one or more exposed loops comprise an insertion site selected from the group consisting of site 1 and site 4.

Preferably, the virus protein other than murine polyomavirus VP1 is derived

from influenza virus.

Suitably, although not limited thereto, the influenza virus is a H5N1 strain inclusive of variants and newly arising strains such as those resulting from antigenic drift and antigenic shift.

- 5 It is envisaged that the virus protein other than murine polyomavirus VP1 can be any class of viral protein which is capable of eliciting an immune response such as, but not limited to, transmembrane proteins, structural proteins and non-structural proteins, or a fragment thereof.

- In one embodiment, the virus protein other than murine polyomavirus VP1 is
10 an influenza virus protein selected from the group consisting of hemagglutinin (HA), neuraminidase (NA), nuclear protein (NP), matrix protein M1 and matrix protein M2.

 Preferably, the virus protein other than murine polyomavirus VP1 is selected from the group consisting of HA and M2.

- Advantageously, the virus protein other than VP1 corresponds to a
15 hypervariable region of HA.

 Preferably, the virus protein other than murine polyomavirus VP1 corresponds to an exposed loop of HA selected from the group consisting of loop A, loop B, loop C, loop D and loop E.

- More preferably, the exposed loop of HA is selected from the group
20 consisting of loop A and loop B.

 The invention further contemplates that the virus protein other than murine polyomavirus VP1 may be either the same protein in each insertion site or a different protein in each insertion site.

 In a second aspect, the invention provides for an isolated nucleic acid

encoding the isolated protein of the first aspect.

In one embodiment, the invention provides an isolated nucleic acid encoding a murine polyomavirus VP1 amino acid sequence which has been adapted to receive within one or more exposed loops of said murine polyomavirus VP1 amino acid
5 sequence, an isolated nucleic acid encoding a virus protein other than murine polyomavirus VP1.

In a third aspect, the invention provides an expression construct comprising an isolated nucleic acid according to the second aspect operably-linked to one or more regulatory sequences in an expression vector.

10 In a fourth aspect, the invention provides a host cell comprising the expression construct of the third aspect.

Preferably, the host cell is selected from the group consisting of a prokaryotic cell and an insect cell.

More preferably, the host cell is a bacterium.

15 In a fifth aspect, the invention provides a virus-like particle (VLP) comprising one or more isolated proteins of the first aspect.

In a sixth aspect, the invention provides a method of producing an isolated nucleic acid including the step of inserting into each of one or more nucleotide sequences that encode one or more exposed loops of a murine polyomavirus VP1
20 protein, a nucleotide sequence encoding a virus protein other than murine polyomavirus VP1, or a fragment of said nucleotide sequence encoding a virus protein other than murine polyomavirus VP1.

In a seventh aspect, the invention provides a method of producing a VLP including the steps of:

- (a) introducing the isolated nucleic acid of the second aspect or the expression construct of the third aspect into a host cell;
- (b) culturing said host cell under conditions which facilitate production of the isolated protein of the first aspect;
- 5 (c) optionally purifying the isolated protein of the first aspect; and
- (d) assembling the isolated protein purified according to step (c) to produce the VLP.

In an eighth aspect, the invention provides a pharmaceutical composition comprising an isolated protein, isolated nucleic acid or VLP according to any of the
10 aforementioned aspects and a pharmaceutically acceptable carrier, diluent or excipient.

Preferably, the pharmaceutical composition of the invention is an immunotherapeutic composition.

More preferably, the pharmaceutical composition is a vaccine.

15 Compositions according to this aspect may be used either prophylactically or therapeutically.

In a ninth aspect, the invention provides a method of treating an animal including the step of administering the pharmaceutical composition of the eighth aspect to prophylactically or therapeutically treat a disease, disorder or condition. It
20 will be appreciated that the disease, disorder or condition can be caused by any infectious organism for which a disease-specific or highly-disease associated antigen is, or will be known.

Preferably, the disease, disorder or condition is caused by a virus such as influenza virus, but is not limited thereto. More preferably, the disease, disorder or

condition is caused by an avian influenza virus.

In a tenth aspect, the invention provides a method of immunising an animal including the step of administering the pharmaceutical composition of the eighth aspect to said animal to thereby induce immunity in said animal.

5 An animal can be selected from the group consisting of humans, domestic livestock, laboratory animals, performance animals, companion animals, poultry and other animals of commercial importance, although without limitation thereto.

Preferably, the animal is a mammal.

More preferably, the animal is a human.

10 Throughout this specification, unless the context requires otherwise, the words “comprise”, “comprises” and “comprising” will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

BRIEF DESCRIPTION OF THE FIGURES

15 In order that the invention may be readily understood and put into practical effect, preferred embodiments will now be described by way of example with reference to the accompanying figures wherein like reference numerals refer to like parts and wherein:

Figure 1 Amino acid sequences of generic vectors. The sequences can be
20 identified as follows: VP1 (SEQ ID NO:87); VP1-S1 (SEQ ID NO: 88); VP1-S4 (SEQ ID NO:89); VP1-S3 (SEQ ID NO:90); VP1-S1-S3-S4 (SEQ ID NO:91).

Figure 2 Amino acid sequences of VP1-S1 vectors with inserted peptides. The sequences can be identified as follows: VP1-S1 (SEQ ID NO: 88); VP1-S1B (SEQ ID NO:92); VP1-S1A (SEQ ID NO:93); VP1-S1M2e (SEQ ID NO:94); VP1-

S1hM2e (SEQ ID NO:95).

Figure 3 Purification of GST-VP1-S1A using GSTrap HP column. X-axis is volume in ml; Y1 is absorbance in mAU; Y2 is conductivity in mS/cm. Line A represents the UV trace at 280nm; Line B represents conductivity trace; the vertical dashed line is the injection point of sample onto the column.

Figure 4 Buffer exchange on a desalting column. X-axis is volume in ml; Y1 is absorbance in mAU; Y2 is conductivity in mS/cm. Line A represents the UV trace at 280nm; Line B represents the conductivity trace; the vertical dashed line is the injection point of sample onto the column.

Figure 5 Second purification of GST-VP1-S1A on GSTrap HP column. X-axis is volume in ml; Y1 is absorbance in mAU; Y2 is conductivity in mS/cm. Line A represents the UV trace at 280nm; Line B represents the conductivity trace; the vertical dashed line is the injection point of sample onto the column; the horizontal dashed line is the P960 flow.

Figure 6 Lane 1: eluate after second GST affinity purification; Lane 2: cleavage of GST tag from VP1-S1A.

Figure 7 Size exclusion separation on Superdex 200 to purify VP1-S1A after thrombin treatment. X-axis is volume in ml; Y1 is absorbance in mAU; Y2 is conductivity in mS/cm. Line A represents UV trace at 280nm; Line C represents UV trace at 260nm; line B represents the conductivity trace; the vertical dashed line is the injection point of sample onto the column.

Figure 8 Purified VP1-S1A sample after separation by size exclusion chromatography on a Superdex 200. Lower and upper bands are calibration markers introduced into the purified sample during analysis preparation (i.e. are system

peaks).

Figure 9 AFFF plot showing assembled VLPs. X-axis is time (minutes) and Y-axis is rms radius (nm).

Figure 10 Electron micrograph images showing assembled VLPs.

5 Figure 11 Slot blot showing hM2e antibody reacting with VP1-S1hM2e capsomeres.

Figure 12 Amino acid sequence alignment of HA across various strains of H5N1 subtype of influenza A virus. The boxed regions marked "A" and "B" represent loops A and B respectively. The sequences of full length HA, loop A and loop B
 10 respectively may be identified as follows: DQ343152 (SEQ ID NO: 96; SEQ ID NO: 1 and SEQ ID NO:24); DQ343150 (SEQ ID NO:97; SEQ ID NO: 2 and SEQ ID NO:25); DQ343151 (SEQ ID NO: 98; SEQ ID NO: 3 and SEQ ID NO:26); DQ323672 (SEQ ID NO:99; SEQ ID NO: 4 and SEQ ID NO:27); DQ236085 (SEQ ID NO:100; SEQ ID NO: 5 and SEQ ID NO:28);DQ236077 (SEQ ID NO:101;SEQ
 15 ID NO: 6 and SEQ ID NO:29); DQ211925 (SEQ ID NO:102; SEQ ID NO: 7 and SEQ ID NO:30);DQ182483 (SEQ ID NO: 103; SEQ ID NO: 8 and SEQ ID NO:31); DQ023145 (SEQ ID NO:104; SEQ ID NO: 9 and SEQ ID NO:32); AY741221 (SEQ ID NO:105; SEQ ID NO: 10 and SEQ ID NO:33); AY741219 (SEQ ID NO: 106; SEQ ID NO: 11 and SEQ ID NO:34); AY741217 (SEQ ID NO:108; SEQ ID NO:12
 20 and SEQ ID NO:35); AY741215 (SEQ ID NO:109; SEQ ID NO:13 and SEQ ID NO:36); AY741213 (SEQ ID NO:110; SEQ ID NO:14 and SEQ ID NO:37); AY646175 (SEQ ID NO:111; SEQ ID NO:15 and SEQ ID NO:38); AY646167 (SEQ ID NO:112; SEQ ID NO:16 and SEQ ID NO:39); AY555153 (SEQ ID NO:113; SEQ ID NO:17 and SEQ ID NO:40); AB239125 (SEQ ID NO:114; SEQ ID NO:18 and

SEQ ID NO:41); AB233322 (SEQ ID NO:115; SEQ ID NO:19 and SEQ ID NO:42);
 AB233321 (SEQ ID NO:116; SEQ ID NO:20 and SEQ ID NO:43); AB233320 (SEQ
 ID NO:117; SEQ ID NO:21 and SEQ ID NO:44); AB233319 (SEQ ID NO: 118;
 SEQ ID NO:22 and SEQ ID NO:45); AB212649 (SEQ ID NO:119; SEQ ID NO:23
 5 and SEQ ID NO:46).

Figure 13 Amino acid sequence alignment of HA across various strains of H3N2
 subtype of influenza A virus. The boxed regions marked "A" and "B" represent loops
 A and B respectively. The sequences of full length HA, loop A and loop B
 respectively may be identified as follows: U97740 (SEQ ID NO:120; SEQ ID NO: 47
 10 and SEQ ID NO:61); P03437 (SEQ ID NO:121; SEQ ID NO: 48 and SEQ ID
 NO:62); J02132 (SEQ ID NO: 122; SEQ ID NO:49 and SEQ ID NO:63); J02090
 (SEQ ID NO:123; SEQ ID NO:50 and SEQ ID NO:64); DQ508929 (SEQ ID NO:124;
 SEQ ID NO:51 and SEQ ID NO:65); DQ508865 (SEQ ID NO:125; SEQ ID NO:52
 and SEQ ID NO:66); DQ508849 (SEQ ID NO:126; SEQ ID NO:53 and SEQ ID
 15 NO:67); DQ508833 (SEQ ID NO: 127; SEQ ID NO: 54 and SEQ ID
 NO:68); DQ508825 (SEQ ID NO: 128; SEQ ID NO:55 and SEQ ID
 NO:69); AY779254 (SEQ ID NO:129; SEQ ID NO:56 and SEQ ID
 NO:70); AY779253 (SEQ ID NO:130; SEQ ID NO:57 and SEQ ID
 NO:71); AB019356 (SEQ ID NO:131; SEQ ID NO:58 and SEQ ID
 20 NO:72); AB019354 (SEQ ID NO:132; SEQ ID NO:59 and SEQ ID
 NO:73); AAA43099 (SEQ ID NO: 133; SEQ ID NO:60 and SEQ ID NO:74).

Figure 14 Amino acid sequence alignment of VP1 vectors carrying HA loop A
 and loop B of influenza strain H3N2 inserted in S1 of VP1. The sequences can be
 identified as follows: VP1-S1 (SEQ ID NO:88); VP1-S1H3A (SEQ ID NO:134);

VP1-S1H3B (SEQ ID NO:135).

Figure 15 Amino acid sequence alignment of VP1 vectors carrying HA loop A and loop B of influenza strain H3N2 inserted into S4 of VP1. The sequences can be identified as follows: VP1-S4 (SEQ ID NO:89), VP1-S4-H3A (SEQ ID NO:136),

5 VP1-S4H3B (SEQ ID NO:137).

Figure 16 EM images of VP1-H3-S1A VLPs. Magnification is 200,000x (Scale-bar 100nm).

Figure 17 EM images of VP1-H3-S1B VLPs. Magnification is 200,000x. (Scale-bar 100nm).

10 Figure 18 Amino acid sequence alignment of VP1 vectors carrying HA loop A and loop B of influenza strain H5N1 inserted into S4 of VP1. The sequences can be identified as follows: VP1-S4 (SEQ ID NO:89), VP1-S4A (SEQ ID NO:138), VP1-S4B (SEQ ID NO:139), VP1-S4hM2e (SEQ ID NO: 140).

Figure 19 Purification of GST-VP1-S4A (Figure 19A) and GST-VP1-S4B
15 (Figure 19B) using GSTrap HP column. X-axis is volume in ml; Y1 is absorbance in mAU; Y2 is conductivity in mS/cm. Line A represents the UV trace at 280nm; Line C represents UV trace at 260nm; Line B represents the conductivity trace; the vertical dashed line is the injection point of sample onto the column.

Figure 20 Separation of thrombin digestion and capsomere purification of GST-
20 VP1-S4A (Figure 20A) and GST-VP1-S4B (Figure 20B) on a Superdex S200 10/300 GL size exclusion column (GE Healthcare). X-axis is volume in ml; Y1 is absorbance in mAU; Y2 is conductivity in mS/cm. Line A represents the UV trace at 280nm; ; Line C represents UV trace at 260nm; Line B represents conductivity trace; the vertical dashed line is the injection point of sample onto the column.

Figure 21 Comparison of GST-VP1 with GST-VP1-S4A and GST-VP1-S4B by bioanalyzer analysis.

Figure 22 AFFF plot showing assembled GST-VP1-S4A and GST-VP1-S4B VLPs. X-axis is time (minutes) and Y-axis is rms radius (nm).

5 Figure 23 EM images of VP1-S4A (Figure 23 A), VP1-S4B (Figure 23 B) and wild-type VP1 (Figure 23 C). Magnification of all images is 200,000x (scale-bar 100nm).

DETAILED DESCRIPTION OF THE INVENTION

The isolated proteins of the present invention and VLPs derived therefrom
10 provide a new and advantageous broad spectrum vaccine for treatment of emerging diseases and, in particular, influenza. Surprisingly, the inventors have utilised the natural mechanism which viruses have evolved to evade adaptive immunity to produce a broad-spectrum vaccine which can be manufactured rapidly in response to a new viral threat, has low manufacturing costs and low requirements for specialised
15 infrastructure during manufacture, and complies with regulatory standards.

In particular, present conventional approaches in eukaryotes to VLP vaccine production principally rely upon *in vivo* assembly of the VLP from overexpression of the viral proteins and extensive *ex vivo* post-expression processing to separate the VLP from structurally related contaminants, DNA and harmful unrelated viruses that
20 may be present as a result of the cell culture process or else through contamination during the extended times required for cell culture. Separation of the VLP from viruses having closely related physical properties presents a significant processing challenge. VLP vaccines to influenza based on eukaryotic expression of full-length HA and M protein, with or without co-expression of NA, also incorporate an ill-

defined membrane which is labile during processing, giving complex and heterogeneous VLP structures following purification. These problems with existing VLP vaccines remain largely unresolved for influenza vaccines, particularly for complex structures such as those comprising HA, M and/or NA protein that must be
5 assembled *in vivo*.

The present invention overcomes the purification-separation problems and avoids the creation of a VLP having a complex structure including a labile membrane. By creating a simple minimalist VLP structure, this invention enables disassembly-reassembly processing of the VLP structure.

10 For culture methods that create a relatively simple VLP structure *in vivo*, that is for example a VLP comprising one foreign protein, such VLPs can be disassembled and the VLP protein purified with high efficiency using conventional technologies widely available at large scale. Purified protein can be sterile filtered to ensure removal of adventitious virus, as routinely practised for conventional protein
15 therapeutics. Following the preparation of purified sterile-filtered protein, the VLP is recreated *in vitro* through appropriate chemical control of the reactor environment.

For culture methods that do not create a VLP structure *in vivo* (e.g. using fast-growing bacterium such as *E. coli*), the process of manufacture is further speeded and simplified. In such cases the current invention is not predicated on the availability of
20 specialised infrastructure nor extended cultivation times, allowing for rapid production in diverse manufacturing sites using technologies widely available for the production of protein therapeutics. The use of a simple and minimalist VLP structure allows for the creation of a VLP structure through *in vitro* assembly after protein expression and purification.

Regardless of the culture method employed, the approach of present invention of *in vitro* assembly following protein purification and sterile filtering provides for precise control of the VLP assembly step. The assembly of the VLP structure is under control of the process operator thus removing limitations inherent for *in vivo* assembly approaches. This improved control overcomes problems with conventional VLP technologies, and in particular, for influenza VLP vaccines, and produces a superior VLP which has higher morphological homogeneity. Precise control of VLP assembly also allows for the incorporation of precisely defined antigenic DNA sequences into the growing VLP structure, under the control of the process operator, giving opportunity for rapid evolution of vaccine design.

Isolated proteins

It is appreciated by a person of skill in the art that VP1 from polyomavirus is particularly well suited to the present invention. Preferably, the VP1 is derived from murine polyomavirus.

Although not wishing to be bound by any particular theory, the presence of loops on the surface of a virus particle provide ideal candidates for recognition by the immune system. Such loops are particularly suitable if tolerant to insertion of foreign sequences without disruption to the protein structure.

Although not limited thereto, VP1 comprises four surface exposed loops which span around about residues 82-89, 221-224, 247-249 and 292-297 and are referred to as site 1, site 2, site 3 and site 4 respectively. In the context of the present invention, typically, although not exclusively, at least one exposed loop site has an insertion. It can be appreciated that to facilitate generation of a more potent or, alternatively a broad-spectrum VLP, one, two, three or four sites may comprise an

insertion.

Preferably, one, two or three exposed loops comprise an insertion. More preferably, the one or more exposed loops comprising an insertion are selected from the group consisting of site 1, site 3 and site 4.

- 5 In more preferred embodiments, the one or more exposed loops comprising an insertion are selected from the group consisting of site 1 and site 4.

The isolated protein of the invention may be referred to hereinafter as a “*VPI chimera*”. By “*chimera*” is meant a fusion between at least two proteins or a fusion between fragments of said at least two proteins. Typically, although not exclusively,
10 the proteins are unrelated however it is readily contemplated that the proteins may be homologues.

By “*protein*” is meant an amino acid polymer. The amino acids may be natural or non-natural amino acids, D- or L- amino acids as are well understood in the art.

- 15 The term “*protein*” includes and encompasses “*peptide*”, which is typically used to describe a protein having no more than fifty (50) amino acids and “*polypeptide*”, which is typically used to describe a protein having more than fifty (50) amino acids.

For the purposes of this invention, by “*isolated*” is meant material that has
20 been removed from its natural state or otherwise been subjected to human manipulation. Isolated material may be substantially or essentially free from components that normally accompany it in its natural state, or may be manipulated so as to be in an artificial state together with components that normally accompany it in its natural state. Isolated material may be in native or recombinant form.

The invention also contemplates use of a fragment of the VP1 chimera or alternatively, a fragment of the virus protein other than VP1.

In one embodiment, a "*fragment*" includes a protein comprising an amino acid sequence that constitutes less than 100% of an amino acid sequence of an entire
5 VP1 or a virus protein other than VP1.

In the general embodiments which contemplate a fragment of the VP1 chimera, preferably the fragment comprises less than 99%, 98%, 97%, 96%, 95%, 94%, 93%, 92%, 91%, 90%, 85%, 80%, 75% or 70%, but greater than 50%, of the entire protein.

10 In the other general embodiments which contemplate a fragment of the virus protein other than VP1, preferably the fragment comprises less than 99%, 98%, 97%, 96%, 95%, 94%, 93%, 92%, 91%, 90%, 85%, 80%, 75%, 70%, 65%, 60%, 55% or 50% but can also relate to a peptide as hereinbefore described.

Preferably, the fragment is a "*biologically active*" fragment, which retains
15 biological, structural and/or physical activity of a given protein, or an encoding nucleic acid. In the context of VP1, the biologically active fragment preferably has the ability to self-assemble and form VLPs.

The choice of which virus protein other than VP1 to insert into the exposed loops can be made taking into account the particular desired end result. The invention
20 is well suited to proteins which are involved in eliciting an immune response to a pathogen such as, but not limited to, influenza virus, human immunodeficiency virus, hepatitis C virus, Ebola virus, measles virus, parainfluenza virus and respiratory syncytial virus. The invention is particularly suited to proteins that are subject to continuous alteration in circulating epidemic strains. It is envisaged that fragments

which correspond to antigenic epitopes of the virus protein other than VP1 can be used for insertion.

By "*corresponds to*" in the context of the present invention, is meant an amino acid sequence which shares primary sequence characteristics of another amino acid sequence but is not necessarily derived or obtained from the same source as said
5 another amino acid sequence.

In one embodiment, the virus protein other than VP1 is a protein from influenza virus such as HA, NP, NA, M1 or M2.

In a preferred embodiment, the virus protein other than VP1 is selected from
10 the group consisting of HA and M2.

In another preferred embodiment, the virus protein other than VP1 is a domain of M2. Typically, although not exclusively, the domain of M2 is an ectodomain.

In particular preferred embodiments, the virus protein other than VP1 corresponds to an exposed loop of HA selected from the group consisting of loop A,
15 loop B, loop C, loop D and loop E, or a fragment thereof. Preferably, the exposed loop of HA is selected from the group consisting of loop A, loop B, loop C and loop E. More preferably, the exposed loop of HA is selected from the group consisting of loop A and loop B.

In other particular preferred embodiments, the fragment of a virus protein other
20 than VP1 is an antigenic epitope. In more preferred embodiments, the fragment is an antigenic epitope of HA. In even more preferred embodiments, the fragment is an antigenic epitope of an exposed loop of HA selected from the group consisting of loop A, loop B, loop C and loop E.

A person skilled in the art will appreciate that viruses have evolved a number

of mechanisms to evade the host cell immune response and, as a consequence, lead to generation of escape mutants. One such mechanism is the presence of a region within a virus protein/s with a high degree of variability, the so named hypervariable region.

It will further be appreciated that the variability within an antigenic epitope
5 between virus subtypes, and in particular influenza virus subtypes, can be substantial. Advantageously, although not exclusively, loop A and loop B comprise a minimal region which display a high degree of variability across virus subtypes.

Therefore in general embodiments where the virus protein other than VP1 is HA derived from a H5 subtype of influenza virus, at least one consensus amino acid
10 sequence for an antigenic epitope of loop A is PYqGKSS (SEQ ID NO:75) (there is common q<-->N and K<-->R variability) whereas at least one consensus sequence for an antigenic epitope of loop B is PNDAAEQTKLYQNPTTY (SEQ ID NO:76) (there is common K<-->R variability), although without limitation thereto.

In other general embodiments where the virus protein other than VP1 is HA
15 derived from a H3 subtype of influenza virus, at least one consensus amino acid sequence for an antigenic epitope of loop A is KRGPgSG (SEQ ID NO:77) (there is common PgS<-->PaS variability) whereas at least one consensus amino acid sequence for an antigenic epitope of loop B is PSTNQEQTsLYVQASGR (SEQ ID NO:78) (there is common TsL<-->TNL variability), although without limitation
20 thereto.

In yet other general embodiments where the virus protein other than VP1 is HA derived from a H1 subtype of influenza virus, at least one consensus amino acid sequence for an antigenic epitope of loop A is SHK GKSS (SEQ ID NO:79), whereas at least one consensus amino acid sequence of loop B is PSNIEDQKTIYRKENAY

(SEQ ID NO:80), although without limitation thereto.

The present invention also contemplates variants of the virus protein other than VP1.

In light of the foregoing, it will be appreciated that a variant includes within its
5 scope a natural variant such as, although not limited to, a variant arising from natural
antigenic variation of a virus wherein one or more residues are different to at least
one consensus sequence. It will be appreciated that an absence of primary amino acid
consensus sequence between antigenic epitopes from different virus subtypes is not
unexpected considering the propensity for a number of viruses, including influenza,
10 to undergo antigenic shift and antigenic drift in order to generate escape mutants.
Hence a variant includes variation within the subtypes of a virus and/or variation
between subtypes of a virus, but is not limited thereto. By way of example only, at
least one consensus amino acid sequence for loop A derived from a H5 variant of
influenza A virus is PYNGKSS (SEQ ID NO: 81) whereas the corresponding region
15 in HA from H3 subtype is KRGPGSG (SEQ ID NO: 82).

According to the aforementioned embodiments, variants are contemplated
where the substitutions in amino acid sequences are conservative in nature.

Exemplary variant antigenic epitopes of loop A and loop B from HA are listed
in Figure 12 and Figure 13.

20 Therefore it is further contemplated that either a hypervariable region or a
conserved region of a virus protein other than VP1 may be inserted into the VP1
chimera, or a combination thereof.

The invention therefore also contemplates variants of epitopes, isolated
proteins and encoding nucleic acids which share an appropriate level of sequence

identity with isolated proteins and encoding nucleic acids as set forth herein.

The term "*sequence identity*" is used herein in its broadest sense to include the number of exact nucleotide or amino acid matches having regard to an appropriate alignment using a standard algorithm, having regard to the extent that sequences are
5 identical over a window of comparison. Thus, a "*percentage of sequence identity*" is calculated by comparing two optimally aligned sequences over the window of comparison, determining the number of positions at which the identical nucleic acid base (e.g., A, T, C, G, U) or amino acid residue occurs in both sequences to yield the number of matched positions, dividing the number of matched positions by the total
10 number of positions in the window of comparison (i.e., the window size), and multiplying the result by 100 to yield the percentage of sequence identity. For example, "*sequence identity*" may be understood to mean the "match percentage" calculated by the DNASIS computer program (Version 2.5 for windows; available from Hitachi Software engineering Co., Ltd., South San Francisco, California, USA).

15 In particular embodiments, variants will share at least 30%, 40%, 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85% or 90% and more preferably at least 95%, 96%, 97%, 98% or 99% sequence identity with the isolated proteins and/or isolated nucleic acids of the invention. It will be appreciated that a variant comprises all integer values less than 100%, for example the percent value as set forth above and others.

20 The VP1 chimera may also comprise one or more additional amino acid sequences. "*Additions*" of amino acids may include fusion of a VP1 protein of the invention or a fragment thereof with other proteins or peptides. The other protein may, by way of example, assist in the purification of the protein. For instance, these include a polyhistidine tag, maltose binding protein (MBP), green fluorescent protein

(GFP), Protein A or glutathione S-transferase (GST). Other additions include "epitope tags" such as FLAG and c-myc epitope tags. It is further contemplated that more than one fusion partner may be included into the isolated protein.

Well known examples of fusion partners include, but are not limited to, glutathione-S-transferase (GST), Fc portion of human IgG, maltose binding protein (MBP), NusA and hexahistidine (HIS₆), which are particularly useful for isolation of the fusion protein by affinity chromatography. For the purposes of fusion protein purification by affinity chromatography, relevant matrices for affinity chromatography are glutathione-, amylose-, and nickel- or cobalt-conjugated resins respectively. Many such matrices are available in "kit" form, such as the QIAexpressTM system (Qiagen) useful with (HIS₆) fusion partners and the Pharmacia GST purification system.

In some cases, the fusion partners also have protease cleavage sites, such as for Factor X_a, Thrombin or human rhinovirus 3C protease, which allow the relevant protease to partially digest the fusion protein of the invention and thereby liberate the recombinant protein of the invention therefrom. The liberated protein can then be isolated from the fusion partner by subsequent chromatographic separation.

The invention also contemplates chemical derivatives of the VP1 chimera, such as produced using techniques described in CURRENT PROTOCOLS IN PROTEIN SCIENCE Chapter 15, for example.

In particularly preferred embodiments, the isolated protein or VP1 chimera of the present invention comprises an amino acid sequence selected from the group consisting of SEQ ID NO:92; SEQ ID NO:93; SEQ ID NO:94; SEQ ID NO:95; SEQ ID NO:134; SEQ ID NO:135; SEQ ID NO:136; SEQ ID NO:137; SEQ ID NO:138;

SEQ ID NO:139; and SEQ ID NO: 140.

Isolated nucleic acids and expression constructs

It will be appreciated from the foregoing and also from pharmaceutical compositions described in more detail hereinafter, that the invention also provides
5 use of an isolated nucleic acid encoding the VP1 chimeric protein of the invention. Non-limiting examples of isolated nucleic acids are provided in Figures 1 and 2.

The term “*nucleic acid*” as used herein designates single-or double-stranded mRNA, RNA, cRNA and DNA inclusive of cDNA, genomic DNA and DNA-RNA hybrids. Nucleic acids may also be conjugated with fluorochromes, enzymes and
10 peptides as are well known in the art.

A “*probe*” may be a single or double-stranded oligonucleotide or polynucleotide, suitably labeled for the purpose of detecting complementary sequences in Northern or Southern blotting, for example.

A “*primer*” is usually a single-stranded oligonucleotide, preferably having 15-
15 50 contiguous nucleotides, which is capable of annealing to a complementary nucleic acid “template” and being extended in a template-dependent fashion by the action of a DNA polymerase such as *Taq* polymerase, RNA-dependent DNA polymerase or SequenaseTM.

It can be readily appreciated by a person of skill in the art that the isolated
20 nucleic acids of the present invention may be produced and manipulated using an assortment of recombinant techniques. Examples of preparation of such isolated nucleic acids is given in Examples 1 and 2.

In a preferred embodiment, the nucleotide sequences encoding the one or more exposed loops of VP1 are adapted to receive an isolated nucleic acid encoding a

virus protein other than VP1. By "*adapted to receive*" is meant the manipulation, by recombinant means or other, of nucleotide sequences in order to facilitate insertion, excision or mutagenesis of native or foreign nucleotide sequences. By way of example only, a nucleotide sequence may be engineered to incorporate new
5 restriction enzyme sites in order to improve the speed and efficiency of cloning procedures. Although not limited thereto, restriction enzymes that do not create an overhang are the most amenable to high speed cloning of amplification products generated by PCR with super high-fidelity polymerases such as *Pfx*. A nucleotide sequence adapted in such a manner is also amenable to high-throughput screening of
10 vaccine candidates.

A person of skill in the art would readily appreciate that mutagenesis can be performed using an assortment of recombinant techniques. Non-limiting examples of suitable techniques include random mutagenesis (*e.g.*, transposon mutagenesis), oligonucleotide-mediated (or site-directed) mutagenesis, PCR mutagenesis and
15 cassette mutagenesis.

In a preferred embodiment, the isolated nucleic acid comprises a nucleotide sequence encoding the VP1 chimera wherein the nucleotide sequence of one or more exposed loops has been mutated to include a recognition site for a restriction enzyme which generates blunt-ends.

20 The invention also contemplates variant VP1 nucleic acids having one or more codon sequences altered by taking advantage of codon sequence redundancy.

A particular example of a variant VP1 nucleic acid is optimization of a nucleic acid sequence according to codon usage, as is well known in the art. This can effectively "tailor" a nucleic acid for optimal expression in a particular organism, or

cells thereof, where preferential codon usage has been established.

The invention further contemplates an expression construct comprising an isolated nucleic acid encoding the VP1 chimera operably-linked to one or more regulatory sequences in an expression vector.

- 5 An “*expression vector*” may be either a self-replicating extra-chromosomal vector such as a plasmid, or a vector that integrates into a host genome, inclusive of vectors of viral origin such as adenovirus, lentivirus, poxvirus and flavivirus vectors as are well known in the art.

- By “*operably linked*” is meant that said regulatory nucleotide sequence(s)
10 is/are positioned relative to the recombinant nucleic acid of the invention to initiate, control, regulate or otherwise direct transcription and/or other processes associated with expression of said nucleic acid.

- Regulatory nucleotide sequences will generally be appropriate for the host cell used for expression. Numerous types of appropriate expression vectors and
15 suitable regulatory sequences are known in the art for a variety of host cells.

- Typically, said one or more regulatory nucleotide sequences may include, but are not limited to, promoter sequences, leader or signal sequences, ribosomal binding sites, transcriptional start and termination sequences, translational start and termination sequences, splice donor/acceptor sequences, enhancer or activator
20 sequences and nucleic acid packaging signals.

 Preferably, said promoter is operable in a bacterial cell. Non-limiting examples include T7 promoter, *tac* promoter and T5 promoter.

 Inducible/repressible promoters (such as *tet*-repressible promoters and IPTG-, alcohol-, metallothionine- or ecdysone-inducible promoters) are well known in the art

and are contemplated by the invention, as are tissue-specific promoters such as α -crystallin promoters. It will also be appreciated that promoters may be hybrid promoters that combine elements of more than one promoter (such as SR α promoter).

5 The expression construct may also include a fusion partner (typically provided by the expression vector) so that the VP1 chimera is expressed as a fusion protein with said fusion partner, as hereinbefore described. Expression constructs may also include a selection marker nucleic acid that confers transformed host cell resistance to a selection agent. Selection markers useful for the purposes of selection
10 of transformed bacteria include *bla*, *kanR* and *tetR* while transformed eukaryotic cells may be selected by markers such as hygromycin, G418 and puromycin, although without limitation thereto.

Expression constructs may be introduced into cells or tissues, inclusive of cells capable of VLP production, by any of a number of well known methods
15 typically referred to as “*transfection*” “*transduction*”, “*transformation*” and the like. Non-limiting examples of such methods include transformation by heat shock, electroporation, DEAE-Dextran transfection, microinjection, liposome-mediated transfection (e.g. lipofectamine, lipofectin), calcium phosphate precipitated transfection, viral transformation, protoplast fusion, microparticle bombardment and
20 the like.

It is readily contemplated that any recombinant protein expression system may be used for the present invention such as bacterial, yeast, plant, mammalian and insect-based expression systems but is not limited thereto.

In one preferred embodiment, recombinant protein expression occurs in cells

of prokaryotic origin. Suitable host cells for recombinant protein expression are bacterial cells such as *Escherichia coli* (BL21 and various derivative strains thereof which have been optimised for certain applications, such as Rosetta, for example).

Methodology for production of VLPs

5 One broad application of the isolated proteins, isolated nucleic acids and expression constructs of the present invention is a platform technology for production of a vaccine. In particular, the present invention facilitates rapid assembly and production of VLPs *in vitro*.

Many methods are well known in the art for VLP assembly. Pattenden and co-
10 workers (2005, Trends in Biotechnology 10: 523-529) provides a non-limiting example of such methodology. The present invention readily contemplates both *in vivo* and *in vitro* approaches to VLP assembly however the invention is particularly suited to *in vitro* processes for assembly of VLPs. Advantages conferred by *in vitro* methods include high compositional consistency and a process which is readily
15 controlled and amenable to scale-up.

Typically, although not exclusively, *in vitro* assembly method of VLPs comprises overexpression of a pentameric subunit of a self-assembly protein, such as VP1 or the VP1 chimera of the present invention, in a recombinant expression system as described above. Although not limited thereto, advantageously the recombinant
20 protein is expressed in the soluble fraction of the cell. The recombinant protein may be subsequently purified using a combination of tag removal, filtration and/or chromatography techniques, followed by sterile filtration, which are well known in the art. This lack of a requirement for specialised infrastructure and the use of well-known readily scaleable operations makes the current invention distinctly

advantageous. Subsequent self-assembly of these subunits into a VLP is achieved by means of controlled changes in the physicochemical environment containing these subunits. By way of example only, assembly of VLPs may be more favourable under high salt or alternatively, low salt conditions. Inclusion and/or removal of low molecular weight compounds such as glycerol and carbohydrates may also facilitate the assembly reaction. Methods typically known in the art such as buffer exchange by dialysis, dilution or size exclusion chromatography may be utilised to effect the changes in the physicochemical conditions of the subunits, but is not limited thereto.

A recombinant protein may be conveniently prepared by a person skilled in the art using standard protocols as for example described in Sambrook *et al.*, MOLECULAR CLONING. A Laboratory Manual (Cold Spring Harbor Press, 1989), incorporated herein by reference, in particular Sections 16 and 17; CURRENT PROTOCOLS IN MOLECULAR BIOLOGY Eds. Ausubel *et al.*, (John Wiley & Sons, Inc. 1995-1999), incorporated herein by reference, in particular Chapters 10 and 16; and CURRENT PROTOCOLS IN PROTEIN SCIENCE Eds. Coligan *et al.*, (John Wiley & Sons, Inc. 1995-1999) which is incorporated by reference herein, in particular Chapters 1, 5 and 6.

By “purify”, “purified” and “purification”, particularly in the context of recombinant protein purification, is meant enrichment of a recombinant protein so that the relative abundance and/or specific activity of said recombinant protein is increased compared to that before enrichment.

By “chromatography” such as in the context of chromatographic steps of the invention, is meant any technique used for the separation of biomolecules (eg protein and/or nucleic acids) from complex mixtures that employs two phases: a stationary

bed phase and a mobile phase that moves through the stationary bed. Molecules may be separated on the basis of a particular physicochemical property such as charge, size, affinity and hydrophobicity.

Chromatography may be performed by a person skilled in the art using
5 standard protocols as for example described in CURRENT PROTOCOLS IN
PROTEIN SCIENCE Eds. Coligan *et al.*, (John Wiley & Sons, Inc. 1995-1999)
which is incorporated by reference herein, in particular Chapters 8 and 9.

The invention also readily contemplates overexpression of the isolated
proteins and isolated nucleic acids of the present invention to generate an intact VLP,
10 which obviates the need for an *in vitro* assembly process. A person skilled in the art
will appreciate that there are a variety of expression systems which are suited for this
application such as, but not limited to, mammalian-based and insect-based expression
systems. In general embodiments, the baculovirus expression system is particularly
amenable to expression of an intact VLP of the invention.

15 It will be appreciated that because of the flexibility of the present invention, a
VLP assembled according to the method of the present invention may comprise a
VP1 backbone with the following combinations inserted into the exposed loops: (a) a
single protein from a single virus; (b) a plurality of different proteins from the same
virus; or (c) a mixture of proteins from various viruses. The present invention is also
20 readily amenable to production of a mixed population of VLPs wherein one or more
VP1 chimeras according to (a), (b) or (c) are assembled into VLPs to thereby produce
a multivalent vaccine delivery system. The present invention is also contemplates
production of a mixed population of VLPs by means of introduction of one or more
expression constructs into a cell.

Pharmaceutical and immunotherapeutic compositions, vaccines and methods of treatment

The present invention provides a VP1 chimera which exploits the self-assembly capacity of VP1 and the potential immunogenicity of exposed loops as a vehicle for delivery for VLP production and vaccine delivery. However, the invention more broadly provides a pharmaceutical composition not limited to use in vaccine delivery, but inclusive of pharmaceutical compositions in several forms such as vessels for the delivery of a number of palliatives such as, but not limited to, small molecules, catalytic nucleic acids such as ribozymes and nucleic acids for gene therapy.

The pharmaceutical composition may further comprise a pharmaceutically-acceptable carrier, diluent or excipient.

In a preferred form, the pharmaceutical composition of the invention is an immunogenic composition comprising an isolated protein, isolated nucleic acid or VLP and an immunologically acceptable carrier, diluent or excipient.

By “*immunogenic*” is meant capable of eliciting an immune response, preferably a protective immune response, upon administration to a host.

Thus in a particular form, the immunogenic composition of the invention may be a vaccine which induces a protective immune response when administered to a host.

It will be appreciated that compositions, vaccines and methods of treatment may be used therapeutically or prophylactically.

Suitably, the immunogenic composition and/or vaccine of the invention is administrable to an animal host, inclusive of domestic animals, livestock,

performance animals and humans.

Any suitable procedure is contemplated for producing vaccine compositions. Exemplary procedures include, for example, those described in New Generation Vaccines (1997, Levine *et al.*, Marcel Dekker, Inc. New York, Basel, Hong Kong)

5 which is incorporated herein by reference.

As hereinbefore described, the immunogenic composition and/or vaccine of the invention may include an “*immunologically-acceptable carrier, diluent or excipient*”.

Useful carriers are well known in the art and include for example:

10 thyroglobulin; albumins such as human serum albumin; toxins, toxoids or any mutant crossreactive material (CRM) of the toxin from tetanus, diphtheria, pertussis, *Pseudomonas*, *E. coli*, *Staphylococcus*, and *Streptococcus*; polyamino acids such as poly(lysine:glutamic acid); influenza; Rotavirus VP6, Parvovirus VP1 and VP2; hepatitis B virus core protein; hepatitis B virus recombinant vaccine and the like.

15 Alternatively, a fragment or epitope of a carrier protein or other immunogenic protein may be used. For example, a T cell epitope of a bacterial toxin, toxoid or CRM may be used. In this regard, reference may be made to U.S. Patent No 5,785,973 which is incorporated herein by reference.

The “*immunologically-acceptable carrier, diluent or excipient*” includes

20 within its scope water, bicarbonate buffer, phosphate buffered saline or saline and/or an adjuvant as is well known in the art.

As will be understood in the art, an “*adjuvant*” means one or more substances that enhances the immunogenicity and/or efficacy of a vaccine composition. Non-limiting examples of suitable adjuvants include squalane and squalene (or other

- oils of animal origin); block copolymers; detergents such as Tween®-80; Quil® A, mineral oils such as Drakeol or Marcol, vegetable oils such as peanut oil; *Corynebacterium*-derived adjuvants such as *Corynebacterium parvum*; *Propionibacterium*-derived adjuvants such as *Propionibacterium acne*;
- 5 *Mycobacterium bovis* (Bacille Calmette and Guerin or BCG); interleukins such as interleukin 2 and interleukin 12; monokines such as interleukin 1; tumour necrosis factor; interferons such as gamma interferon; surface active substances such as hexadecylamine, octadecylamine, octadecyl amino acid esters, lysolecithin, dimethyldioctadecylammonium bromide, *N,N*-dioctadecyl-*N'*, *N'*bis(2-
- 10 hydroxyethyl-propanediamine), methoxyhexadecylglycerol, and pluronic polyols; polyamines such as pyran, dextran sulfate, poly IC carbopol; peptides such as muramyl dipeptide and derivatives, dimethylglycine, tuftsin; oil emulsions; and mineral gels such as aluminum phosphate, aluminum hydroxide or alum; combinations such as saponin-aluminium hydroxide or Quil-A aluminium hydroxide;
- 15 liposomes; ISCOM® and ISCOMATRIX® adjuvant; mycobacterial cell wall extract; synthetic glycopeptides such as muramyl dipeptides or other derivatives; Avridine; Lipid A derivatives; dextran sulfate; DEAE-Dextran or with aluminium phosphate; carboxypolymethylene such as Carbopol' EMA; acrylic copolymer emulsions such as Neocryl A640 (e.g. U.S. Pat. No. 5,047,238); vaccinia or animal poxvirus proteins;
- 20 sub-viral particle adjuvants such as cholera toxin, or mixtures thereof.

Any safe route of administration may be employed for providing a patient with the immunotherapeutic composition of the invention. For example, oral, rectal, parenteral, sublingual, buccal, intravenous, intra-articular, intra-muscular, intra-dermal, subcutaneous, intranasal, inhalational, intraocular, intraperitoneal,

intracerebroventricular, transdermal and the like may be employed. Intra-muscular and subcutaneous injection is appropriate, for example, for administration of immunogenic compositions and vaccines.

Dosage forms include tablets, dispersions, powders, suspensions, injections, solutions, syrups, troches, capsules, suppositories, aerosols, transdermal patches and the like. These dosage forms may also include injecting or implanting controlled releasing devices designed specifically for this purpose or other forms of implants modified to act additionally in this fashion. Controlled release of the therapeutic agent may be effected by coating the same, for example, with hydrophobic polymers including acrylic resins, waxes, higher aliphatic alcohols, polylactic and polyglycolic acids and certain cellulose derivatives such as hydroxypropylmethyl cellulose. In addition, the controlled release may be effected by using other polymer matrices, liposomes and/or microspheres.

Pharmaceutical compositions of the present invention suitable for oral or parenteral administration may be presented as discrete units such as capsules, sachets or tablets each containing a pre-determined amount of one or more therapeutic agents of the invention, as a powder or granules or as a solution or a suspension in an aqueous liquid, a non-aqueous liquid, an oil-in-water emulsion or a water-in-oil liquid emulsion. Such compositions may be prepared by any of the methods of pharmacy but all methods include the step of bringing into association one or more agents as described above with the carrier which constitutes one or more necessary ingredients. In general, the compositions are prepared by uniformly and intimately admixing the agents of the invention with liquid carriers or finely divided solid carriers or both, and then, if necessary, shaping the product into the desired

presentation.

The above compositions may be administered in a manner compatible with the dosage formulation, and in such amount as is pharmaceutically-effective. The dose administered to a patient, in the context of the present invention, should be
5 sufficient to effect a beneficial response in a patient over an appropriate period of time. The quantity of agent(s) to be administered may depend on the subject to be treated inclusive of the age, sex, weight and general health condition thereof, factors that will depend on the judgement of the practitioner.

Immunotherapeutic compositions of the invention may be used to
10 prophylactically or therapeutically immunize animals such as humans.

However, other animals are contemplated, preferably vertebrate animals including domestic animals such as livestock and companion animals.

Immune responses may be induced against viruses by expressing appropriately immunogenic proteins and peptide epitopes inclusive of polyepitopes
15 using the vaccine of the invention. A non-limiting list of potential viruses include influenza virus, human immunodeficiency virus, hepatitis C virus, Ebola virus, measles virus, parainfluenza virus and respiratory syncytial virus.

It is envisaged that an immune response involves induction of antibodies and/or T-cells.

20 So that the invention may be readily understood and put into practical effect, the following non-limiting Examples are provided.

EXAMPLES

Example 1

Construction of generic vectors carrying VP1 sequences able to accept antigenic

peptide sequences

Murine polyomavirus VP1 sequence (GenBank accession number: M34958) was cloned between the *Bam*HI and *Xho*I sites within the multiple cloning site of the commercial vector pGEX-4T-1 (GE healthcare). Surface-exposed loops of polyomavirus VP1 are known as Site 1, Site 2, Site 3 and Site 4. These sites can tolerate insertion of peptide sequences without disrupting the structure of VP1.

Sites 1-4 (S1-4) were identified on murine polyomavirus VP1 (GenBank accession number: M34958). Three unique blunt-end restriction sites were created in the S1, S3 and S4 of VP1. No restriction site was created in S2 as it is not a favourable site for insertion of foreign peptides. Blunt-end restriction sites were chosen, as they allowed rapid cloning of any peptide sequences into VP1 without the need to create sticky ends on vectors/inserts. This strategy also removes the possibility of incompatible restriction sites that may be present on target peptide sequence.

The amino acid sequence of VP1 present in the generic vectors is depicted in Figure 1. S1 of VP1 was mutated to include *Nae*I restriction site (LATSDTDED; SEQ ID NO: 107 mutated to LATSAGTED; SEQ ID NO: 141). S3 of VP1 was mutated to include *Pml*I restriction site (GTTT; SEQ ID NO: 142 mutated to GTHV; SEQ ID NO: 143). S4 of VP1 was mutated to include *Afe*I restriction site (TRNYDV; SEQ ID NO: 144 mutated to TRSAYDV; SEQ ID NO: 145).

Resulting generic vectors with modified VP1 sequences to enable the insertion of one or multiple foreign peptides are: pGEX4T1-VP1 S1, pGEX4T1-VP1 S3, pGEX4T1-VP1 S4, pGEX4T1-VP1 S1/S4 and pGEX4T1-VP1 S1/S3/S4.

Example 2

25 Construction and sequencing of vectors expressing a foreign antigen

Construction and sequencing of vectors carrying HA epitopes from loop A and loop B of H5N1:

E. coli codon optimised oligonucleotides were designed for epitopes A (7 amino acids, PYNGKSS) and B (17 amino acids, PNDAAEQTKLYQNPTTY) for insertion
 5 into generic vectors. The sequences of epitopes A and B are of H5N1 (A/Vietnam/3028/2004).

Resulting constructs carrying either HA epitopes A or B are pGEX4T1-VP1 S1A, pGEX4T1-VP1 S1/S3/S4 1A, pGEX4T1-VP1 S1/S3/S4 3A, pGEX4T1-VP1 S1/S3/S4 4A, pGEX4T1-VP1 S1B, pGEX4T1-VP1 S1/S3/S4 1B, pGEX4T1-VP1
 10 S1/S3/S4 3B and pGEX4T1-VP1 S1/S3/S4 4B.

Construction of vectors carrying M2e:

E. coli codon optimised oligonucleotides were designed to insert M2e peptide (SLLTEVETPTRNEWECRCSDSSD; SEQ ID NO: 83) into the generic vectors.

Resulting constructs carrying M2e are designated pGEX4T1-VP1 S1M2e,
 15 pGEX4T1-VP1 S1/S3/S4 1M2e, pGEX4T1-VP1 S1/S3/S4 3M2e and pGEX4T1-VP1 S1/S3/S4 4M2e.

Construction of vectors carrying hM2e:

hM2e (23 amino acids) antibody is commercially available and has been shown to target the specific hM2e amino acid sequence
 20 (SLLTEVETPIRNEWGCRCNDSSD; SEQ ID NO: 84).

E. coli codon optimised oligos for hM2e were designed to insert hM2e into the generic vectors. This system is used as a proof-of-concept model since no commercial antibody against other cloned peptides is available.

Resulting constructs carrying hM2e are designated as follows pGEX4T1-VP1 S1hM2e, pGEX4T1-VP1 S1/S3/S4 1hM2e, pGEX4T1-VP1 S1/S3/S4 3hM2e and pGEX4T1-VP1 S1/S3/S4 4hM2e.

The amino acid sequence of VP1-S1 with inserted peptides from
5 representative constructs is exemplified in Figure 2.

Example 3

Expression and purification GST-VP1-S1A and assembly of VP1-S1A into multimerically-defined VLPs

Expression

10 VP1-S1A protein was expressed in Rosetta (DE3) pLysS (Novagen) as a glutathione-s-transferase-VP1-S1A (GST-VP1-S1A) fusion protein using the pGEX-4T-1-VP1-S1A expression vector. For solid agar medium, 15 g/L of agar was added to Luria-Bertani (LB) medium (10 g/L tryptone, 5 g/L yeast extract, 10 g/L NaCl, pH 7.0). Liquid medium used for cell cultures was Terrific Broth (TB) containing
15 peptone, 24 g/L yeast extract, 0.4% (v/v) glycerol, 2.31 g/L KH_2PO_4 and 12.54 g/L K_2HPO_4 . All media used were supplemented with 50 $\mu\text{g/mL}$ of ampicillin and 34 $\mu\text{g/mL}$ of chloramphenicol. Overnight cultures were set up by inoculating single colonies of the transformed cells into 5 mL of TB medium and cultivated at 30 °C on a rotary shaker at 180 rpm. After incubation of 16 hours, the overnight cultures were
20 diluted 1000 times into 400 mL cultures in 2 L baffled flasks. These cultures were cultivated to an OD_{600} of 0.5 at 37 °C and then cooled to 26 °C under running tap water and subsequently induced with IPTG at final concentration of 0.2 mM. The induced cultures were then cultivated at 26 °C for a further 16 hours and harvested by centrifugation at 8000 g, 4°C for 30 mins.

Purification of VP1-S1A capsomeres

Two pellets from 2x400 mL cultures were re-suspended in 150 mL of buffer L (200 mM NaCl, 40 mM Tris, 5mM dithiothreitol, 1 mM EDTA, 5% v/v glycerol, pH 8 with HCl). The cell suspension was passed through a high-pressure
5 homogenizer (Niro-Soavi) once at 1000 bar; dilution gave a final volume of 175 mL. The resulting homogenate was centrifuged at 16000 g, 4°C for 30 mins and the supernatant which contained soluble GST-VP1-S1A was filtered through an 0.45 µm syringe filters (Millipore) giving a recovery of 135 mL.

Protein purification was performed with an Äkta Explorer system from GE
10 Healthcare. GST-VP1-S1A in the clarified homogenate was captured using a GSTrap™ HP 5 mL column from GE Healthcare pre-equilibrated with buffer L. The bound GST-VP1-S1A was eluted with elution buffer (Buffer L with 10 mM reduced glutathione). Eluted samples were stored at -80°C until required.

Purified thawed GST-VP1-S1A was buffer exchanged into buffer L by
15 desalting (Desalting column 15/12, in-house packed) on the Akta Explorer system.

The eluate was pooled and loaded onto a 5 mL GSTrap™ HP column equilibrated in buffer L. Elution was achieved with elution buffer (buffer L with 10 mM reduced glutathione). Eluate (4.2 mg/mL) was stored at -80°C.

The eluate from above was thawed on ice and 8 M urea was added to a final
20 concentration of 0.5 M (to inhibit capsomere aggregation after release from the solubilising GST tag). Thrombin (20 U/mg of GST-VP1-S1A, Sigma) was added followed by 3 hours incubation at room temperature on a roller.

500 µL of thrombin treated capsomere was injected onto a Superdex S200 10/300 GL size exclusion column (GE Healthcare) equilibrated in buffer L

supplemented with 0.5 M urea, to separate capsomeres from aggregates, GST and thrombin. Capsomere fractions eluting at a volume of 10-12 mL were pooled, aliquoted and frozen at -80°C for subsequent VLP assembly.

Assembly of capsomeres into multimerically-defined VLPs

- 5 The starting material after S200 separation is shown in Figure 8. Capsomeres were assembled by dialysis against buffer 1 (0.5 M (NH₄)₂SO₄, 20 mM Tris, pH 7.4, 5 % (v/v) glycerol, 1 mM CaCl₂) for 17.5 hours, and then against buffer 2 (200 mM NaCl, 20 mM Tris, pH 7.4, 5 % (v/v) glycerol, 1 mM CaCl₂) for another 24 hours. Dialysis was at room temperature with a 10,000 MWCO dialysis membrane.

10 Physical Characterisation of multimerically-defined VLPs

- Assembled VLPs were analysed by both asymmetric field-flow fractionation (AFFF, Wyatt Technologies) and electron microscopy (EM). The Eclipse AFFF system purchased from Wyatt Technology Corporation. The separation channel comprised a polyetheretherketone (PEEK) lower block fitted with a stainless steel
15 frit. The upper block was an aluminum frame to which a replaceable polycarbonate inlay was secured. The spacer used was trapezoidal with a thickness of 350 µm and a length of 26.5 cm. The breadths of the spacer near the channel inlet and outlet were 1.5 and 0.5 cm, respectively. A regenerated cellulose membrane with a molecular weight cut-off of 10 kDa was utilized as the accumulation wall. The cross-flow and
20 injection flow rates were each monitored and regulated by a LiquiFlow device (Bronkhorst). For precise control of the focusing point, motor-driven needle valves were also used to regulate the focus and injection flows. The channel pressure was monitored by a pressure sensor, and overpressure of the channel module was prevented by means of a pressure-relief valve. Separation methods were written using

the Eclipse software, which served to control the AFFF system. AFFF analysis of VLP samples were performed in GL buffer 2. The flow rate through the detectors was maintained at 0.75 mL/min during operation. A typical AFFF separation involved an initial increase of flow from zero to 0.75 mL/min in elution mode.

- 5 The cross-flow rate was then maintained when the focusing mode was started. 100 μ L of sample was then injected into the channel through the injection port at 0.2 mL/min, after which focusing was maintained for another 7 mins. To minimize the perturbations of detector signals at the switching between focusing and elution modes, a stream of bypass flow was maintained through the detectors during focusing
- 10 mode at 0.75 mL/min. At the end of focusing mode, the analytes were eluted under the same cross-flow rate for 30 mins, after which the cross-flow rate was ramped down to zero to allow elution of highly retained analytes. The results of the AFFF analysis are shown in Figure 9.

- For EM, 2 μ L of samples were applied to glow-discharged, Formvar carbon-coated grids. The remaining liquid on the grids were drained off after 2 mins, and the
- 15 grids were then negatively stained with 2 % uranyl acetate for 20 s. The samples on the grids were viewed under the Philips TECNAI 12 electron microscope and digital images were acquired using the integrated CCD camera and image acquisition software. EM images showing assembled VLPs are in Figure 10. The results show
- 20 that (i) protein was produced at high expression levels and purified to high homogeneity using conventional chromatographic operations and with efficient removal of the tag (Figure 6), and (ii) this protein could be efficiently assembled into VLP structures (Figure 10) having a size appropriate for VP1 VLPs (Figure 9).

Example 4

Expression of VP1-S1hM2e capsomeres and antibody challenge

GST-VP1-S1hM2e protein was prepared as described in example 3 for GST-VP1-S1A. Protein was purified only once by GST chromatography and stored at -80°C.

5 GST-VP1-S1hM2e protein was thawed and challenged in a slot blot with mouse monoclonal [14C2] antibody to influenza A virus M2 protein from Abcam (Cambridge, UK) recognizing the hM2e sequence inserted into S1 of VP1 (α hM2e), or else α VP1 antibody (Dr Ke An, Kansas State University). Figure 11 shows the result of slot blot analysis. As a negative control, VP1 native VLPs (prepared by
10 expression in baculovirus) were challenged with the same antibodies. VP1 concentrations ranged from 10 μ g/ml (lane 2) to 0.1 μ g/ml (lane 10) with 200 μ L loaded per well. Negative control was BSA. The membrane was blocked, challenged with primary antibody, washed 3x in PBS/0.1% Tween, and challenged with secondary antibody followed by chromogenic development.

15 Figure 11 shows conclusively that the antibody to the hM2e epitope recognised the chimeric VP1 containing the hM2e sequence, but did not react with the unmodified VP1 protein, suggesting that this epitope will be well presented to the immune system.

Example 5**20 Sequence Alignment of HA from subtypes of Influenza virus**

A sequence alignment of HA from various strains of H5 and H3 subtypes of influenza was performed. The results of this alignment are presented in Figure 12 and Figure 13.

The consensus H5N1 sequence for the epitopes is:

A: PYqGKSS (there is common q<-->N and K<-->R variability)

B: PNDAAEQTKLYQNPTTY (there is common K<-->R variability)

Note the q<-->N variability in A between the consensus. There is also K<-->R variability in both A&B. All of these mutations are conservative (e.g. K<-->R preserves the charge structure). The variability between H5 types is in the A&B regions is small compared with the variability across virus variants.

Mem71 is a H3 variant. The sequence was obtained and aligned; the corresponding peptide loops are:

A: KRGPgSG (there is common PgS<-->PaS variability)

10 B: PSTNQEQTsLYVQASGR (there is common TsL<-->TNL variability)

Again the variability is conservative, although there is a lack of primary sequence consensus with H5.

Although the alignment is not presented, starting with H1N1 accession P18875, a consensus was generated by Blastp against UNIPROT and then ClustalW then CONSP. The resulting loops A and B are:

A: SHKGKSS (SEQ ID NO:85)

B: PSNIEDQKTIYRKENAY (SEQ ID NO:86)

Example 6

Immunization with VLPs and Challenge Experiments in Animal Model

20 Challenge will be intranasally with Mem71 at week 5, after vaccination at week 0 and week 3 with VP1-S1 VLPs containing inserted peptide antigen from loops A (KRGPgSG; SEQ ID NO: 81) and loops B (PSTNQEQTsLYVQASGR; SEQ ID NO: 78) of the H3 Mem71 virus.

Two doses of 3µg of HA will be given in the form of split Mem71 virus

vaccine as a positive control as this will give complete protection after two doses.

Assuming that HA is 30% of the virion, this would be the equivalent of 9µg/dose of virus. Whole, unsplit virus is more immunogenic than split. A volume of 50µL of VLP vaccine will be injected. The carrier VLP with no insertion will also

5 be tested.

The challenge design is:

VLP Testing

Mouse group	# of animals	Immunogen	Challenge (Mem71, 10 ^{4.5} pfu)
1	8	VLP 1 (H3 Peptide A (KRGPGSG) inserted into VP1-S1)	+
2	8	VLP 2 (H3 Peptide B PSTNQEQTSLYVQA SGR inserted into VP1-S1)	+
3	8	wt VLP (VP1 with no insertion)	+
4	8	Split Mem/Bel (3ug/dose)	+
5	8	PBS	+

Week 0

*s.c. – base of tail injection

10 Duration of Study: 7 weeks, continuous monitoring

Vaccination: week 0 (1st shot sc), week 3 (2nd shot sc), intranasal challenge
week 5.

Mice: 40 BALB/c mice

Readouts: ELISA, HAI, and virus neutralisation assay of serum

15 post primary and secondary vaccinations and plaque assay on lung homogenates 5

days post challenge

Vaccine samples: 50 µL injected per sc shot. VLPs were expressed in baculovirus, purified by sucrose and CsCl ultracentrifugation, and dialysed into PBS. See Example 8 for experimental detail of how VLPs used as vaccine samples were
5 prepared. Final composition was 77 µg of VLP protein and 45 µg Al(OH)₃ adjuvant per 50 µL dose. Endotoxin was tested to ensure acceptability.

Example 7

**Construction and sequencing of vectors carrying HA loop A and loop B of influenza strain H3N2 inserted in S1 and S4 for expression in *E. coli* and insect
10 cells**

Figures 14 and Figure 15 present two alignments. First one shows insertion of loop A and loop B in S1 of VP1 (Figure 14), second one shows insertion of loop A and loop B in S4 of VP1 (Figure 15).

Resulting constructs are pGEX4T1-VP1 S1H3A, pGEX4T1-VP1 S1H3B,
15 pGEX4T1-VP1 S4H3A, and pGEX4T1-VP1 S4H3B for expression in *E. coli* and pENTR-VP1 S1H3A and pENTR-VP1 S1H3B for expression in insect cells.

Example 8

Preparation of VLPs for challenge experiments using baculovirus

The following VLPs were prepared for challenge experiments detailed in example 6:

- 20
- VP1-H3-S1A: VP1 containing H3N2 loop A peptide inserted into the S1 site of VP1
 - VP1-H3-S1B: VP1 containing H3N2 loop B peptide inserted into the S1 site of VP1

- VP1-wt: wild-type VP1 sequence not containing any insertion nor modification

VP1 proteins for the above constructs were heterologously expressed in *Spodoptera frugiperda* (Sf9) cells infected with recombinant baculovirus encoding the chosen VP1 chimeric protein. Cells were harvested approximately 72h postinfection, pelleted by centrifugation, and frozen at -80°C. For preparation of VLPs (all the steps were performed at 4°C), cell pellets were resuspended in Lysis buffer (50 mM MOPS, 500mM NaCl, 0.002% Tween 80, pH 7.0) and lysed with Branson Ultra-sonics Sonifier. Homogenized lysate was then centrifuged at 16,000xg for 30 min. The supernatant containing soluble VLPs was layered on the top of a 30% sucrose cushion and centrifuged for 1.5 h at 32000 rpm using a Beckman SW 32 Ti Rotor. The pellet was then resuspended in Lysis buffer and subjected to 15 seconds of sonication at low power setting to disperse any aggregates. Homogenate was then centrifuged at 15,000 rpm for 30 min. Clarified supernatant with CsCl added to a final concentration of 35% (wt/vol) was centrifuged at 50,000rpm for 16 hours using a Beckman SW 60 Ti Rotor. Purified VLPs were collected by extracting the top band from the CsCl gradients. Recovered VLPs were dialyzed into PBS overnight and stored at 4°C. Protein concentration was determined by Agilent Bioanalyzer. Samples for electron microscopy were prepared as described in Example 3 and imaged at 200,000x (scale-bar 100nm). After dialysis, VLPs in PBS were formulated with aluminium hydroxide gel (colloidal Al(OH)₃) to give a final dose of 50 µL consisting of 77 µg (protein equivalent) of VLP and 45 µg Al(OH)₃, balance PBS. Figure 16 shows EM images of VP1-H3-S1A VLPs. Figure 17 shows EM images of VP1-H3-S1B VLPs.

Example 9**Construction and sequencing of vectors carrying HA epitopes of loop A and loop B of influenza strain H5N1 inserted in S4**

Figure 18 shows sequence alignment of HA loop A and loop B of influenza strain H5N1 inserted in S4 of VP1. Resulting constructs are pGEX4T1-VP1 S4A, pGEX4T1-VP1 S4B and pGEX4T1-VP1 S4hM2e.

Example 10**Expression and purification of GST-VP1-S4A and GST-VP1-S4B and assembly of VP1-S4A and VP1-S4B into multimerically defined VLPs**

The following VP1 variants were processed:

- GST-VP1 (wild-type protein with no inserted antigen; control)
- GST-VP1-S4A
- GST-VP1-S4B

The purpose of this example is to demonstrate that multimerically defined VLPs can be obtained using the same process used for unmodified VP1 protein, even after very different insertions (A or B) into site S4 of VP1.

In this example, “A” in the above constructs refers to antigenic peptide taken from influenza virus H5N1 corresponding to loop A in the HA protein, as in example 2 (7 amino acids, PYNGKSS). “B” in the above constructs refers to antigenic peptide taken from influenza virus H5N1 corresponding to loop B in the HA protein, as in example 2 (17 amino acids, PNDAAEQTKLYQNPTTY).

For each construct, protein was expressed as described in Example 2.

For purification of each construct, a pellet from 800 mL of culture was re-suspended in 40 mL of buffer L (200 mM NaCl, 40 mM Tris, 1 mM EDTA, 5 mM

dithiothreitol, 5% v/v glycerol, pH 8 with HCl). The cell suspension was passed through a high-pressure homogenizer (Niro-Soavi) once at 1000 bar. The homogenate was diluted with L buffer and centrifuged. Supernatant containing soluble VP1 fusion protein was filtered through two 0.45 µm syringe filters
5 (Millipore), giving a recovery of 100-125 mL per construct examined. Protein purification was performed with an Äkta Explorer system from GE Healthcare. 100 mL of filtered homogenate containing the selected GST-VP1 fusion protein (listed above) was loaded onto a GSTrap™ HP 5 mL column from GE Healthcare pre-equilibrated with buffer L (Figure 19A and B). The bound GST-VP1 fusion protein
10 was eluted with elution buffer (Buffer L with 10 mM reduced glutathione). Eluted fractions of 250 µL were stored at -80°C until required.

The eluate from above was thawed on ice and thrombin (50 U/mL, Sigma) was added followed by 2 h incubation at room temperature on a roller. 200 µL of thrombin-treated capsomere was injected onto a Superdex S200 10/300 GL size
15 exclusion column (GE Healthcare) equilibrated in buffer L, to separate capsomeres from aggregates, GST and thrombin (Figure 20A and B). Capsomere fractions (150 µL) were assembled by dialysis against buffer 1 (0.5 M (NH₄)₂SO₄, 20 mM Tris, pH 7.4, 5 % (v/v) glycerol, 1 mM CaCl₂) for 17 h, and then against buffer 2 (200 mM NaCl, 20 mM Tris, pH 7.4, 5 % (v/v) glycerol, 1 mM CaCl₂) for another 24 hours.
20 Dialysis was at room temperature with a 10,000 MWCO dialysis membrane.

Comparison of GST-VP1 with GST-VP1-S4A and GST-VP1-S4B by Bioanalyzer analysis is shown in Figure 21.

Assembled VLPs were analysed by both asymmetric field-flow fractionation (AFFF, Wyatt Technologies) (Figure 22) and electron microscopy (EM) as described

in Example 3 (see Figure 23 A, B and C).

Throughout the specification the aim has been to describe the preferred embodiments of the invention without limiting the invention to any one embodiment or specific collection of features. It will therefore be appreciated by those of skill in the art that, in light of the instant disclosure, various modifications and changes can be made in the particular embodiments exemplified without departing from the scope of the present invention.

All computer programs, algorithms, patent and scientific literature referred to herein is incorporated herein by reference.

CLAIMS

1. An isolated protein comprising a murine polyomavirus VP1 amino acid sequence, or a fragment thereof wherein one or more exposed loops of said murine polyomavirus VP1 amino acid sequence has an insertion of an amino acid sequence
5 of a virus protein other than murine polyomavirus VP1, or a fragment of said virus protein other than murine polyomavirus VP1 wherein the one or more exposed loops of said murine polyomavirus VP1 amino acid sequence comprise an insertion site selected from the group consisting of site 1, site 3 and site 4.
2. The isolated protein of claim 1, wherein the insertion site is selected from the
10 group consisting of site 1 and site 4.
3. The isolated protein of any one of claim 1 or claim 2, wherein the virus protein other than murine polyomavirus VP1 or a fragment thereof, is an influenza virus protein.
4. The isolated protein of claim 3, wherein the influenza virus protein is
15 selected from the group consisting of HA, NP, NA, M2 and M1.
5. The isolated protein of claim 4, wherein the influenza virus protein is selected from the group consisting of HA and M2.
6. The isolated protein of any one of Claims 1, 4 or 5, wherein the virus protein other than murine polyomavirus VP1 corresponds to an exposed loop of HA selected
20 from the group consisting of loop A, loop B, loop C, loop D and loop E, or a fragment thereof.
7. The isolated protein of claim 6, wherein the exposed loop of HA is selected from the group consisting of loop A and loop B, or a fragment thereof.
8. The isolated protein of claim 7, wherein the fragment of loop A is an

antigenic epitope comprising an amino acid sequence selected from the group consisting of SEQ ID NO: 75, SEQ ID NO: 77 and SEQ ID NO: 79, or a variant thereof.

9. The isolated protein of claim 8, wherein the variant comprises an amino acid
5 sequence selected from the group consisting of SEQ ID NO: 1; SEQ ID NO:2; SEQ ID NO:3; SEQ ID NO:4; SEQ ID NO:7; SEQ ID NO:8; SEQ ID NO:9; SEQ ID NO:10; SEQ ID NO:11; SEQ ID NO:12; SEQ ID NO:13; SEQ ID NO:14; SEQ ID NO:19; SEQ ID NO:20; SEQ ID NO:22; SEQ ID NO:23; SEQ ID NO:47; SEQ ID NO:51; SEQ ID NO:52; SEQ ID NO:53; SEQ ID NO:54; SEQ ID NO:55; SEQ ID
10 NO:56; SEQ ID NO:57; SEQ ID NO:58; SEQ ID NO:59 and SEQ ID NO:60.

10. The isolated protein of claim 8, wherein the variant has at least 30% sequence identity to the amino acid sequence selected from the group consisting of SEQ ID NO: 75, SEQ ID NO: 77 and SEQ ID NO: 79.

11. The isolated protein of claim 7, wherein the fragment of loop B is an
15 antigenic epitope comprising an amino acid sequence selected from the group consisting of SEQ ID NO: 76, SEQ ID NO: 78 and SEQ ID NO: 80, or a variant thereof.

12. The isolated protein of claim 11, wherein the variant comprises an amino acid sequence selected from the group consisting of SEQ ID NO:25; SEQ ID NO:26;
20 SEQ ID NO:27; SEQ ID NO:30; SEQ ID NO:34; SEQ ID NO:35; SEQ ID NO:36; SEQ ID NO:42; SEQ ID NO:43; SEQ ID NO:44; SEQ ID NO:45; SEQ ID NO:46; SEQ ID NO:61; SEQ ID NO:65; SEQ ID NO:66; SEQ ID NO:67; SEQ ID NO:69; SEQ ID NO:70; SEQ ID NO:71; SEQ ID NO:72; SEQ ID NO:73 and SEQ ID NO:74.

13. The isolated protein of claim 11, wherein the variant has at least 30% sequence identity to the amino acid sequence selected from the group consisting of SEQ ID NO: 76, SEQ ID NO: 78 and SEQ ID NO: 80.
14. The isolated protein of any one of claims 1 to 13, wherein the said virus
5 protein other than murine polyomavirus VP1, or a fragment thereof, is a single protein or a plurality of proteins.
15. An isolated nucleic acid comprising a nucleotide sequence encoding the isolated protein of any one of the preceding claims.
16. The isolated nucleic acid of claim 15, which is DNA.
- 10 17. The isolated nucleic acid of claim 15, wherein the nucleotide sequence encoding the murine polyomavirus VP1 amino acid sequence is adapted to receive within one or more exposed loops of said murine polyomavirus VP1 amino acid sequence, an isolated nucleic acid comprising a nucleotide sequence encoding a virus protein other than murine polyomavirus VP1 or a fragment of said nucleotide
15 sequence encoding a virus protein other than murine polyomavirus VP1.
18. An expression construct comprising the isolated nucleic acid of claim 15 operably-linked to one or more regulatory sequences in an expression vector.
19. The expression construct of claim 18, wherein the one or more regulatory
20 sequences is selected from the group consisting of an enhancer of transcription, an enhancer of translation, a nucleotide sequence for autonomous replication, a regulatory element for mRNA processing, a selectable marker and a screenable marker.
20. A host cell comprising the expression construct of claim 18.
21. The host cell of claim 20, which is selected from the group consisting of a

prokaryotic cell and an insect cell.

22. The host cell of claim 21, which is a bacterium.
23. A virus-like particle comprising one or more isolated proteins of claim 1.
24. A method of producing an isolated nucleic acid, said method including the
5 step of inserting into each of one or more nucleotide sequences that encode one or
more exposed loops of a murine polyomavirus VP1 protein, a nucleotide sequence
encoding a virus protein other than murine polyomavirus VP1, or a fragment of said
virus protein other than murine polyomavirus VP1, wherein the one or more
nucleotide sequences that encode one or more exposed loops of the murine
10 polyomavirus VP1 protein is adapted to receive the nucleotide sequence encoding the
virus protein other than murine polyomavirus VP1 or a fragment of said virus protein
other than murine polyomavirus VP1, wherein the one of more exposed loops of a
murine polyomavirus VP1 protein comprise an insertion site selected from the group
consisting of site 1, site 3 and site 4.
- 15 25. The method of claim 24, wherein the insertion site is selected from the group
consisting of site 1 and site 4.
26. The method of claim 24 or 25, wherein the virus protein other than murine
polyomavirus, or a fragment thereof, is an influenza virus protein selected from the
group consisting of HA, NP, NA, M2 and M1.
- 20 27. The method of claim 26, wherein the influenza virus protein is selected from
the group consisting of HA and M2.
28. The method of claim 26 or claim 27, wherein the virus protein other than
VP1 corresponds to an exposed loop of HA selected from the group consisting loop
A, loop B, loop C, loop D and loop E, or a fragment thereof.

29. The method of claim 28, wherein the exposed loop of HA is selected from the group consisting of loop A and loop B, or a fragment thereof.
30. The method of claim 29, wherein the fragment of loop A is an antigenic epitope comprising an amino acid sequence selected from the group consisting of
5 SEQ ID NO: 75, SEQ ID NO: 77 and SEQ ID NO: 79, or a variant thereof.
31. The method of claim 30, wherein the variant comprises an amino acid sequence selected from the group consisting of SEQ ID NO: 1; SEQ ID NO:2; SEQ ID NO:3; SEQ ID NO:4; SEQ ID NO:7; SEQ ID NO:8; SEQ ID NO:9; SEQ ID NO:10; SEQ ID NO:11; SEQ ID NO:12; SEQ ID NO:13; SEQ ID NO:14; SEQ ID
10 NO:19; SEQ ID NO:20; SEQ ID NO:22; SEQ ID NO:23; SEQ ID NO:47; SEQ ID NO:51; SEQ ID NO:52; SEQ ID NO:53; SEQ ID NO:54; SEQ ID NO:55; SEQ ID NO:56; SEQ ID NO:57; SEQ ID NO:58; SEQ ID NO:59 and SEQ ID NO:60.
32. The method of claim 30, wherein the variant has at least 30% sequence identity to the amino acid sequence selected from the group consisting of SEQ ID
15 NO: 75, SEQ ID NO: 77 and SEQ ID NO: 79.
33. The method of claim 29, wherein the fragment of loop B is an antigenic epitope comprising an amino acid sequence selected from the group consisting of SEQ ID NO: 76, SEQ ID NO: 78 and SEQ ID NO: 80, or a variant thereof.
34. The method of claim 33, wherein the variant comprises an amino acid
20 sequence selected from the group consisting of SEQ ID NO:25; SEQ ID NO:26; SEQ ID NO:27; SEQ ID NO:30; SEQ ID NO:34; SEQ ID NO:35; SEQ ID NO:36; SEQ ID NO:42; SEQ ID NO:43; SEQ ID NO:44; SEQ ID NO:45; SEQ ID NO:46; SEQ ID NO:61; SEQ ID NO:65; SEQ ID NO:66; SEQ ID NO:67; SEQ ID NO:69; SEQ ID NO:70; SEQ ID NO:71; SEQ ID NO:72; SEQ ID NO:73 and SEQ ID NO:74.

35. The method of claim 33, wherein the variant has at least 30% sequence identity to the amino acid sequence selected from the group consisting of SEQ ID NO: 76, SEQ ID NO: 78 and SEQ ID NO: 80.
36. A method of producing a virus-like particle, said method including the steps
5 of:
- (a) introducing the isolated nucleic acid of claim 15 or an expression construct of claim 18 into a host cell;
 - (b) culturing said host cell under conditions which facilitate production of the isolated protein of claim 1;
 - 10 (c) optionally purifying the isolated protein of claim 1; and
 - (d) assembling the isolated protein purified according to step (c) to produce the virus-like particle.
37. The method of claim 36, wherein the host cell is a bacterium.
38. A virus-like particle produced according to the method of claim 36.
- 15 39. A pharmaceutical composition comprising: the isolated protein of claim 1, the isolated nucleic acid of claim 15 or the virus-like particle of claim 23 or claim 38 and a pharmaceutically-acceptable carrier, diluent or excipient.
40. The pharmaceutical composition of claim 39, wherein the pharmaceutical composition is an immunotherapeutic composition.
- 20 41. The pharmaceutical composition of claim 40, which is a vaccine.
42. The pharmaceutical composition of any one of claims 39 to 41, wherein the pharmaceutical composition is capable of prophylactically or therapeutically treating a disorder, disorder or condition caused by an influenza virus.
43. The pharmaceutical composition of claim 42, wherein the influenza virus is

avian influenza virus.

44. A pharmaceutical composition according to any one of claims 39 to 43 for use in prophylactic or therapeutic treatment of a disease, disorder or condition of an animal.

5 45. The pharmaceutical composition of claim 44, wherein the disease, disorder or condition is caused by an influenza virus.

46. The pharmaceutical composition of claim 44, wherein said animal is a mammal.

47. The pharmaceutical composition of claim 46, wherein said mammal is a
10 human.

48. A pharmaceutical composition according to any one of claims 39 to 43 for use in immunising an animal to thereby induce immunity in said animal.

49. The pharmaceutical composition of claim 48, wherein the animal is a mammal.

15 50. The pharmaceutical composition of claim 49, wherein the mammal is a human.

51. The pharmaceutical composition of claim 48, wherein the animal is prophylactically or therapeutically treated for a disorder, disease or condition caused by an influenza virus.

20 52. The pharmaceutical composition of claim 51, wherein the influenza virus is avian influenza virus.

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Pro Asn Asp Ala Ala Glu Gln Thr Arg Leu Tyr Gln Asn Pro Thr Thr
1 5 10 15

Tyr

<210> 43
<211> 17
<212> PRT
<213> Influenza A virus

<400> 43

Pro Asn Asp Ala Ala Glu Gln Thr Arg Leu Tyr Gln Asn Pro Thr Thr
1 5 10 15

Tyr

<210> 44
<211> 17
<212> PRT
<213> Influenza A virus

<400> 44

Pro Asn Asp Ala Ala Glu Gln Thr Arg Leu Tyr Gln Asn Pro Thr Thr
1 5 10 15

Tyr

<210> 45
<211> 17
<212> PRT
<213> Influenza A virus

<400> 45

Pro Asn Asp Ala Ala Glu Gln Thr Arg Leu Tyr Gln Asn Pro Thr Thr
1 5 10 15

Tyr

<210> 46
<211> 17
<212> PRT
<213> Influenza A virus

<400> 46

Pro Asn Asp Ala Ala Glu Gln Thr Arg Leu Tyr Gln Asn Pro Thr Thr
1 5 10 15

Tyr

<210> 47
<211> 7
<212> PRT
<213> Influenza A virus

<400> 47

Lys Arg Gly Ser Val Lys Ser
1 5

<210> 48
<211> 7
<212> PRT
<213> Influenza A virus

<400> 48

Lys Arg Gly Pro Gly Ser Gly
1 5

<210> 49
<211> 7
<212> PRT
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<400> 49

Lys Arg Gly Pro Gly Ser Gly
1 5

<210> 50
<211> 7
<212> PRT
<213> Influenza A virus

<400> 50

Lys Arg Gly Pro Gly Ser Gly
1 5

<210> 51
<211> 7
<212> PRT
<213> Influenza A virus

<400> 51

Lys Arg Gly Pro Asp Ser Gly
1 5

<210> 52
<211> 7
<212> PRT
<213> Influenza A virus

<400> 52

Lys Arg Arg Ser Asn Lys Ser
1 5

<210> 53

<211> 7
<212> PRT
<213> Influenza A virus

<400> 53

Lys Arg Gly Ser Val Asn Ser
1 5

<210> 54
<211> 7
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<400> 54

Lys Arg Gly Ser Val Lys Ser
1 5

<210> 55
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<400> 55

Lys Arg Gly Ser Asp Asn Ser
1 5

<210> 56
<211> 7
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<213> Influenza A virus

<400> 56

Lys Arg Gly Ser Val Lys Ser
1 5

<210> 57
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<212> PRT
<213> Influenza A virus

<400> 57

Lys Arg Gly Ser Val Lys Ser
1 5

<210> 58
<211> 7
<212> PRT
<213> Influenza A virus

<400> 58

Lys Arg Arg Ser Ile Lys Ser
1 5

<210> 59
<211> 7
<212> PRT

<213> Influenza A virus

<400> 59

Lys Arg Gly Ser Val Asn Ser
1 5

<210> 60

<211> 7

<212> PRT

<213> Influenza A virus

<400> 60

Lys Arg Gly Pro Asp Ser Gly
1 5

<210> 61

<211> 17

<212> PRT

<213> Influenza A virus

<400> 61

Pro Ser Thr Asp Arg Glu Gln Thr Lys Leu Tyr Val Arg Ala Ser Gly
1 5 10 15

Arg

<210> 62

<211> 17

<212> PRT

<213> Influenza A virus

<400> 62

Pro Ser Thr Asn Gln Glu Gln Thr Ser Leu Tyr Val Gln Ala Ser Gly
1 5 10 15

Arg

<210> 63

<211> 17

<212> PRT

<213> Influenza A virus

<400> 63

Pro Ser Thr Asn Gln Glu Gln Thr Ser Leu Tyr Val Gln Ala Ser Gly
1 5 10 15

Arg

<210> 64

<211> 17

<212> PRT

<213> Influenza A virus

381698_1.TXT

<400> 64

Pro Ser Thr Asn Gln Glu Gln Thr Ser Leu Tyr Val Gln Ala Ser Gly
1 5 10 15

Arg

<210> 65

<211> 17

<212> PRT

<213> Influenza A virus

<400> 65

Pro Ser Thr Asp Gln Glu Gln Thr Ser Leu Tyr Val Gln Ala Ser Gly
1 5 10 15

Arg

<210> 66

<211> 17

<212> PRT

<213> Influenza A virus

<400> 66

Pro Ser Thr Asp Ser Asp Gln Ile Ser Ile Tyr Ala Gln Ala Ser Gly
1 5 10 15

Arg

<210> 67

<211> 17

<212> PRT

<213> Influenza A virus

<220>

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<222> (2)..(2)

<223> Xaa can be any naturally occurring amino acid

<400> 67

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1 5 10 15

Arg

<210> 68

<211> 17

<212> PRT

<213> Influenza A virus

<400> 68

381698_1.TXT

Pro Ser Thr Asp Arg Glu Gln Thr Asn Leu Tyr Val Arg Ala Ser Gly
1 5 10 15

Arg

<210> 69
<211> 17
<212> PRT
<213> Influenza A virus

<400> 69

Pro Ser Thr Asp Lys Glu Gln Thr Lys Leu Tyr Val Arg Ala Ser Gly
1 5 10 15

Arg

<210> 70
<211> 17
<212> PRT
<213> Influenza A virus

<400> 70

Pro Ser Thr Asp Arg Asp Gln Thr Ser Leu Tyr Val Gln Ala Ser Gly
1 5 10 15

Arg

<210> 71
<211> 17
<212> PRT
<213> Influenza A virus

<400> 71

Pro Ser Thr Asp Arg Asp Gln Thr Ser Leu Tyr Val Gln Ala Ser Gly
1 5 10 15

Arg

<210> 72
<211> 17
<212> PRT
<213> Influenza A virus

<400> 72

Pro Ser Thr Asp Ser Asp Gln Thr Ser Leu Tyr Ala Gln Ala Ser Gly
1 5 10 15

Arg

381698_1.TXT

<210> 73
 <211> 17
 <212> PRT
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<400> 73

Pro Ser Thr Asp Ser Asp Gln Thr Ser Leu Tyr Val Gln Ala Ser Gly
 1 5 10 15

Arg

<210> 74
 <211> 17
 <212> PRT
 <213> Influenza A virus

<400> 74

Pro Ser Thr Asp Gln Glu Gln Thr Ser Leu Tyr Val Gln Ala Ser Gly
 1 5 10 15

Arg

<210> 75
 <211> 7
 <212> PRT
 <213> Influenza A virus

<400> 75

Pro Tyr Gln Gly Lys Ser Ser
 1 5

<210> 76
 <211> 17
 <212> PRT
 <213> Influenza A virus

<400> 76

Pro Asn Asp Ala Ala Glu Gln Thr Lys Leu Tyr Gln Asn Pro Thr Thr
 1 5 10 15

Tyr

<210> 77
 <211> 7
 <212> PRT
 <213> Influenza A virus

<400> 77

Lys Arg Gly Pro Gly Ser Gly
 1 5

<210> 78
 <211> 17
 <212> PRT
 <213> Influenza A virus

<400> 78

Pro Ser Thr Asn Gln Glu Gln Thr Ser Leu Tyr Val Gln Ala Ser Gly
 1 5 10 15

Arg

<210> 79
 <211> 7
 <212> PRT
 <213> Influenza A virus

<400> 79

Ser His Lys Gly Lys Ser Ser
 1 5

<210> 80
 <211> 17
 <212> PRT
 <213> Influenza A virus

<400> 80

Pro Ser Asn Ile Glu Asp Gln Lys Thr Ile Tyr Arg Lys Glu Asn Ala
 1 5 10 15

Tyr

<210> 81
 <211> 7
 <212> PRT
 <213> Influenza A virus

<400> 81

Pro Tyr Asn Gly Lys Ser Ser
 1 5

<210> 82
 <211> 7
 <212> PRT
 <213> Influenza A virus

<400> 82

Lys Arg Gly Pro Gly Ser Gly
 1 5

<210> 83
 <211> 23
 <212> PRT
 <213> Influenza A virus

<400> 83

Ser Leu Leu Thr Glu Val Glu Thr Pro Thr Arg Asn Glu Trp Glu Cys
 1 5 10 15

Arg Cys Ser Asp Ser Ser Asp
 20

<210> 84

<211> 23

<212> PRT

<213> Influenza A virus

<400> 84

Ser Leu Leu Thr Glu Val Glu Thr Pro Ile Arg Asn Glu Trp Gly Cys
 1 5 10 15

Arg Cys Asn Asp Ser Ser Asp
 20

<210> 85

<211> 7

<212> PRT

<213> Influenza A virus

<400> 85

Ser His Lys Gly Lys Ser Ser
 1 5

<210> 86

<211> 17

<212> PRT

<213> Influenza A virus

<400> 86

Pro Ser Asn Ile Glu Asp Gln Lys Thr Ile Tyr Arg Lys Glu Asn Ala
 1 5 10 15

Tyr

<210> 87

<211> 384

<212> PRT

<213> Polyomavirus sp

<400> 87

Met Ala Pro Lys Arg Lys Ser Gly Val Ser Lys Cys Glu Thr Lys Cys
 1 5 10 15

Thr Lys Ala Cys Pro Arg Pro Ala Pro Val Pro Lys Leu Leu Ile Lys
 20 25 30

Gly Gly Met Glu Val Leu Asp Leu Val Thr Gly Pro Asp Ser Val Thr
 35 40 45

381698_1.TXT

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

381698_1.TXT

Pro Met Ala Ser Leu Ile Ser Ser Leu Phe Asn Asn Met Leu Pro Gln
325 330 335

Val Gln Gly Gln Pro Met Glu Gly Glu Asn Thr Gln Val Glu Glu Val
340 345 350

Arg Val Tyr Asp Gly Thr Glu Pro Val Pro Gly Asp Pro Asp Met Thr
355 360 365

Arg Tyr Val Asp Arg Phe Gly Lys Thr Lys Thr Val Phe Pro Gly Asn
370 375 380

<210> 88

<211> 385

<212> PRT

<213> Polyomavirus sp

<400> 88

Met Ala Pro Lys Arg Lys Ser Gly Val Ser Lys Cys Glu Thr Lys Cys
1 5 10 15

Thr Lys Ala Cys Pro Arg Pro Ala Pro Val Pro Lys Leu Leu Ile Lys
20 25 30

Gly Gly Met Glu Val Leu Asp Leu Val Thr Gly Pro Asp Ser Val Thr
35 40 45

Glu Ile Glu Ala Phe Leu Asn Pro Arg Met Gly Gln Pro Pro Thr Pro
50 55 60

Glu Ser Leu Thr Glu Gly Gly Gln Tyr Tyr Gly Trp Ser Arg Gly Ile
65 70 75 80

Asn Leu Ala Thr Ser Ala Gly Thr Glu Asp Ser Pro Gly Asn Asn Thr
85 90 95

Leu Pro Thr Trp Ser Met Ala Lys Leu Gln Leu Pro Met Leu Asn Glu
100 105 110

Asp Leu Thr Cys Asp Thr Leu Gln Met Trp Glu Ala Val Ser Val Lys
115 120 125

Thr Glu Val Val Gly Ser Gly Ser Leu Leu Asp Val His Gly Phe Asn
130 135 140

Lys Pro Thr Asp Thr Val Asn Thr Lys Gly Ile Ser Thr Pro Val Glu
145 150 155 160

Gly Ser Gln Tyr His Val Phe Ala Val Gly Gly Glu Pro Leu Asp Leu
165 170 175

381698_1.TXT

Gln Gly Leu Val Thr Asp Ala Arg Thr Lys Tyr Lys Glu Glu Gly Val
180 185 190

Val Thr Ile Lys Thr Ile Thr Lys Lys Asp Met Val Asn Lys Asp Gln
195 200 205

Val Leu Asn Pro Ile Ser Lys Ala Lys Leu Asp Lys Asp Gly Met Tyr
210 215 220

Pro Val Glu Ile Trp His Pro Asp Pro Ala Lys Asn Glu Asn Thr Arg
225 230 235 240

Tyr Phe Gly Asn Tyr Thr Gly Gly Thr Thr Thr Pro Pro Val Leu Gln
245 250 255

Phe Thr Asn Thr Leu Thr Thr Val Leu Leu Asp Glu Asn Gly Val Gly
260 265 270

Pro Leu Cys Lys Gly Glu Gly Leu Tyr Leu Ser Cys Val Asp Ile Met
275 280 285

Gly Trp Arg Val Thr Arg Asn Tyr Asp Val His His Trp Arg Gly Leu
290 295 300

Pro Arg Tyr Phe Lys Ile Thr Leu Arg Lys Arg Trp Val Lys Asn Pro
305 310 315 320

Tyr Pro Met Ala Ser Leu Ile Ser Ser Leu Phe Asn Asn Met Leu Pro
325 330 335

Gln Val Gln Gly Gln Pro Met Glu Gly Glu Asn Thr Gln Val Glu Glu
340 345 350

Val Arg Val Tyr Asp Gly Thr Glu Pro Val Pro Gly Asp Pro Asp Met
355 360 365

Thr Arg Tyr Val Asp Arg Phe Gly Lys Thr Lys Thr Val Phe Pro Gly
370 375 380

Asn
385

<210> 89
<211> 385
<212> PRT
<213> Polyomavirus sp

<400> 89

Met Ala Pro Lys Arg Lys Ser Gly Val Ser Lys Cys Glu Thr Lys Cys
1 5 10 15

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

Trp Arg Val Thr Arg Ser Ala Tyr Asp Val His His Trp Arg Gly Leu
290 295 300

Pro Arg Tyr Phe Lys Ile Thr Leu Arg Lys Arg Trp Val Lys Asn Pro
305 310 315 320

Tyr Pro Met Ala Ser Leu Ile Ser Ser Leu Phe Asn Asn Met Leu Pro
325 330 335

Gln Val Gln Gly Gln Pro Met Glu Gly Glu Asn Thr Gln Val Glu Glu
340 345 350

Val Arg Val Tyr Asp Gly Thr Glu Pro Val Pro Gly Asp Pro Asp Met
355 360 365

Thr Arg Tyr Val Asp Arg Phe Gly Lys Thr Lys Thr Val Phe Pro Gly
370 375 380

Asn
385

<210> 90
<211> 385
<212> PRT
<213> Polyomavirus sp

<400> 90

Met Ala Pro Lys Arg Lys Ser Gly Val Ser Lys Cys Glu Thr Lys Cys
1 5 10 15

Thr Lys Ala Cys Pro Arg Pro Ala Pro Val Pro Lys Leu Leu Ile Lys
20 25 30

Gly Gly Met Glu Val Leu Asp Leu Val Thr Gly Pro Asp Ser Val Thr
35 40 45

Glu Ile Glu Ala Phe Leu Asn Pro Arg Met Gly Gln Pro Pro Thr Pro
50 55 60

Glu Ser Leu Thr Glu Gly Gly Gln Tyr Tyr Gly Trp Ser Arg Gly Ile
65 70 75 80

Asn Leu Ala Thr Ser Asp Thr Glu Asp Ser Pro Gly Asn Asn Thr Leu
85 90 95

Pro Thr Trp Ser Met Ala Lys Leu Gln Leu Pro Met Leu Asn Glu Asp
100 105 110

Leu Thr Cys Asp Thr Leu Gln Met Trp Glu Ala Val Ser Val Lys Thr
115 120 125

Glu Val Val Gly Ser Gly Ser Leu Leu Asp Val His Gly Phe Asn Lys
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130

135

140

Pro Thr Asp Thr Val Asn Thr Lys Gly Ile Ser Thr Pro Val Glu Gly
 145 150 155 160

Ser Gln Tyr His Val Phe Ala Val Gly Gly Glu Pro Leu Asp Leu Gln
 165 170 175

Gly Leu Val Thr Asp Ala Arg Thr Lys Tyr Lys Glu Glu Gly Val Val
 180 185 190

Thr Ile Lys Thr Ile Thr Lys Lys Asp Met Val Asn Lys Asp Gln Val
 195 200 205

Leu Asn Pro Ile Ser Lys Ala Lys Leu Asp Lys Asp Gly Met Tyr Pro
 210 215 220

Val Glu Ile Trp His Pro Asp Pro Ala Lys Asn Glu Asn Thr Arg Tyr
 225 230 235 240

Phe Gly Asn Tyr Thr Gly Gly Thr His Val Thr Pro Pro Val Leu Gln
 245 250 255

Phe Thr Asn Thr Leu Thr Thr Val Leu Leu Asp Glu Asn Gly Val Gly
 260 265 270

Pro Leu Cys Lys Gly Glu Gly Leu Tyr Leu Ser Cys Val Asp Ile Met
 275 280 285

Gly Trp Arg Val Thr Arg Asn Tyr Asp Val His His Trp Arg Gly Leu
 290 295 300

Pro Arg Tyr Phe Lys Ile Thr Leu Arg Lys Arg Trp Val Lys Asn Pro
 305 310 315 320

Tyr Pro Met Ala Ser Leu Ile Ser Ser Leu Phe Asn Asn Met Leu Pro
 325 330 335

Gln Val Gln Gly Gln Pro Met Glu Gly Glu Asn Thr Gln Val Glu Glu
 340 345 350

Val Arg Val Tyr Asp Gly Thr Glu Pro Val Pro Gly Asp Pro Asp Met
 355 360 365

Thr Arg Tyr Val Asp Arg Phe Gly Lys Thr Lys Thr Val Phe Pro Gly
 370 375 380

Asn
 385

<210> 91

<211> 387
 <212> PRT
 <213> Polyomavirus sp

<400> 91

Met Ala Pro Lys Arg Lys Ser Gly Val Ser Lys Cys Glu Thr Lys Cys
 1 5 10 15

Thr Lys Ala Cys Pro Arg Pro Ala Pro Val Pro Lys Leu Leu Ile Lys
 20 25 30

Gly Gly Met Glu Val Leu Asp Leu Val Thr Gly Pro Asp Ser Val Thr
 35 40 45

Glu Ile Glu Ala Phe Leu Asn Pro Arg Met Gly Gln Pro Pro Thr Pro
 50 55 60

Glu Ser Leu Thr Glu Gly Gly Gln Tyr Tyr Gly Trp Ser Arg Gly Ile
 65 70 75 80

Asn Leu Ala Thr Ser Ala Gly Thr Glu Asp Ser Pro Gly Asn Asn Thr
 85 90 95

Leu Pro Thr Trp Ser Met Ala Lys Leu Gln Leu Pro Met Leu Asn Glu
 100 105 110

Asp Leu Thr Cys Asp Thr Leu Gln Met Trp Glu Ala Val Ser Val Lys
 115 120 125

Thr Glu Val Val Gly Ser Gly Ser Leu Leu Asp Val His Gly Phe Asn
 130 135 140

Lys Pro Thr Asp Thr Val Asn Thr Lys Gly Ile Ser Thr Pro Val Glu
 145 150 155 160

Gly Ser Gln Tyr His Val Phe Ala Val Gly Gly Glu Pro Leu Asp Leu
 165 170 175

Gln Gly Leu Val Thr Asp Ala Arg Thr Lys Tyr Lys Glu Glu Gly Val
 180 185 190

Val Thr Ile Lys Thr Ile Thr Lys Lys Asp Met Val Asn Lys Asp Gln
 195 200 205

Val Leu Asn Pro Ile Ser Lys Ala Lys Leu Asp Lys Asp Gly Met Tyr
 210 215 220

Pro Val Glu Ile Trp His Pro Asp Pro Ala Lys Asn Glu Asn Thr Arg
 225 230 235 240

Tyr Phe Gly Asn Tyr Thr Gly Gly Thr His Val Thr Pro Pro Val Leu
 245 250 255

381698_1.TXT

Gln Phe Thr Asn Thr Leu Thr Thr Val Leu Leu Asp Glu Asn Gly Val
260 265 270

Gly Pro Leu Cys Lys Gly Glu Gly Leu Tyr Leu Ser Cys Val Asp Ile
275 280 285

Met Gly Trp Arg Val Thr Arg Ser Ala Tyr Asp Val His His Trp Arg
290 295 300

Gly Leu Pro Arg Tyr Phe Lys Ile Thr Leu Arg Lys Arg Trp Val Lys
305 310 315 320

Asn Pro Tyr Pro Met Ala Ser Leu Ile Ser Ser Leu Phe Asn Asn Met
325 330 335

Leu Pro Gln Val Gln Gly Gln Pro Met Glu Gly Glu Asn Thr Gln Val
340 345 350

Glu Glu Val Arg Val Tyr Asp Gly Thr Glu Pro Val Pro Gly Asp Pro
355 360 365

Asp Met Thr Arg Tyr Val Asp Arg Phe Gly Lys Thr Lys Thr Val Phe
370 375 380

Pro Gly Asn
385

<210> 92
<211> 402
<212> PRT
<213> Polyomavirus sp

<400> 92

Met Ala Pro Lys Arg Lys Ser Gly Val Ser Lys Cys Glu Thr Lys Cys
1 5 10 15

Thr Lys Ala Cys Pro Arg Pro Ala Pro Val Pro Lys Leu Leu Ile Lys
20 25 30

Gly Gly Met Glu Val Leu Asp Leu Val Thr Gly Pro Asp Ser Val Thr
35 40 45

Glu Ile Glu Ala Phe Leu Asn Pro Arg Met Gly Gln Pro Pro Thr Pro
50 55 60

Glu Ser Leu Thr Glu Gly Gly Gln Tyr Tyr Gly Trp Ser Arg Gly Ile
65 70 75 80

Asn Leu Ala Thr Ser Ala Pro Asn Asp Ala Ala Glu Gln Thr Lys Leu
85 90 95

381698_1.TXT

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

381698_1.TXT

Glu Val Arg Val Tyr Asp Gly Thr Glu Pro Val Pro Gly Asp Pro Asp
370 375 380

Met Thr Arg Tyr Val Asp Arg Phe Gly Lys Thr Lys Thr Val Phe Pro
385 390 395 400

Gly Asn

<210> 93
<211> 392
<212> PRT
<213> Polyomavirus sp

<400> 93

Met Ala Pro Lys Arg Lys Ser Gly Val Ser Lys Cys Glu Thr Lys Cys
1 5 10 15

Thr Lys Ala Cys Pro Arg Pro Ala Pro Val Pro Lys Leu Leu Ile Lys
20 25 30

Gly Gly Met Glu Val Leu Asp Leu Val Thr Gly Pro Asp Ser Val Thr
35 40 45

Glu Ile Glu Ala Phe Leu Asn Pro Arg Met Gly Gln Pro Pro Thr Pro
50 55 60

Glu Ser Leu Thr Glu Gly Gly Gln Tyr Tyr Gly Trp Ser Arg Gly Ile
65 70 75 80

Asn Leu Ala Thr Ser Ala Pro Tyr Asn Gly Lys Ser Ser Gly Thr Glu
85 90 95

Asp Ser Pro Gly Asn Asn Thr Leu Pro Thr Trp Ser Met Ala Lys Leu
100 105 110

Gln Leu Pro Met Leu Asn Glu Asp Leu Thr Cys Asp Thr Leu Gln Met
115 120 125

Trp Glu Ala Val Ser Val Lys Thr Glu Val Val Gly Ser Gly Ser Leu
130 135 140

Leu Asp Val His Gly Phe Asn Lys Pro Thr Asp Thr Val Asn Thr Lys
145 150 155 160

Gly Ile Ser Thr Pro Val Glu Gly Ser Gln Tyr His Val Phe Ala Val
165 170 175

Gly Gly Glu Pro Leu Asp Leu Gln Gly Leu Val Thr Asp Ala Arg Thr
180 185 190

Lys Tyr Lys Glu Glu Gly Val Val Thr Ile Lys Thr Ile Thr Lys Lys
195 200 205

Asp Met Val Asn Lys Asp Gln Val Leu Asn Pro Ile Ser Lys Ala Lys
210 215 220

Leu Asp Lys Asp Gly Met Tyr Pro Val Glu Ile Trp His Pro Asp Pro
225 230 235 240

Ala Lys Asn Glu Asn Thr Arg Tyr Phe Gly Asn Tyr Thr Gly Gly Thr
245 250 255

Thr Thr Pro Pro Val Leu Gln Phe Thr Asn Thr Leu Thr Thr Val Leu
260 265 270

Leu Asp Glu Asn Gly Val Gly Pro Leu Cys Lys Gly Glu Gly Leu Tyr
275 280 285

Leu Ser Cys Val Asp Ile Met Gly Trp Arg Val Thr Arg Asn Tyr Asp
290 295 300

Val His His Trp Arg Gly Leu Pro Arg Tyr Phe Lys Ile Thr Leu Arg
305 310 315 320

Lys Arg Trp Val Lys Asn Pro Tyr Pro Met Ala Ser Leu Ile Ser Ser
325 330 335

Leu Phe Asn Asn Met Leu Pro Gln Val Gln Gly Gln Pro Met Glu Gly
340 345 350

Glu Asn Thr Gln Val Glu Glu Val Arg Val Tyr Asp Gly Thr Glu Pro
355 360 365

Val Pro Gly Asp Pro Asp Met Thr Arg Tyr Val Asp Arg Phe Gly Lys
370 375 380

Thr Lys Thr Val Phe Pro Gly Asn
385 390

<210> 94
<211> 408
<212> PRT
<213> Polyomavirus sp

<400> 94

Met Ala Pro Lys Arg Lys Ser Gly Val Ser Lys Cys Glu Thr Lys Cys
1 5 10 15

Thr Lys Ala Cys Pro Arg Pro Ala Pro Val Pro Lys Leu Leu Ile Lys
20 25 30

Gly Gly Met Glu Val Leu Asp Leu Val Thr Gly Pro Asp Ser Val Thr
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35

40

45

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

305 310 315 320
 Val His His Trp Arg Gly Leu Pro Arg Tyr Phe Lys Ile Thr Leu Arg
 325 330 335
 Lys Arg Trp Val Lys Asn Pro Tyr Pro Met Ala Ser Leu Ile Ser Ser
 340 345 350
 Leu Phe Asn Asn Met Leu Pro Gln Val Gln Gly Gln Pro Met Glu Gly
 355 360 365
 Glu Asn Thr Gln Val Glu Glu Val Arg Val Tyr Asp Gly Thr Glu Pro
 370 375 380
 Val Pro Gly Asp Pro Asp Met Thr Arg Tyr Val Asp Arg Phe Gly Lys
 385 390 395 400
 Thr Lys Thr Val Phe Pro Gly Asn
 405

<210> 95
 <211> 408
 <212> PRT
 <213> Polyomavirus sp

<400> 95

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

381698_1.TXT

Trp Glu Ala Val Ser Val Lys Thr Glu Val Val Gly Ser Gly Ser Leu
145 150 155 160

Leu Asp Val His Gly Phe Asn Lys Pro Thr Asp Thr Val Asn Thr Lys
165 170 175

Gly Ile Ser Thr Pro Val Glu Gly Ser Gln Tyr His Val Phe Ala Val
180 185 190

Gly Gly Glu Pro Leu Asp Leu Gln Gly Leu Val Thr Asp Ala Arg Thr
195 200 205

Lys Tyr Lys Glu Glu Gly Val Val Thr Ile Lys Thr Ile Thr Lys Lys
210 215 220

Asp Met Val Asn Lys Asp Gln Val Leu Asn Pro Ile Ser Lys Ala Lys
225 230 235 240

Leu Asp Lys Asp Gly Met Tyr Pro Val Glu Ile Trp His Pro Asp Pro
245 250 255

Ala Lys Asn Glu Asn Thr Arg Tyr Phe Gly Asn Tyr Thr Gly Gly Thr
260 265 270

Thr Thr Pro Pro Val Leu Gln Phe Thr Asn Thr Leu Thr Thr Val Leu
275 280 285

Leu Asp Glu Asn Gly Val Gly Pro Leu Cys Lys Gly Glu Gly Leu Tyr
290 295 300

Leu Ser Cys Val Asp Ile Met Gly Trp Arg Val Thr Arg Asn Tyr Asp
305 310 315 320

Val His His Trp Arg Gly Leu Pro Arg Tyr Phe Lys Ile Thr Leu Arg
325 330 335

Lys Arg Trp Val Lys Asn Pro Tyr Pro Met Ala Ser Leu Ile Ser Ser
340 345 350

Leu Phe Asn Asn Met Leu Pro Gln Val Gln Gly Gln Pro Met Glu Gly
355 360 365

Glu Asn Thr Gln Val Glu Glu Val Arg Val Tyr Asp Gly Thr Glu Pro
370 375 380

Val Pro Gly Asp Pro Asp Met Thr Arg Tyr Val Asp Arg Phe Gly Lys
385 390 395 400

Thr Lys Thr Val Phe Pro Gly Asn
405

381698_1.TXT

<210> 96
 <211> 568
 <212> PRT
 <213> Influenza A virus

<400> 96

Met Glu Arg Ile Val Leu Leu Leu Ala Ile Val Ser Leu Val Lys Ser
 1 5 10 15

Asp Gln Ile Cys Ile Gly Tyr His Ala Asn Asn Ser Thr Glu Gln Ala
 20 25 30

Asp Thr Ile Met Glu Lys Asn Val Thr Val Thr His Ala Gln Asn Ile
 35 40 45

Leu Glu Lys Thr His Asn Gly Lys Leu Cys Asp Leu Asp Gly Val Lys
 50 55 60

Pro Leu Ile Leu Arg Asp Cys Ser Val Ala Gly Trp Leu Leu Gly Asn
 65 70 75 80

Pro Met Cys Asp Glu Phe Ile Asn Val Pro Glu Trp Ser Tyr Ile Val
 85 90 95

Glu Lys Ala Asn Pro Ala Asn Asp Leu Cys Tyr Pro Gly Asp Phe Asn
 100 105 110

Asp Tyr Glu Glu Leu Lys His Leu Leu Ser Arg Ile Asn His Phe Glu
 115 120 125

Lys Ile Gln Ile Ile Pro Lys Ser Ser Trp Ser Asn His Glu Ala Ser
 130 135 140

Ser Gly Val Arg Ser Ala Cys Pro Tyr Asn Gly Lys Ser Ser Phe Phe
 145 150 155 160

Arg Asn Val Val Trp Leu Ile Lys Lys Asn Ser Ala Tyr Pro Thr Ile
 165 170 175

Lys Arg Ser Tyr Asn Asn Thr Asn Gln Glu Asp Leu Leu Ile Leu Trp
 180 185 190

Gly Ile His His Pro Asn Asp Ala Ala Glu Gln Thr Lys Leu Tyr Gln
 195 200 205

Asn Pro Ile Thr Tyr Ile Ser Val Gly Thr Ser Thr Leu Asn Gln Arg
 210 215 220

Leu Val Pro Lys Ile Ala Thr Arg Ser Lys Val Asn Gly Gln Ser Gly
 225 230 235 240

381698_1.TXT

Arg Met Glu Phe Phe Trp Thr Ile Leu Lys Pro Asn Asp Ala Ile Asn
 245 250 255
 Phe Glu Ser Asn Gly Asn Phe Ile Ala Pro Glu Tyr Ala Tyr Lys Ile
 260 265 270
 Val Lys Lys Gly Asp Ser Ala Ile Met Lys Ser Glu Leu Glu Tyr Gly
 275 280 285
 Asn Cys Asn Thr Lys Cys Gln Thr Pro Met Gly Ala Ile Asn Ser Ser
 290 295 300
 Met Pro Phe His Asn Ile His Pro Leu Thr Ile Gly Glu Cys Pro Lys
 305 310 315 320
 Tyr Val Lys Ser Asn Arg Leu Val Leu Ala Thr Gly Leu Arg Asn Thr
 325 330 335
 Pro Gln Arg Glu Arg Arg Arg Lys Lys Arg Gly Leu Phe Gly Ala Ile
 340 345 350
 Ala Gly Phe Ile Glu Gly Gly Trp Gln Gly Met Val Asp Gly Trp Tyr
 355 360 365
 Gly Tyr His His Ser Asn Glu Gln Gly Ser Gly Tyr Ala Ala Asp Lys
 370 375 380
 Glu Ser Thr Gln Arg Ala Ile Asp Gly Val Thr Asn Lys Val Asn Ser
 385 390 395 400
 Ile Ile Gly Lys Met Asn Thr Gln Phe Glu Ala Val Gly Arg Glu Phe
 405 410 415
 Asn Asn Leu Glu Arg Arg Ile Glu Asn Leu Asn Lys Lys Met Glu Asp
 420 425 430
 Gly Phe Leu Asp Val Trp Thr Tyr Asn Ala Glu Leu Leu Val Leu Met
 435 440 445
 Glu Asn Glu Arg Thr Leu Asp Phe His Asp Ser Asn Val Lys Asn Leu
 450 455 460
 Tyr Asp Lys Val Arg Leu Gln Leu Arg Asp Asn Ala Lys Glu Leu Gly
 465 470 475 480
 Asn Gly Cys Phe Glu Phe Tyr His Lys Cys Asp Asn Glu Cys Met Glu
 485 490 495
 Ser Val Lys Asn Gly Thr Tyr Asp Tyr Pro Arg Tyr Ser Glu Glu Ala
 500 505 510

381698_1.TXT

Arg Leu Asn Arg Glu Glu Ile Ser Gly Val Lys Leu Glu Ser Met Gly
515 520 525

Thr Tyr Gln Ile Leu Ser Ile Tyr Ser Thr Val Ala Ser Ser Leu Ala
530 535 540

Leu Ala Ile Met Val Ala Gly Leu Ser Leu Trp Met Cys Ser Asn Gly
545 550 555 560

Ser Leu Gln Cys Arg Ile Cys Ile
565

<210> 97
<211> 568
<212> PRT
<213> Influenza A virus
<400> 97

Met Glu Arg Ile Val Leu Leu Leu Ala Ile Ile Gly Leu Val Lys Ser
1 5 10 15

Asp Gln Ile Cys Ile Gly Tyr His Ala Asn Asn Ser Thr Glu Gln Val
20 25 30

Asp Thr Ile Met Glu Lys Asn Val Thr Val Thr His Ala Gln Asp Ile
35 40 45

Leu Glu Lys Thr His Asn Gly Lys Leu Cys Asn Pro Asp Gly Val Lys
50 55 60

Pro Leu Ile Leu Lys Asp Cys Ser Val Ala Gly Trp Leu Leu Gly Asn
65 70 75 80

Pro Met Cys Asp Glu Phe Ile Asn Val Pro Glu Trp Ser Tyr Ile Val
85 90 95

Glu Lys Ala Ser Pro Ala Asn Gly Leu Cys Tyr Pro Gly Asp Phe Asn
100 105 110

Asp Tyr Glu Glu Leu Lys His Leu Leu Ser Arg Ile Asn His Phe Glu
115 120 125

Lys Ile Gln Ile Ile Pro Lys Ser Ser Trp Ser Asp His Gly Ala Ser
130 135 140

Ser Gly Val Ser Ser Ala Cys Ser Tyr Leu Gly Lys Pro Ser Phe Phe
145 150 155 160

Arg Asn Val Val Trp Leu Ile Lys Lys Asn Asn Thr Tyr Pro Pro Ile
165 170 175

381698_1.TXT

Lys Val Ser Tyr Asn Asn Thr Asn Gln Glu Asp Leu Leu Val Leu Trp
 180 185 190
 Gly Ile His His Pro Asn Asp Glu Ala Glu Gln Ile Lys Ile Tyr Gln
 195 200 205
 Asn Pro Thr Thr Tyr Ile Ser Val Gly Thr Ser Thr Leu Asn Gln Arg
 210 215 220
 Leu Val Pro Lys Ile Ala Thr Arg Ser Lys Val Asn Gly Gln Ser Gly
 225 230 235 240
 Arg Met Glu Phe Phe Trp Thr Ile Leu Lys Pro Asn Asp Ala Ile Asn
 245 250 255
 Phe Asp Ser Asn Gly Asn Phe Ile Ala Pro Glu Tyr Ala Tyr Lys Ile
 260 265 270
 Val Lys Lys Gly Asp Ser Ala Ile Met Lys Ser Glu Leu Glu Tyr Gly
 275 280 285
 Asn Cys Asn Thr Lys Cys Gln Thr Pro Met Gly Ala Ile Asn Ser Ser
 290 295 300
 Met Pro Phe His Asn Ile His Pro Leu Thr Val Gly Glu Cys Pro Lys
 305 310 315 320
 Tyr Val Lys Ser Asn Arg Leu Val Leu Ala Thr Gly Leu Arg Asn Ala
 325 330 335
 Pro Gln Arg Glu Gly Gly Arg Lys Lys Arg Gly Leu Phe Gly Ala Ile
 340 345 350
 Ala Gly Phe Ile Glu Gly Gly Trp Gln Gly Met Val Asp Gly Trp Tyr
 355 360 365
 Gly Tyr His His Ser Asn Glu Gln Gly Ser Gly Tyr Ala Ala Asp Lys
 370 375 380
 Glu Ser Thr Gln Lys Ala Ile Asp Gly Val Thr Asn Lys Val Asn Ser
 385 390 395 400
 Ile Ile Asp Lys Met Asn Thr Gln Phe Glu Ala Val Gly Arg Glu Phe
 405 410 415
 Asn Asn Leu Glu Arg Arg Ile Glu Asn Leu Asn Lys Lys Met Glu Asp
 420 425 430
 Gly Phe Leu Asp Val Trp Thr Tyr Asn Ala Glu Leu Leu Val Leu Met
 435 440 445

381698_1.TXT

Glu Asn Glu Arg Thr Leu Asp Phe His Asp Ser Asn Val Lys Asn Leu
450 455 460

Tyr Glu Lys Val Arg Leu Gln Leu Arg Asp Asn Ala Lys Glu Leu Gly
465 470 475 480

Asn Gly Cys Phe Glu Phe Tyr His Lys Cys Asp Asn Glu Cys Met Glu
485 490 495

Ser Val Lys Asn Gly Thr Tyr Asp Tyr Pro Gln Tyr Ser Glu Glu Ala
500 505 510

Arg Leu Asn Arg Glu Glu Ile Ser Gly Val Lys Leu Glu Ser Met Gly
515 520 525

Thr Tyr Gln Ile Leu Ser Ile Tyr Ser Thr Val Ala Ser Ser Leu Ala
530 535 540

Leu Ala Ile Met Val Ala Gly Leu Ser Leu Trp Met Cys Ser Asn Gly
545 550 555 560

Ser Leu Gln Cys Arg Ile Cys Ile
565

<210> 98
<211> 568
<212> PRT
<213> Influenza A virus

<400> 98

Met Glu Gly Thr Val Leu Leu Leu Ala Ile Ile Ser Leu Val Lys Ser
1 5 10 15

Asp Gln Ile Cys Ile Gly Tyr His Ala Asn Asn Ser Thr Glu Gln Val
20 25 30

Asp Thr Ile Met Glu Lys Asn Val Thr Val Thr His Ala Gln Asp Ile
35 40 45

Leu Glu Lys Thr His Asn Gly Lys Leu Cys Asp Leu Asp Gly Val Lys
50 55 60

Pro Leu Ile Leu Arg Asp Cys Ser Val Ala Gly Trp Leu Leu Gly Asn
65 70 75 80

Pro Met Cys Asp Glu Phe Ile Asn Val Pro Glu Trp Ser Tyr Ile Val
85 90 95

Glu Lys Ala Ser Pro Ala Asn Asp Leu Cys Tyr Pro Gly Asp Phe Asn
100 105 110

Asp Tyr Glu Glu Leu Lys His Leu Leu Ser Arg Ile Asn His Phe Glu

115

120

125

Lys Ile Gln Ile Ile Pro Lys Ser Ser Trp Ser Asn His Glu Ala Ser
 130 135 140

Ser Gly Val Ser Ser Ala Cys Pro Tyr Leu Gly Lys Ser Ser Phe Phe
 145 150 155 160

Arg Asn Val Val Trp Leu Ile Lys Lys Asn Ser Ala Tyr Pro Thr Ile
 165 170 175

Lys Arg Ser Tyr Asn Asn Thr Asn Gln Glu Asp Leu Leu Val Leu Trp
 180 185 190

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

Asn Pro Thr Thr Tyr Ile Ser Val Gly Thr Ser Thr Leu Asn Gln Arg
 210 215 220

Leu Val Pro Lys Ile Ala Thr Arg Ser Lys Val Asn Gly Gln Ser Gly
 225 230 235 240

Arg Met Glu Phe Phe Trp Thr Ile Leu Lys Pro Asn Asp Ala Ile Asn
 245 250 255

Phe Glu Ser Asn Gly Asn Phe Ile Ala Pro Glu Tyr Ala Tyr Lys Ile
 260 265 270

Val Lys Lys Gly Asp Ser Ala Ile Met Lys Ser Glu Leu Glu Tyr Gly
 275 280 285

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

Met Pro Phe His Asn Ile His Pro Leu Thr Ile Gly Glu Cys Pro Lys
 305 310 315 320

Tyr Val Lys Ser Asn Arg Leu Val Leu Ala Thr Gly Leu Arg Asn Thr
 325 330 335

Pro Gln Arg Glu Arg Arg Arg Lys Lys Arg Gly Leu Phe Gly Ala Ile
 340 345 350

Ala Gly Phe Ile Glu Gly Gly Trp Gln Gly Met Val Asp Gly Trp Tyr
 355 360 365

Gly Tyr His His Ser Asn Glu Gln Gly Ser Gly Tyr Ala Ala Asp Lys
 370 375 380

Glu Ser Thr Gln Lys Ala Ile Asp Gly Val Thr Asn Lys Val Asn Ser
 Page 37

385 390 395 400
 Ile Ile Asp Lys Met Asn Thr Gln Phe Glu Ala Val Gly Arg Glu Phe
 405 410 415
 Asn Asn Leu Glu Arg Arg Ile Glu Asn Leu Asn Lys Lys Met Glu Asp
 420 425 430
 Gly Phe Leu Asp Val Trp Thr Tyr Asn Ala Glu Leu Leu Val Leu Met
 435 440 445
 Glu Asn Glu Arg Thr Leu Asp Phe His Asp Ser Asn Val Lys Asn Leu
 450 455 460
 Tyr Asp Lys Val Arg Leu Gln Leu Arg Asp Asn Ala Lys Glu Leu Gly
 465 470 475 480
 Asn Gly Cys Phe Glu Phe Tyr His Lys Cys Asp Asn Glu Cys Met Glu
 485 490 495
 Ser Val Lys Asn Gly Thr Tyr Asp Tyr Pro Gln Tyr Ser Glu Glu Ala
 500 505 510
 Arg Leu Asn Arg Glu Glu Ile Ser Gly Val Lys Leu Glu Ser Met Gly
 515 520 525
 Thr Tyr Gln Ile Leu Ser Ile Tyr Ser Thr Val Val Ser Ser Leu Ala
 530 535 540
 Leu Ala Ile Met Val Ala Gly Leu Ser Leu Trp Met Cys Ser Asn Gly
 545 550 555 560
 Ser Leu Gln Cys Arg Ile Cys Ile
 565

<210> 99
 <211> 568
 <212> PRT
 <213> Influenza A virus
 <400> 99

Met Glu Lys Ile Val Leu Leu Leu Ala Ile Val Ser Leu Val Lys Ser
 1 5 10 15
 Asp Gln Ile Cys Ile Gly Tyr His Ala Asn Asn Ser Thr Glu Gln Val
 20 25 30
 Asp Thr Ile Met Glu Lys Asn Val Thr Val Thr His Ala Gln Asp Ile
 35 40 45
 Leu Glu Lys Thr His Asn Gly Lys Leu Cys Asp Leu Asp Gly Val Lys
 50 55 60

381698_1.TXT

Pro Leu Ile Leu Arg Asp Cys Ser Val Ala Gly Trp Leu Leu Gly Asn
65 70 75 80

Pro Met Cys Asp Glu Phe Leu Asn Val Pro Glu Trp Ser Tyr Ile Val
85 90 95

Glu Lys Ile Asn Pro Ala Asn Asp Leu Cys Tyr Pro Gly Asn Phe Asn
100 105 110

Asp Tyr Glu Glu Leu Lys His Leu Leu Ser Arg Ile Asn His Phe Glu
115 120 125

Lys Ile Gln Ile Ile Pro Lys Ser Ser Trp Ser Asp His Glu Ala Ser
130 135 140

Ser Gly Val Ser Ser Ala Cys Pro Tyr Gln Gly Arg Ser Ser Phe Phe
145 150 155 160

Arg Asn Val Val Trp Leu Ile Lys Lys Asp Asn Ala Tyr Pro Thr Ile
165 170 175

Lys Arg Ser Tyr Asn Asn Thr Asn Gln Glu Asp Leu Leu Val Leu Trp
180 185 190

Gly Ile His His Pro Asn Asp Ala Ala Glu Gln Thr Arg Leu Tyr Gln
195 200 205

Asn Pro Thr Thr Tyr Ile Ser Val Gly Thr Ser Thr Leu Asn Gln Arg
210 215 220

Leu Val Pro Lys Ile Ala Thr Arg Ser Lys Val Asn Gly Gln Ser Gly
225 230 235 240

Arg Met Glu Phe Phe Trp Thr Ile Leu Lys Pro Asn Asp Ala Ile Asn
245 250 255

Phe Glu Ser Asn Gly Asn Phe Ile Ala Pro Glu Asn Ala Tyr Lys Ile
260 265 270

Val Lys Lys Gly Asp Ser Thr Ile Met Lys Ser Glu Leu Glu Tyr Gly
275 280 285

Asn Cys Asn Thr Lys Cys Gln Thr Pro Ile Gly Ala Ile Asn Ser Ser
290 295 300

Met Pro Phe His Asn Ile His Pro Leu Thr Ile Gly Glu Cys Pro Lys
305 310 315 320

Tyr Val Lys Ser Asn Arg Leu Val Leu Ala Thr Gly Leu Arg Asn Ser
325 330 335

381698_1.TXT

Pro Gln Gly Glu Arg Arg Arg Lys Lys Arg Gly Leu Phe Gly Ala Ile
340 345 350

Ala Gly Phe Ile Glu Gly Gly Trp Gln Gly Met Val Asp Gly Trp Tyr
355 360 365

Gly Tyr His His Ser Asn Glu Gln Gly Ser Gly Tyr Ala Ala Asp Lys
370 375 380

Glu Ser Thr Gln Lys Ala Ile Asp Gly Val Thr Asn Lys Val Asn Ser
385 390 395 400

Ile Ile Asp Lys Met Asn Thr Gln Phe Glu Ala Val Gly Arg Glu Phe
405 410 415

Asn Asn Leu Glu Arg Arg Ile Glu Asn Leu Asn Lys Lys Met Glu Asp
420 425 430

Gly Phe Leu Asp Val Trp Thr Tyr Asn Ala Glu Leu Leu Val Leu Met
435 440 445

Glu Asn Glu Arg Thr Leu Asp Phe His Asp Ser Asn Val Lys Asn Leu
450 455 460

Tyr Asp Lys Val Arg Leu Gln Leu Arg Asp Asn Ala Lys Glu Leu Gly
465 470 475 480

Asn Gly Cys Phe Glu Phe Tyr His Arg Cys Asp Asn Glu Cys Met Glu
485 490 495

Ser Val Arg Asn Gly Thr Tyr Asp Tyr Pro Gln Tyr Ser Glu Glu Ala
500 505 510

Arg Leu Lys Arg Glu Glu Ile Ser Gly Val Lys Leu Glu Ser Ile Gly
515 520 525

Thr Tyr Gln Ile Leu Ser Ile Tyr Ser Thr Val Ala Ser Ser Leu Ala
530 535 540

Leu Ala Ile Met Val Ala Gly Leu Ser Leu Trp Met Cys Ser Asn Gly
545 550 555 560

Ser Leu Gln Cys Arg Ile Cys Ile
565

<210> 100
<211> 568
<212> PRT
<213> Influenza A virus
<400> 100

381698_1.TXT

Met Glu Lys Ile Val Leu Leu Phe Ala Ile Val Ser Leu Val Lys Ser
 1 5 10 15
 Asp Gln Ile Cys Ile Gly Tyr His Ala Asn Asn Ser Thr Glu Gln Val
 20 25 30
 Asp Thr Ile Met Glu Lys Asn Val Thr Val Thr His Ala Gln Asp Ile
 35 40 45
 Leu Glu Lys Thr His Asn Gly Lys Leu Cys Asp Leu Asp Gly Val Lys
 50 55 60
 Pro Leu Ile Leu Arg Asp Cys Ser Val Ala Gly Trp Leu Leu Gly Asn
 65 70 75 80
 Pro Met Cys Asp Glu Phe Ile Asn Val Pro Glu Trp Ser Tyr Ile Val
 85 90 95
 Glu Lys Ala Asn Pro Val Asn Asp Leu Cys Tyr Pro Gly Asp Phe Asn
 100 105 110
 Asp Tyr Glu Glu Leu Lys His Leu Leu Ser Arg Ile Asn His Phe Glu
 115 120 125
 Lys Ile Gln Ile Ile Pro Lys Ser Ser Trp Ser Ser His Glu Ala Ser
 130 135 140
 Leu Gly Val Ser Ser Ala Cys Pro Tyr Gln Gly Lys Ser Ser Phe Phe
 145 150 155 160
 Arg Asn Val Val Trp Leu Ile Lys Lys Asn Ser Thr Tyr Pro Thr Ile
 165 170 175
 Lys Arg Ser Tyr Asn Asn Thr Asn Gln Glu Asp Leu Leu Val Leu Trp
 180 185 190
 Gly Ile His His Pro Asn Asp Ala Ala Glu Gln Thr Lys Leu Tyr Gln
 195 200 205
 Asn Pro Thr Thr Tyr Ile Ser Val Gly Thr Ser Thr Leu Asn Gln Arg
 210 215 220
 Leu Val Pro Arg Ile Ala Thr Arg Ser Lys Val Asn Gly Gln Ser Gly
 225 230 235 240
 Arg Met Glu Phe Phe Trp Thr Ile Leu Lys Pro Asn Asp Ala Ile Asn
 245 250 255
 Phe Glu Ser Asn Gly Asn Phe Ile Ala Pro Glu Tyr Ala Tyr Lys Ile
 260 265 270

381698_1.TXT

Val Lys Lys Gly Asp Ser Thr Ile Met Lys Ser Glu Leu Glu Tyr Gly
 275 280 285
 Asn Cys Asn Thr Lys Cys Gln Thr Pro Met Gly Ala Ile Asn Ser Ser
 290 295 300
 Met Pro Phe His Asn Ile His Pro Leu Thr Ile Gly Glu Cys Pro Lys
 305 310 315 320
 Tyr Val Lys Ser Asn Arg Leu Val Leu Ala Thr Gly Leu Arg Asn Ser
 325 330 335
 Pro Gln Arg Glu Arg Arg Arg Lys Lys Arg Gly Leu Phe Gly Ala Ile
 340 345 350
 Ala Gly Phe Ile Glu Gly Gly Trp Gln Gly Met Val Asp Gly Trp Tyr
 355 360 365
 Gly Tyr His His Ser Asn Glu Gln Gly Ser Gly Tyr Ala Ala Asp Lys
 370 375 380
 Glu Ser Thr Gln Lys Ala Ile Asp Gly Val Thr Asn Lys Val Asn Ser
 385 390 395 400
 Ile Ile Asp Lys Met Asn Thr Gln Phe Glu Ala Val Gly Arg Glu Phe
 405 410 415
 Asn Asn Leu Glu Arg Arg Ile Glu Asn Leu Asn Lys Lys Met Glu Asp
 420 425 430
 Gly Phe Leu Asp Val Trp Thr Tyr Asn Ala Glu Leu Leu Val Leu Met
 435 440 445
 Glu Asn Glu Arg Thr Leu Asp Phe His Asp Ser Asn Val Lys Asn Leu
 450 455 460
 Tyr Asp Lys Val Arg Leu Gln Leu Arg Asp Asn Ala Lys Glu Leu Gly
 465 470 475 480
 Asn Gly Cys Phe Glu Phe Tyr His Lys Cys Asp Asn Glu Cys Met Glu
 485 490 495
 Ser Val Arg Asn Gly Thr Tyr Asp Tyr Pro Gln Tyr Ser Glu Glu Ala
 500 505 510
 Arg Leu Lys Arg Glu Glu Ile Ser Gly Val Lys Leu Glu Ser Ile Gly
 515 520 525
 Ile Tyr Gln Ile Leu Ser Ile Tyr Ser Thr Val Ala Ser Ser Leu Ala
 530 535 540

381698_1.TXT

Leu Ala Ile Met Val Ala Gly Leu Ser Leu Trp Met Cys Ser Asn Gly
545 550 555 560

Ser Leu Gln Cys Arg Ile Cys Ile
565

<210> 101
<211> 568
<212> PRT
<213> Influenza A virus

<400> 101

Met Glu Lys Ile Val Leu Leu Phe Ala Ile Val Ser Leu Val Lys Ser
1 5 10 15

Asp Gln Ile Cys Ile Gly Tyr His Ala Asn Asn Ser Thr Glu Gln Val
20 25 30

Asp Thr Ile Met Glu Lys Asn Val Thr Val Thr His Ala Gln Asp Ile
35 40 45

Leu Glu Lys Thr His Asn Gly Lys Leu Cys Asp Leu Asp Gly Val Lys
50 55 60

Pro Leu Ile Leu Arg Asp Cys Ser Val Ala Gly Trp Leu Leu Gly Asn
65 70 75 80

Pro Met Cys Asp Glu Phe Ile Asn Val Pro Glu Trp Ser Tyr Ile Val
85 90 95

Glu Lys Ala Asn Pro Val Asn Asp Leu Cys Tyr Pro Gly Asp Phe Asn
100 105 110

Asp Tyr Glu Glu Leu Lys His Leu Leu Ser Arg Ile Asn His Phe Glu
115 120 125

Lys Ile Gln Ile Ile Pro Lys Ser Ser Trp Ser Ser His Glu Ala Ser
130 135 140

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

Arg Asn Val Val Trp Leu Ile Lys Lys Asn Ser Thr Tyr Pro Thr Ile
165 170 175

Lys Arg Ser Tyr Asn Asn Thr Asn Gln Glu Asp Leu Leu Val Leu Trp
180 185 190

Gly Ile His His Pro Asn Asp Ala Ala Glu Gln Thr Lys Leu Tyr Gln
195 200 205

381698_1.TXT

Asn Pro Thr Thr Tyr Ile Ser Val Gly Thr Ser Thr Leu Asn Gln Arg
 210 215 220
 Leu Val Pro Arg Ile Ala Thr Arg Ser Lys Val Asn Gly Gln Ser Gly
 225 230 235 240
 Arg Met Glu Phe Phe Trp Thr Ile Leu Lys Pro Asn Asp Ala Ile Asn
 245 250 255
 Phe Glu Ser Asn Gly Asn Phe Ile Ala Pro Glu Tyr Ala Tyr Lys Ile
 260 265 270
 Val Lys Lys Gly Asp Ser Thr Ile Met Lys Ser Glu Leu Glu Tyr Gly
 275 280 285
 Asn Cys Asn Thr Lys Cys Gln Thr Pro Met Gly Ala Ile Asn Ser Ser
 290 295 300
 Met Pro Phe His Asn Ile His Pro Leu Thr Ile Gly Glu Cys Pro Lys
 305 310 315 320
 Tyr Val Lys Ser Asn Arg Leu Val Leu Ala Thr Gly Leu Arg Asn Ser
 325 330 335
 Pro Gln Arg Glu Arg Arg Arg Lys Lys Arg Gly Leu Phe Gly Ala Ile
 340 345 350
 Ala Gly Phe Ile Glu Gly Gly Trp Gln Gly Met Val Asp Gly Trp Tyr
 355 360 365
 Gly Tyr His His Ser Asn Glu Gln Gly Ser Gly Tyr Ala Ala Asp Lys
 370 375 380
 Glu Ser Thr Gln Lys Ala Ile Asp Gly Val Thr Asn Lys Val Asn Ser
 385 390 395 400
 Ile Ile Asp Lys Met Asn Thr Gln Phe Glu Ala Val Gly Arg Glu Phe
 405 410 415
 Asn Asn Leu Glu Arg Arg Ile Glu Asn Leu Asn Lys Lys Met Glu Asp
 420 425 430
 Gly Phe Leu Asp Val Trp Thr Tyr Asn Ala Glu Leu Leu Val Leu Met
 435 440 445
 Glu Asn Glu Arg Thr Leu Asp Phe His Asp Ser Asn Val Lys Asn Leu
 450 455 460
 Tyr Asp Lys Val Arg Leu Gln Leu Arg Asp Asn Ala Lys Glu Leu Gly
 465 470 475 480

381698_1.TXT

Asn Gly Cys Phe Glu Phe Tyr His Lys Cys Asp Asn Glu Cys Met Glu
 485 490 495

Ser Val Arg Asn Gly Thr Tyr Asp Tyr Pro Gln Tyr Ser Glu Glu Ala
 500 505 510

Arg Leu Lys Arg Glu Glu Ile Ser Gly Val Lys Leu Glu Ser Ile Gly
 515 520 525

Ile Tyr Gln Ile Leu Ser Ile Tyr Ser Thr Val Ala Ser Ser Leu Ala
 530 535 540

Leu Ala Ile Met Val Ala Gly Leu Ser Leu Trp Met Cys Ser Asn Gly
 545 550 555 560

Ser Leu Gln Cys Arg Ile Cys Ile
 565

<210> 102
 <211> 568
 <212> PRT
 <213> Influenza A virus

<400> 102

Met Glu Lys Ile Val Leu Leu Leu Ala Ile Val Ser Leu Val Lys Ser
 1 5 10 15

Asp Gln Ile Cys Ile Gly Tyr His Ala Asn Asn Ser Thr Glu Gln Val
 20 25 30

Asp Thr Ile Met Glu Lys Asn Val Thr Val Thr His Ala Gln Asn Ile
 35 40 45

Leu Glu Lys Thr His Asn Gly Lys Leu Cys Asp Leu Asp Gly Val Lys
 50 55 60

Pro Leu Ile Leu Arg Asp Cys Ser Val Ala Gly Trp Leu Leu Gly Asn
 65 70 75 80

Pro Met Cys Asp Glu Phe Ile Asn Val Pro Glu Trp Ser Tyr Ile Val
 85 90 95

Glu Lys Ala Asn Pro Ala Asn Asp Leu Cys Tyr Pro Gly Asp Phe Asn
 100 105 110

Asp Tyr Glu Glu Leu Lys His Leu Leu Ser Arg Ile Asn His Phe Glu
 115 120 125

Lys Ile Gln Ile Ile Pro Lys Ser Ser Trp Ser Asn His Glu Ala Ser
 130 135 140

Ser Gly Val Ser Ser Ala Cys Pro Tyr Asn Gly Lys Ser Ser Phe Phe
 Page 45

145 150 155 160
 Arg Asn Val Val Trp₁₆₅ Leu Ile Lys Lys Asn₁₇₀ Ser Ala Tyr Pro Thr₁₇₅ Ile
 Lys Arg Ser Tyr₁₈₀ Asn Asn Thr Asn Gln₁₈₅ Glu Asp Leu Leu Ile₁₉₀ Leu Trp
 Gly Ile His₁₉₅ His Pro Asn Asp Ala₂₀₀ Ala Glu Gln Thr Arg₂₀₅ Leu Tyr Gln
 Asn Pro₂₁₀ Ile Thr Tyr Ile Ser₂₁₅ Val Gly Thr Ser Thr₂₂₀ Leu Asn Gln Arg
 Leu Val Pro Lys Ile Ala₂₃₀ Thr Arg Ser Lys Val₂₃₅ Asn Gly Gln Ser Gly₂₄₀
 Arg Met Glu Phe Phe₂₄₅ Trp Thr Ile Leu Lys₂₅₀ Pro Asn Asp Ala Ile₂₅₅ Asn
 Phe Glu Ser Asn₂₆₀ Gly Asn Phe Ile Ala₂₆₅ Pro Glu Tyr Ala Tyr₂₇₀ Lys Ile
 Val Lys Lys₂₇₅ Gly Asp Ser Ala Ile₂₈₀ Met Lys Ser Glu Leu₂₈₅ Glu Tyr Gly
 Asn Cys₂₉₀ Asn Thr Lys Cys Gln₂₉₅ Thr Pro Met Gly Ala₃₀₀ Ile Asn Ser Ser
 Met Pro Phe His Asn Ile₃₁₀ His Pro Leu Thr Ile₃₁₅ Gly Glu Cys Pro Lys₃₂₀
 Tyr Val Lys Ser Asn₃₂₅ Arg Leu Val Leu Ala₃₃₀ Thr Gly Leu Arg Asn₃₃₅ Thr
 Pro Gln Arg Glu₃₄₀ Arg Arg Arg Lys Lys₃₄₅ Arg Gly Leu Phe Gly₃₅₀ Ala Ile
 Ala Gly Phe₃₅₅ Ile Glu Gly Gly Trp₃₆₀ Gln Gly Met Val Asp₃₆₅ Gly Trp Tyr
 Gly Tyr₃₇₀ His His Ser Asn Glu₃₇₅ Gln Gly Ser Gly Tyr₃₈₀ Ala Ala Asp Lys
 Glu Ser Thr Gln Lys Ala₃₉₀ Ile Asp Gly Val Thr₃₉₅ Asn Lys Val Asn Ser₄₀₀
 Ile Ile Gly Lys Met₄₀₅ Asn Thr Gln Phe Glu₄₁₀ Ala Val Gly Arg Glu₄₁₅ Phe
 Asn Asn Leu Glu Arg Arg Ile Glu Asn Leu Asn Lys Lys Met Glu Asp

420

425

430

Gly Phe Leu Asp Val Trp Thr Tyr Asn Ala Glu Leu Leu Val Leu Met
 435 440 445

Glu Asn Glu Arg Thr Leu Asp Phe His Asp Ser Asn Val Lys Asn Leu
 450 455 460

Tyr Asp Lys Val Arg Leu Gln Leu Arg Asp Asn Ala Lys Glu Leu Gly
 465 470 475 480

Asn Gly Cys Phe Glu Phe Tyr His Lys Cys Asp Asn Glu Cys Met Glu
 485 490 495

Ser Val Lys Asn Gly Thr Tyr Asp Tyr Pro Arg Tyr Ser Glu Glu Ala
 500 505 510

Arg Leu Asn Arg Glu Glu Ile Ser Gly Val Lys Leu Glu Ser Met Gly
 515 520 525

Thr Tyr Gln Ile Leu Ser Ile Tyr Ser Thr Val Ala Ser Ser Leu Ala
 530 535 540

Leu Ala Ile Met Val Ala Gly Leu Ser Leu Trp Met Cys Ser Asn Gly
 545 550 555 560

Ser Leu Gln Cys Arg Ile Cys Ile
 565

<210> 103
 <211> 568
 <212> PRT
 <213> Influenza A virus

<400> 103

Met Glu Lys Ile Val Leu Leu Phe Ala Ile Val Ser Leu Val Lys Ser
 1 5 10 15

Asp Gln Ile Cys Ile Gly Tyr His Ala Asn Asn Ser Thr Glu Gln Val
 20 25 30

Asp Thr Ile Met Glu Lys Asn Val Thr Val Thr His Ala Gln Asp Ile
 35 40 45

Leu Glu Lys Thr His Asn Gly Lys Leu Cys Asp Leu Asp Gly Val Lys
 50 55 60

Pro Leu Ile Leu Arg Asp Cys Ser Val Ala Gly Trp Leu Leu Gly Asn
 65 70 75 80

Pro Met Cys Asp Glu Phe Ile Asn Val Pro Glu Trp Ser Tyr Ile Val
 85 90 95

381698_1.TXT

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

381698_1.TXT

Gly Tyr His His Ser Asn Lys Gln Gly Ser Gly Tyr Ala Ala Asp Lys
370 375 380

Glu Ser Thr Gln Lys Ala Ile Asp Gly Val Thr Asn Lys Val Asn Ser
385 390 395 400

Ile Ile Asp Lys Met Asn Thr Gln Phe Glu Ala Val Gly Arg Glu Phe
405 410 415

Asn Asn Leu Glu Arg Arg Ile Glu Asn Leu Asn Lys Lys Met Glu Asp
420 425 430

Gly Phe Leu Asp Val Trp Thr Tyr Asn Ala Glu Leu Leu Val Leu Met
435 440 445

Glu Asn Glu Arg Thr Leu Asp Phe His Asp Ser Asn Val Lys Asn Leu
450 455 460

Tyr Asp Lys Val Arg Leu Gln Leu Arg Asp Asn Ala Lys Glu Leu Gly
465 470 475 480

Asn Gly Cys Phe Glu Phe Tyr His Lys Cys Asp Asn Glu Cys Met Glu
485 490 495

Ser Val Arg Asn Gly Thr Tyr Asp Tyr Pro Gln Tyr Ser Glu Glu Ala
500 505 510

Arg Leu Lys Arg Glu Glu Ile Ser Gly Val Lys Leu Glu Ser Ile Gly
515 520 525

Ile Tyr Gln Ile Leu Ser Ile Tyr Ser Thr Val Ala Ser Ser Leu Ala
530 535 540

Leu Ala Ile Met Val Ala Gly Leu Ser Leu Trp Met Cys Ser Asn Gly
545 550 555 560

Ser Leu Gln Cys Arg Ile Cys Ile
565

<210> 104
<211> 568
<212> PRT
<213> Influenza A virus

<400> 104

Met Glu Lys Thr Val Leu Leu Leu Ala Ile Val Ser Leu Val Lys Ser
1 5 10 15

Asp Gln Ile Cys Ile Gly Tyr His Ala Asn Asn Ser Thr Glu Gln Val
20 25 30

381698_1.TXT

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

381698_1.TXT

Met Pro Phe His Asn Ile His Pro Leu Thr Ile Gly Glu Cys Pro Lys
 305 310 315 320
 Tyr Val Lys Ser Asn Arg Leu Val Leu Ala Thr Gly Leu Arg Asn Thr
 325 330 335
 Pro Gln Arg Glu Arg Arg Arg Lys Lys Arg Gly Leu Phe Gly Ala Ile
 340 345 350
 Ala Gly Phe Ile Glu Gly Gly Trp Gln Gly Met Val Asp Gly Trp Tyr
 355 360 365
 Gly Tyr His His Ser Asn Glu Gln Gly Ser Gly Tyr Ala Ala Asp Lys
 370 375 380
 Glu Ser Thr Gln Lys Ala Ile Asp Gly Val Thr Asn Lys Val Asn Ser
 385 390 395 400
 Ile Ile Asp Lys Met Asn Thr Gln Phe Glu Ala Val Gly Arg Glu Phe
 405 410 415
 Asn Asn Leu Glu Arg Arg Ile Glu Ser Leu Asn Lys Lys Met Glu Asp
 420 425 430
 Gly Phe Leu Asp Val Trp Thr Tyr Asn Ala Glu Leu Leu Val Leu Met
 435 440 445
 Glu Asn Glu Arg Thr Leu Asp Phe His Asp Ser Asn Val Lys Asn Leu
 450 455 460
 Tyr Asp Lys Val Arg Leu Gln Leu Arg Asp Asn Ala Lys Glu Leu Gly
 465 470 475 480
 Asn Gly Cys Phe Glu Phe Tyr His Lys Cys Asp Asn Glu Cys Met Glu
 485 490 495
 Ser Val Lys Asn Gly Thr Tyr Asp Tyr Pro Gln Tyr Ser Glu Glu Ala
 500 505 510
 Arg Leu Asn Arg Glu Glu Ile Ser Gly Val Lys Leu Glu Ser Met Gly
 515 520 525
 Thr Tyr Gln Ile Leu Ser Ile Tyr Ser Thr Val Ala Ser Ser Leu Ala
 530 535 540
 Leu Ala Ile Met Val Ala Gly Leu Ser Leu Trp Met Cys Ser Asn Gly
 545 550 555 560
 Ser Leu Gln Cys Arg Ile Cys Ile
 565

381698_1.TXT

<210> 105
 <211> 568
 <212> PRT
 <213> Influenza A virus

<400> 105

Met Glu Lys Ile Val Leu Leu Leu Ala Ile Val Ser Leu Val Lys Ser
 1 5 10 15

Asp Gln Ile Cys Ile Gly Tyr His Ala Asn Asn Ser Thr Glu Gln Val
 20 25 30

Asp Thr Ile Met Gln Lys Asn Val Thr Val Thr His Ala Gln Asp Ile
 35 40 45

Leu Glu Lys Thr His Asn Gly Lys Leu Cys Asp Leu Asp Gly Val Lys
 50 55 60

Pro Leu Ile Leu Arg Asp Cys Ser Val Ala Gly Trp Leu Leu Gly Asn
 65 70 75 80

Pro Met Cys Asp Glu Phe Ile Asn Val Pro Glu Trp Ser Tyr Ile Val
 85 90 95

Glu Lys Ala Ser Pro Ala Asn Asp Leu Cys Tyr Pro Gly Asp Phe Asn
 100 105 110

Asp Tyr Glu Glu Leu Lys His Leu Leu Ser Arg Ile Asn His Phe Glu
 115 120 125

Lys Ile Gln Ile Ile Pro Lys Ser Ser Trp Ser Asp His Glu Ala Ser
 130 135 140

Ser Gly Val Ser Ser Ala Cys Pro Tyr Gln Gly Ser Pro Ser Phe Phe
 145 150 155 160

Arg Asn Val Val Trp Leu Ile Lys Lys Asn Ser Ala Tyr Pro Thr Ile
 165 170 175

Lys Arg Ser Tyr Asn Asn Thr Asn Gln Glu Asp Leu Leu Val Leu Trp
 180 185 190

Gly Ile His His Pro Asn Asp Ala Ala Glu Gln Thr Lys Leu Tyr Gln
 195 200 205

Asn Pro Thr Thr Tyr Ile Ser Val Gly Thr Ser Thr Leu Asn Gln Arg
 210 215 220

Leu Val Pro Lys Ile Ala Thr Arg Ser Lys Val Asn Gly Gln Ser Gly
 225 230 235 240

381698_1.TXT

Arg Met Glu Phe Phe Trp Thr Ile Leu Lys Pro Asn Asp Ala Ile Asn
 245 250 255
 Phe Glu Ser Asn Gly Asn Phe Ile Ala Pro Glu Tyr Ala Tyr Lys Ile
 260 265 270
 Val Lys Lys Gly Asp Ser Ala Ile Met Lys Ser Glu Leu Glu Tyr Gly
 275 280 285
 Asn Cys Asn Thr Lys Cys Gln Thr Pro Met Gly Ala Ile Asn Ser Ser
 290 295 300
 Met Pro Phe His Asn Ile His Pro Leu Thr Ile Gly Glu Cys Pro Lys
 305 310 315 320
 Tyr Val Lys Ser Asn Arg Leu Val Leu Ala Thr Gly Leu Arg Asn Ser
 325 330 335
 Pro Gln Arg Glu Arg Arg Arg Lys Lys Arg Gly Leu Phe Gly Ala Ile
 340 345 350
 Ala Gly Phe Ile Glu Gly Gly Trp Gln Gly Met Val Asp Gly Trp Tyr
 355 360 365
 Gly Tyr His His Ser Asn Glu Gln Gly Ser Gly Tyr Ala Ala Asp Lys
 370 375 380
 Glu Ser Thr Gln Lys Ala Ile Asp Gly Val Thr Asn Lys Val Asn Ser
 385 390 395 400
 Ile Ile Asp Lys Met Asn Thr Gln Phe Glu Ala Val Gly Arg Glu Phe
 405 410 415
 Asn Asn Leu Glu Arg Arg Ile Glu Asn Leu Asn Lys Lys Met Glu Asp
 420 425 430
 Gly Phe Leu Asp Val Trp Thr Tyr Asn Ala Glu Leu Leu Val Leu Met
 435 440 445
 Glu Asn Glu Arg Thr Leu Asp Phe His Asp Ser Asn Val Lys Asn Leu
 450 455 460
 Tyr Glu Lys Val Arg Leu Gln Leu Arg Asp Asn Ala Lys Glu Leu Gly
 465 470 475 480
 Asn Gly Cys Phe Glu Phe Tyr His Lys Cys Asp Asn Glu Cys Met Glu
 485 490 495
 Ser Val Lys Asn Gly Thr Tyr Asp Tyr Pro Gln Tyr Ser Glu Glu Ala
 500 505 510

381698_1.TXT

Arg Leu Asn Arg Glu Glu Ile Ser Gly Val Lys Leu Glu Ser Ile Gly
 515 520 525

Thr Tyr Gln Ile Leu Ser Ile Tyr Ser Thr Val Val Ser Ser Leu Ala
 530 535 540

Leu Ala Ile Met Val Ala Gly Leu Ser Leu Trp Met Cys Ser Asn Gly
 545 550 555 560

Ser Leu Gln Cys Arg Ile Cys Ile
 565

<210> 106
 <211> 568
 <212> PRT
 <213> Influenza A virus
 <400> 106

Met Glu Lys Ile Val Leu Leu Leu Ala Ile Val Ser Leu Val Lys Ser
 1 5 10 15

Asp Gln Ile Cys Ile Gly Tyr His Ala Asn Asn Ser Thr Glu Gln Val
 20 25 30

Asp Thr Ile Met Glu Lys Asn Val Thr Val Thr His Ala Gln Asp Ile
 35 40 45

Leu Glu Lys Thr His Asn Gly Lys Leu Cys Asp Leu Asp Gly Val Lys
 50 55 60

Pro Leu Ile Leu Arg Asp Cys Ser Val Ala Gly Trp Leu Leu Gly Asn
 65 70 75 80

Pro Met Cys Asp Glu Phe Ile Asn Val Pro Glu Trp Ser Tyr Ile Val
 85 90 95

Glu Lys Ala Ser Pro Ala Asn Asp Leu Cys Tyr Pro Gly Asp Phe Asn
 100 105 110

Asp Tyr Glu Glu Leu Lys His Leu Leu Ser Arg Ile Asn His Phe Glu
 115 120 125

Lys Ile Arg Ile Ile Pro Lys Ser Ser Trp Ser Asn His Asp Ala Ser
 130 135 140

Ser Gly Val Ser Ser Ala Cys Pro Tyr Gln Gly Lys Pro Ser Phe Phe
 145 150 155 160

Arg Asn Val Val Trp Leu Ile Lys Lys Asn Ser Thr Tyr Pro Thr Ile
 165 170 175

Lys Arg Ser Tyr Asn Asn Thr Asn Pro Glu Asp Leu Leu Val Leu Trp

Gly Ile His His Pro Asn Asp Ala Ala Glu Gln Ile Lys Leu Tyr Gln
 195 200 205
 Asn Pro Thr Thr Tyr Ile Ser Val Gly Thr Ser Thr Leu Asn Gln Arg
 210 215 220
 Leu Val Pro Lys Ile Ala Thr Arg Ser Lys Val Asn Gly Gln Ser Gly
 225 230 235 240
 Arg Met Glu Phe Phe Trp Thr Ile Leu Lys Pro Asn Asp Ala Ile Asn
 245 250 255
 Phe Glu Ser Asn Gly Asn Phe Ile Ala Pro Glu Tyr Ala Tyr Lys Ile
 260 265 270
 Val Lys Lys Gly Asp Ser Ala Ile Met Lys Ser Glu Leu Glu Tyr Gly
 275 280 285
 Asn Cys Asn Thr Lys Cys Gln Thr Pro Met Gly Ala Ile Asn Ser Ser
 290 295 300
 Met Pro Phe His Asn Ile His Pro Leu Thr Ile Gly Glu Cys Pro Lys
 305 310 315 320
 Tyr Val Lys Ser Asn Arg Leu Val Leu Ala Thr Gly Leu Arg Asn Ser
 325 330 335
 Pro Gln Arg Glu Gly Arg Arg Lys Lys Arg Gly Leu Phe Gly Ala Ile
 340 345 350
 Ala Gly Phe Ile Glu Gly Gly Trp Gln Gly Met Val Asp Gly Trp Tyr
 355 360 365
 Gly Tyr His His Ser Asn Glu Gln Gly Ser Gly Tyr Ala Ala Asp Lys
 370 375 380
 Glu Ser Thr Gln Lys Ala Ile Asp Gly Val Thr Asn Lys Val Asn Ser
 385 390 395 400
 Ile Ile Asp Lys Met Asn Thr Gln Phe Glu Ala Val Gly Arg Glu Phe
 405 410 415
 Asn Asn Leu Glu Arg Arg Ile Glu Asn Leu Asn Lys Lys Met Glu Asp
 420 425 430
 Gly Phe Leu Asp Val Trp Thr Tyr Asn Ala Glu Leu Leu Val Leu Met
 435 440 445
 Glu Asn Glu Arg Thr Leu Asp Phe His Asp Ser Asn Val Lys Asn Leu

450 455 460
 Tyr Glu Lys Val Arg Leu Gln Leu Arg Asp Asn Ala Lys Glu Leu Gly
 465 470 475 480
 Asn Gly Cys Phe Glu Phe Tyr His Lys Cys Asp Asn Glu Cys Met Glu
 485 490 495
 Ser Val Lys Asn Gly Thr Tyr Asp Tyr Pro Gln Tyr Thr Glu Glu Ala
 500 505 510
 Arg Leu Asn Arg Glu Glu Ile Ser Gly Val Lys Leu Glu Ser Ile Gly
 515 520 525
 Thr Tyr Gln Ile Leu Ser Ile Tyr Ser Thr Val Val Ser Ser Leu Ala
 530 535 540
 Leu Ala Ile Met Val Ala Gly Leu Ser Leu Trp Met Cys Ser Asn Gly
 545 550 555 560
 Ser Leu Gln Cys Arg Ile Cys Ile
 565

<210> 107
 <211> 8
 <212> PRT
 <213> Nocardia aerocolonigenes

<400> 107

Leu Ala Thr Ser Asp Thr Glu Asp
 1 5

<210> 108
 <211> 568
 <212> PRT
 <213> Influenza A virus

<400> 108

Met Glu Lys Ile Val Leu Leu Leu Ala Ile Val Ser Leu Val Lys Ser
 1 5 10 15

Asp Gln Ile Cys Ile Gly Tyr His Ala Asn Asn Ser Thr Glu Gln Val
 20 25 30

Asp Thr Ile Met Glu Lys Asn Val Thr Val Thr His Ala Gln Asp Ile
 35 40 45

Leu Glu Lys Thr His Asn Gly Lys Leu Cys Asp Leu Asp Gly Val Lys
 50 55 60

Pro Leu Ile Leu Lys Asp Cys Ser Val Ala Gly Trp Leu Leu Gly Asn
 65 70 75 80

381698_1.TXT

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

381698_1.TXT

Ala Gly Phe Ile Glu Gly Gly Trp Gln Gly Met Val Asp Gly Trp Tyr
355 360 365

Gly Tyr His His Ser Asn Glu Gln Gly Ser Gly Tyr Ala Ala Asp Lys
370 375 380

Glu Ser Thr Gln Lys Ala Ile Asp Gly Val Thr Asn Lys Val Asn Ser
385 390 395 400

Ile Ile Asp Lys Met Asn Thr Gln Phe Glu Ala Val Gly Arg Glu Phe
405 410 415

Asn Asn Leu Glu Arg Arg Ile Glu Asn Leu Asn Lys Lys Met Glu Asp
420 425 430

Gly Phe Leu Asp Val Trp Thr Tyr Asn Ala Glu Leu Leu Val Leu Met
435 440 445

Glu Asn Glu Arg Thr Leu Asp Phe His Asp Ser Asn Val Lys Asn Leu
450 455 460

Tyr Glu Lys Val Arg Leu Gln Leu Arg Asp Asn Ala Lys Glu Leu Gly
465 470 475 480

Asn Gly Cys Phe Glu Phe Tyr His Lys Cys Asp Asn Glu Cys Met Glu
485 490 495

Ser Val Lys Asn Gly Thr Tyr Asp Tyr Arg Leu Asp Ser Glu Glu Ala
500 505 510

Arg Leu Asn Arg Glu Glu Ile Ser Gly Val Lys Leu Glu Ser Ile Gly
515 520 525

Thr Tyr Gln Ile Leu Ser Ile Tyr Ser Thr Val Ala Ser Ser Leu Ala
530 535 540

Leu Ala Ile Met Val Ala Gly Leu Ser Leu Trp Met Cys Ser Asn Gly
545 550 555 560

Ser Leu Gln Cys Arg Ile Cys Ile
565

<210> 109
<211> 568
<212> PRT
<213> Influenza A virus
<400> 109

Met Glu Lys Ile Val Leu Leu Arg Ala Met Ile Asn Leu Val Lys Ser
1 5 10 15

381698_1.TXT

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

381698_1.TXT

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

Met Pro Phe His Asn Ile His Pro Leu Thr Ile Gly Glu Cys Pro Lys
305 310 315 320

Tyr Val Lys Ser Asn Arg Leu Val Leu Ala Thr Gly Leu Arg Asn Ser
325 330 335

Pro Gln Arg Glu Arg Arg Arg Lys Lys Arg Gly Leu Phe Gly Ala Ile
340 345 350

Ala Gly Phe Ile Glu Gly Gly Trp Gln Gly Met Val Asp Gly Trp Tyr
355 360 365

Gly Tyr His His Ser Asn Glu Gln Gly Ser Gly Tyr Ala Ala Asp Lys
370 375 380

Glu Ser Thr Gln Lys Ala Ile Asp Gly Val Thr Asn Lys Val Asn Ser
385 390 395 400

Ile Ile Asp Lys Met Asn Thr Gln Phe Glu Ala Val Gly Arg Glu Phe
405 410 415

Asn Asn Leu Glu Arg Arg Ile Glu Asn Leu Asn Lys Lys Met Glu Asp
420 425 430

Gly Phe Leu Asp Val Trp Thr Tyr Asn Ala Glu Leu Leu Val Leu Met
435 440 445

Glu Asn Glu Arg Thr Leu Asp Phe His Asp Ser Asn Val Lys Asn Leu
450 455 460

Tyr Glu Lys Val Arg Leu Gln Leu Arg Asp Asn Ala Lys Glu Leu Gly
465 470 475 480

Asn Gly Cys Phe Glu Phe Tyr His Lys Cys Asp Asn Glu Cys Met Glu
485 490 495

Ser Val Lys Asn Gly Thr Tyr Asp Tyr Pro Gln Tyr Ser Glu Glu Ala
500 505 510

Arg Leu Asn Arg Glu Glu Ile Ser Gly Val Lys Leu Glu Ser Ile Gly
515 520 525

Thr Tyr Gln Ile Leu Ser Ile Tyr Ser Thr Val Ala Ser Ser Leu Ala
530 535 540

Leu Ala Ile Met Val Ala Gly Leu Ser Leu Trp Met Cys Ser Asn Gly
545 550 555 560

Ser Leu Gln Cys Arg Ile Cys Ile
565

<210> 110
<211> 568
<212> PRT
<213> Influenza A virus

<400> 110

Met Glu Lys Ile Val Leu Leu Leu Ala Ile Val Ser Leu Val Lys Ser
1 5 10 15

Asp Gln Ile Cys Ile Gly Tyr His Ala Asn Asn Ser Thr Glu Gln Val
20 25 30

Asp Thr Ile Met Glu Lys Asn Val Thr Val Thr His Ala Gln Asp Val
35 40 45

Leu Asp Lys Thr His Asn Gly Lys Leu Cys Glu Leu Asp Gly Val Lys
50 55 60

Pro Leu Ile Leu Arg Asp Cys Ser Val Ala Gly Trp Leu Leu Gly Asn
65 70 75 80

Pro Met Cys Asp Glu Phe Ile Asn Val Pro Glu Trp Ser Tyr Ile Val
85 90 95

Glu Lys Ala Ser Pro Ala Asn Asp Leu Cys Tyr Pro Gly Asp Phe Asn
100 105 110

Asp Tyr Glu Glu Leu Lys His Leu Leu Ser Arg Ile Asn His Phe Glu
115 120 125

Lys Ile Gln Ile Ile Pro Lys Ser Ser Trp Ser Asp His Glu Ala Ser
130 135 140

Ser Gly Val Ser Ser Ala Cys Pro Tyr Gln Gly Asn Pro Ser Phe Phe
145 150 155 160

Arg Asn Val Val Trp Leu Ile Lys Lys Asn Ser Ala Tyr Pro Thr Ile
165 170 175

Lys Arg Ser Tyr Asn Asn Thr Asn Gln Ala Asp Leu Leu Val Leu Trp
180 185 190

Gly Ile His His Pro Asn Asp Ala Ala Glu Gln Thr Lys Leu Tyr Gln
195 200 205

Asn Pro Thr Thr Tyr Ile Ser Val Gly Thr Ser Thr Leu Asn Gln Arg
210 215 220

Leu Val Pro Lys Ile Ala Thr Arg Ser Lys Val Asn Gly Gln Ser Gly

381098-11.FA1																
225	230										235	240				
Arg	Met	Glu	Phe	Phe 245	Trp	Thr	Ile	Leu	Lys 250	Pro	Asn	Asp	Ala	Ile 255	Asn	
Phe	Glu	Ser	Asn 260	Gly	Asn	Phe	Ile	Ala 265	Pro	Glu	Tyr	Ala	Tyr 270	Lys	Ile	
Val	Lys	Lys 275	Gly	Asp	Ser	Ala	Ile 280	Met	Lys	Ser	Glu	Leu 285	Glu	Tyr	Gly	
Asn	Cys 290	Asn	Thr	Lys	Cys	Gln 295	Thr	Pro	Met	Gly	Ala 300	Ile	Asn	Ser	Ser	
Met 305	Pro	Phe	His	Asn	Ile 310	His	Pro	Leu	Thr	Ile 315	Gly	Glu	Cys	Pro	Lys 320	
Tyr	Val	Lys	Ser	Asn 325	Arg	Leu	Val	Leu	Ala 330	Thr	Gly	Leu	Arg	Asn 335	Ser	
Pro	Gln	Arg	Glu 340	Arg	Arg	Arg	Lys	Lys 345	Arg	Gly	Leu	Phe	Gly 350	Ala	Ile	
Ala	Gly	Phe 355	Ile	Glu	Gly	Gly	Trp 360	Gln	Gly	Met	Val	Asp 365	Gly	Trp	Tyr	
Gly	Tyr 370	His	His	Ser	Asn	Glu 375	Gln	Gly	Ser	Gly	Tyr 380	Ala	Ala	Asp	Lys	
Glu 385	Ser	Thr	Gln	Lys	Ala 390	Ile	Asp	Gly	Val	Thr 395	Asn	Lys	Val	Asn	Ser 400	
Ile	Ile	Asp	Lys	Met 405	Asn	Thr	Gln	Phe	Glu 410	Ala	Val	Gly	Arg	Glu 415	Phe	
Asn	Asn	Leu	Glu 420	Arg	Arg	Ile	Glu	Asn 425	Leu	Asn	Lys	Lys	Met 430	Glu	Asp	
Gly	Phe	Leu 435	Asp	Val	Trp	Thr	Tyr 440	Asn	Ala	Glu	Leu	Leu 445	Val	Leu	Met	
Glu	Asn 450	Glu	Arg	Thr	Leu	Asp 455	Phe	His	Asp	Ser	Asn 460	Val	Lys	Asn	Leu	
Tyr 465	Glu	Lys	Val	Arg	Leu 470	Gln	Leu	Arg	Asp	Asn 475	Ala	Lys	Glu	Leu	Gly 480	
Asn	Gly	Cys	Phe	Glu 485	Phe	Tyr	His	Lys	Cys 490	Asp	Asn	Glu	Cys	Met 495	Glu	
Ser	Val	Arg	Asn	Gly	Thr	Tyr	Asp	Tyr	Pro	Gln	Tyr	Ser	Glu	Glu	Ala	

500

510

Arg Leu Asn Arg Glu Glu Ile Ser Gly Val Lys Leu Glu Ser Ile Gly
515 520 525

Thr Tyr Gln Ile Leu Ser Ile Tyr Ser Thr Val Ala Ser Ser Leu Ala
530 535 540

Leu Ala Ile Met Val Ala Gly Leu Ser Leu Trp Met Cys Ser Asn Gly
545 550 555 560

Ser Leu Gln Cys Arg Ile Cys Ile
565

<210> 111

<211> 568

<212> PRT

<213> Influenza A virus

<400> 111

Met Glu Lys Ile Val Leu Leu Phe Ala Ile Val Ser Leu Val Lys Ser
1 5 10 15

Asp Gln Ile Cys Ile Gly Tyr His Ala Asn Asn Ser Thr Glu Gln Val
20 25 30

Asp Thr Ile Met Glu Lys Asn Val Thr Val Thr His Ala Gln Asp Ile
35 40 45

Leu Glu Lys Thr His Asn Gly Lys Leu Cys Asp Leu Asp Gly Val Lys
50 55 60

Pro Leu Ile Leu Arg Asp Cys Ser Val Ala Gly Trp Leu Leu Gly Asn
65 70 75 80

Pro Met Cys Asp Glu Phe Ile Asn Val Pro Glu Trp Ser Tyr Ile Val
85 90 95

Glu Lys Ala Asn Pro Val Asn Asp Leu Cys Tyr Pro Gly Asp Phe Asn
100 105 110

Asp Tyr Glu Glu Leu Lys His Leu Leu Ser Arg Ile Asn His Phe Glu
115 120 125

Lys Ile Gln Ile Ile Pro Lys Ser Ser Trp Ser Ser His Glu Ala Ser
130 135 140

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

Arg Asn Val Val Trp Leu Ile Lys Lys Asn Ser Thr Tyr Pro Thr Ile
165 170 175

381698_1.TXT

Lys Arg Ser Tyr Asn Asn Thr Asn Gln Glu Asp Leu Leu Val Leu Trp
 180 185 190
 Gly Ile His His Pro Asn Asp Ala Ala Glu Gln Thr Lys Leu Tyr Gln
 195 200 205
 Asn Pro Thr Thr Tyr Ile Ser Val Gly Thr Ser Thr Leu Asn Gln Arg
 210 215 220
 Leu Val Pro Arg Ile Ala Thr Arg Ser Lys Val Asn Gly Gln Ser Gly
 225 230 235 240
 Arg Met Glu Phe Phe Trp Thr Ile Leu Lys Pro Asn Asp Ala Ile Asn
 245 250 255
 Phe Glu Ser Asn Gly Asn Phe Ile Ala Pro Glu Tyr Ala Tyr Lys Ile
 260 265 270
 Val Lys Lys Gly Asp Ser Ala Ile Met Lys Ser Glu Leu Glu Tyr Gly
 275 280 285
 Asn Cys Asn Thr Lys Cys Gln Thr Pro Met Gly Ala Ile Asn Ser Ser
 290 295 300
 Met Pro Phe His Asn Ile His Pro Leu Thr Ile Gly Glu Cys Pro Lys
 305 310 315 320
 Tyr Val Lys Ser Asn Arg Leu Val Leu Ala Thr Gly Leu Arg Asn Ser
 325 330 335
 Pro Gln Arg Glu Arg Arg Arg Lys Lys Arg Gly Leu Phe Gly Ala Ile
 340 345 350
 Ala Gly Phe Ile Glu Gly Gly Trp Gln Gly Met Val Asp Gly Trp Tyr
 355 360 365
 Gly Tyr His His Ser Asn Glu Gln Gly Ser Gly Tyr Ala Ala Asp Lys
 370 375 380
 Glu Ser Thr Gln Lys Ala Ile Asp Gly Val Thr Asn Lys Val Asn Ser
 385 390 395 400
 Ile Ile Asp Lys Met Asn Thr Gln Phe Glu Ala Val Gly Arg Glu Phe
 405 410 415
 Asn Asn Leu Glu Arg Arg Ile Glu Asn Leu Asn Lys Lys Met Glu Asp
 420 425 430
 Gly Phe Leu Asp Val Trp Thr Tyr Asn Ala Glu Leu Leu Val Leu Met
 435 440 445

381698_1.TXT

Glu Asn Glu Arg Thr Leu Asp Phe His Asp Ser Asn Val Lys Asn Leu
450 455 460

Tyr Asp Lys Val Arg Leu Gln Leu Arg Asp Asn Ala Lys Glu Leu Gly
465 470 475 480

Asn Gly Cys Phe Glu Phe Tyr His Lys Cys Asp Asn Glu Cys Met Glu
485 490 495

Ser Val Arg Asn Gly Thr Tyr Asp Tyr Pro Gln Tyr Ser Glu Glu Ala
500 505 510

Arg Leu Lys Arg Glu Glu Ile Ser Gly Val Lys Leu Glu Ser Ile Gly
515 520 525

Ile Tyr Gln Ile Leu Ser Ile Tyr Ser Thr Val Ala Ser Ser Leu Ala
530 535 540

Leu Ala Ile Met Val Ala Gly Leu Ser Leu Trp Met Cys Ser Asn Gly
545 550 555 560

Ser Leu Gln Cys Arg Ile Cys Ile
565

<210> 112
<211> 568
<212> PRT
<213> Influenza A virus
<400> 112

Met Glu Lys Ile Val Leu Leu Phe Ala Ile Val Ser Leu Val Lys Ser
1 5 10 15

Asp Gln Ile Cys Ile Gly Tyr His Ala Asn Asn Ser Thr Glu Gln Val
20 25 30

Asp Thr Ile Met Glu Lys Asn Val Thr Val Thr His Ala Gln Asp Ile
35 40 45

Leu Glu Lys Thr His Asn Gly Lys Leu Cys Asp Leu Asp Gly Val Lys
50 55 60

Pro Leu Ile Leu Arg Asp Cys Ser Val Ala Gly Trp Leu Leu Gly Asn
65 70 75 80

Pro Met Cys Asp Glu Phe Ile Asn Val Pro Glu Trp Ser Tyr Ile Val
85 90 95

Glu Lys Ala Asn Pro Val Asn Asp Leu Cys Tyr Pro Gly Asp Phe Asn
100 105 110

381698_1.TXT

Asp Tyr Glu Glu Leu Lys His Leu Leu Ser Arg Ile Asn His Phe Glu
 115 120 125
 Lys Ile Gln Ile Ile Pro Lys Ser Ser Trp Ser Ser His Glu Ala Ser
 130 135 140
 Leu Gly Val Ser Ser Ala Cys Pro Tyr Gln Gly Lys Ser Ser Phe Phe
 145 150 155 160
 Arg Asn Val Val Trp Leu Ile Lys Lys Asn Ser Thr Tyr Pro Thr Ile
 165 170 175
 Lys Arg Ser Tyr Asn Asn Thr Asn Gln Glu Asp Leu Leu Val Leu Trp
 180 185 190
 Gly Ile His His Pro Asn Asp Ala Ala Glu Gln Thr Lys Leu Tyr Gln
 195 200 205
 Asn Pro Thr Thr Tyr Ile Ser Val Gly Thr Ser Thr Leu Asn Gln Arg
 210 215 220
 Leu Val Pro Arg Ile Ala Thr Arg Ser Lys Val Asn Gly Gln Ser Gly
 225 230 235 240
 Arg Met Glu Phe Phe Trp Thr Ile Leu Lys Pro Asn Asp Ala Ile Asn
 245 250 255
 Phe Glu Ser Asn Gly Asn Phe Ile Ala Pro Glu Tyr Ala Tyr Lys Ile
 260 265 270
 Val Lys Lys Gly Asp Ser Thr Ile Met Lys Ser Glu Leu Glu Tyr Gly
 275 280 285
 Asn Cys Asn Thr Lys Cys Gln Thr Pro Met Gly Ala Ile Asn Ser Ser
 290 295 300
 Met Pro Phe His Asn Ile His Pro Leu Thr Ile Gly Glu Cys Pro Lys
 305 310 315 320
 Tyr Val Lys Ser Asn Arg Leu Val Leu Ala Thr Gly Leu Arg Asn Ser
 325 330 335
 Pro Gln Arg Glu Arg Arg Arg Lys Lys Arg Gly Leu Phe Gly Ala Ile
 340 345 350
 Ala Gly Phe Ile Glu Gly Gly Trp Gln Gly Met Val Asp Gly Trp Tyr
 355 360 365
 Gly Tyr His His Ser Asn Glu Gln Gly Ser Gly Tyr Ala Ala Asp Lys
 370 375 380

381698_1.TXT

Glu Ser Thr Gln Lys Ala Ile Asp Gly Val Thr Asn Lys Val Asn Ser
385 390 395 400

Ile Ile Asp Lys Met Asn Thr Gln Phe Glu Ala Val Gly Arg Glu Phe
405 410 415

Asn Asn Leu Glu Arg Arg Ile Glu Asn Leu Asn Lys Lys Met Glu Asp
420 425 430

Gly Phe Leu Asp Val Trp Thr Tyr Asn Ala Glu Leu Leu Val Leu Met
435 440 445

Glu Asn Glu Arg Thr Leu Asp Phe His Asp Ser Asn Val Lys Asn Leu
450 455 460

Tyr Asp Lys Val Arg Leu Gln Leu Arg Asp Asn Ala Lys Glu Leu Gly
465 470 475 480

Asn Gly Cys Phe Glu Phe Tyr His Lys Cys Asp Asn Glu Cys Met Glu
485 490 495

Ser Val Arg Asn Gly Thr Tyr Asp Tyr Pro Gln Tyr Ser Glu Glu Ala
500 505 510

Arg Leu Lys Arg Glu Glu Ile Ser Gly Val Lys Leu Glu Ser Ile Gly
515 520 525

Ile Tyr Gln Ile Leu Ser Ile Tyr Ser Thr Val Ala Ser Ser Leu Ala
530 535 540

Leu Ala Ile Met Val Ala Gly Leu Ser Leu Trp Met Cys Ser Asn Gly
545 550 555 560

Ser Leu Gln Cys Arg Ile Cys Ile
565

<210> 113
<211> 568
<212> PRT
<213> Influenza A virus

<400> 113

Met Glu Lys Ile Val Leu Leu Phe Ala Ile Val Ser Leu Val Lys Ser
1 5 10 15

Asp Gln Ile Cys Ile Gly Tyr His Ala Asn Asn Ser Thr Glu Gln Val
20 25 30

Asp Thr Ile Met Glu Lys Asn Val Thr Val Thr His Ala Gln Asp Ile
35 40 45

381698_1.TXT

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

381698_1.TXT

Tyr Val Lys Ser Asn Arg Leu Val Leu Ala Thr Gly Leu Arg Asn Ser
325 330 335

Pro Gln Arg Glu Arg Arg Arg Lys Lys Arg Gly Leu Phe Gly Ala Ile
340 345 350

Ala Gly Phe Ile Glu Gly Gly Trp Gln Gly Met Val Asp Gly Trp Tyr
355 360 365

Gly Tyr His His Ser Asn Glu Gln Gly Ser Gly Tyr Ala Ala Ala Lys
370 375 380

Glu Ser Thr Gln Lys Ala Ile Asp Gly Val Thr Asn Lys Val Asn Ser
385 390 395 400

Ile Ile Asp Lys Met Asn Thr Gln Phe Glu Ala Val Gly Arg Glu Phe
405 410 415

Asn Asn Leu Glu Arg Arg Ile Glu Asn Leu Asn Lys Lys Met Glu Asp
420 425 430

Gly Phe Leu Asp Val Trp Thr Tyr Asn Ala Glu Leu Leu Val Leu Met
435 440 445

Glu Asn Glu Arg Thr Leu Asp Phe His Asp Ser Asn Val Lys Asn Leu
450 455 460

Tyr Asp Lys Val Arg Leu Gln Leu Lys Asp Asn Ala Lys Glu Leu Gly
465 470 475 480

Asn Gly Cys Phe Glu Phe Tyr His Lys Cys Asp Asn Glu Cys Met Glu
485 490 495

Ser Val Arg Asn Gly Thr Tyr Asp Tyr Pro Gln Tyr Ser Glu Glu Ala
500 505 510

Arg Leu Lys Arg Glu Glu Ile Ser Gly Val Lys Leu Glu Ser Ile Gly
515 520 525

Ile Tyr Gln Ile Leu Ser Ile Tyr Ser Thr Val Ala Ser Ser Leu Ala
530 535 540

Leu Ala Ile Met Val Ala Gly Leu Ser Leu Trp Met Cys Ser Asn Gly
545 550 555 560

Ser Leu Gln Cys Arg Ile Cys Ile
565

<210> 114
<211> 567
<212> PRT
<213> Influenza A virus

381698_1.TXT

<400> 114

Met Glu Lys Ile Val Leu Leu Phe Ala Ile Val Ser Leu Val Lys Ser
1 5 10 15

Asp Gln Ile Cys Ile Gly Tyr His Ala Asn Asn Ser Thr Glu Gln Val
20 25 30

Asp Thr Ile Met Glu Lys Asn Val Thr Val Thr His Ala Gln Asp Ile
35 40 45

Leu Glu Lys Thr His Asn Gly Lys Leu Cys Asp Leu Asp Gly Val Lys
50 55 60

Pro Leu Ile Leu Arg Asp Cys Ser Val Ala Gly Trp Leu Leu Gly Asn
65 70 75 80

Pro Met Cys Asp Glu Phe Ile Asn Val Pro Glu Trp Ser Tyr Ile Val
85 90 95

Glu Lys Ala Asn Pro Val Asn Asp Leu Cys Tyr Pro Gly Asp Phe Asn
100 105 110

Asp Tyr Glu Glu Leu Lys His Leu Leu Ser Arg Ile Asn His Phe Glu
115 120 125

Lys Ile Gln Ile Ile Pro Lys Ser Ser Trp Leu Ser His Glu Ala Ser
130 135 140

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

Arg Asn Val Val Trp Leu Ile Lys Lys Asn Ser Thr Tyr Pro Thr Ile
165 170 175

Lys Arg Ser Tyr Asn Asn Thr Asn Gln Glu Asp Leu Leu Val Leu Trp
180 185 190

Gly Ile His His Pro Asn Asp Ala Ala Glu Gln Thr Lys Leu Tyr Gln
195 200 205

Asn Pro Thr Thr Tyr Ile Ser Val Gly Thr Ser Thr Leu Asn Gln Arg
210 215 220

Leu Val Pro Arg Ile Ala Thr Arg Ser Lys Val Asn Gly Gln Ser Gly
225 230 235 240

Arg Met Glu Phe Phe Trp Thr Ile Leu Lys Pro Asn Asp Ala Ile Asn
245 250 255

Phe Glu Ser Asn Gly Asn Phe Ile Ala Pro Glu Tyr Ala Tyr Lys Ile

260

265

270

Val Lys Lys Gly Asp Ser Thr Ile Met Lys Ser Glu Leu Glu Tyr Gly
 275 280 285
 Asn Cys Asn Thr Lys Cys Gln Thr Pro Met Gly Ala Ile Asn Ser Ser
 290 295 300
 Met Pro Phe His Asn Ile His Pro Leu Thr Ile Gly Glu Cys Pro Lys
 305 310 315 320
 Tyr Val Lys Ser Asn Arg Leu Val Leu Ala Thr Gly Leu Arg Asn Ser
 325 330 335
 Pro Gln Arg Glu Arg Arg Lys Lys Arg Gly Leu Phe Gly Ala Ile Ala
 340 345 350
 Gly Phe Ile Glu Gly Gly Trp Gln Gly Met Val Asp Gly Trp Tyr Gly
 355 360 365
 Tyr His His Ser Asn Glu Gln Gly Ser Gly Tyr Ala Ala Asp Lys Glu
 370 375 380
 Ser Thr Gln Lys Ala Ile Asp Gly Val Thr Asn Lys Val Asn Ser Ile
 385 390 395 400
 Ile Asp Lys Met Asn Thr Gln Phe Glu Ala Val Gly Arg Glu Phe Asn
 405 410 415
 Asn Leu Glu Arg Arg Ile Glu Asn Leu Asn Lys Lys Met Glu Asp Gly
 420 425 430
 Phe Leu Asp Val Trp Thr Tyr Asn Ala Glu Leu Leu Val Leu Met Glu
 435 440 445
 Asn Glu Arg Thr Leu Asp Phe His Asp Ser Asn Val Lys Asn Leu Tyr
 450 455 460
 Asp Lys Val Arg Leu Gln Leu Arg Asp Asn Ala Lys Glu Leu Gly Asn
 465 470 475 480
 Gly Cys Phe Glu Phe Tyr His Lys Cys Asp Asn Glu Cys Met Glu Ser
 485 490 495
 Val Arg Asn Gly Thr Tyr Asp Tyr Pro Gln Tyr Ser Glu Glu Ala Lys
 500 505 510
 Leu Lys Arg Gly Glu Ile Ser Gly Val Lys Leu Glu Ser Ile Gly Ile
 515 520 525
 Tyr Gln Ile Leu Ser Ile Tyr Ser Thr Val Ala Ser Ser Leu Ala Leu

530

535

Ala Ile Met Val Ala Gly Leu Ser Leu Trp Met Cys Ser Asn Gly Ser
545 550 555 560

Leu Gln Cys Arg Ile Cys Ile
565

<210> 115
<211> 568
<212> PRT
<213> Influenza A virus

<400> 115

Met Glu Lys Ile Val Leu Leu Leu Ala Ile Val Ser Leu Val Lys Ser
1 5 10 15

Asp Gln Ile Cys Ile Gly Tyr His Ala Asn Asn Ser Thr Glu Gln Val
20 25 30

Asp Thr Ile Met Glu Lys Asn Val Thr Val Thr His Ala Gln Asp Ile
35 40 45

Leu Glu Lys Thr His Asn Gly Lys Leu Cys Asp Leu Asp Gly Val Lys
50 55 60

Pro Leu Ile Leu Arg Asp Cys Ser Val Ala Gly Trp Leu Leu Gly Asn
65 70 75 80

Pro Met Cys Asp Glu Phe Leu Asn Val Pro Glu Trp Ser Tyr Ile Val
85 90 95

Glu Lys Ile Asn Pro Ala Asn Asp Leu Cys Tyr Pro Gly Asn Phe Asn
100 105 110

Asp Tyr Glu Glu Leu Lys His Leu Leu Ser Arg Ile Asn His Phe Glu
115 120 125

Lys Ile Gln Ile Ile Pro Lys Ser Ser Trp Ser Asp His Glu Ala Ser
130 135 140

Ser Gly Val Ser Ser Ala Cys Pro Tyr Gln Gly Arg Ser Ser Phe Phe
145 150 155 160

Arg Asn Val Val Trp Leu Ile Lys Lys Asp Asn Ala Tyr Pro Thr Ile
165 170 175

Lys Arg Ser Tyr Asn Asn Thr Asn Gln Glu Asp Leu Leu Val Leu Trp
180 185 190

Gly Ile His His Pro Asn Asp Ala Ala Glu Gln Thr Arg Leu Tyr Gln
195 200 205

381698_1.TXT

Asn Pro Thr Thr Tyr Ile Ser Val Gly Thr Ser Thr Leu Asn Gln Arg
 210 215 220
 Leu Val Pro Lys Ile Ala Thr Arg Ser Lys Val Asn Gly Gln Ser Gly
 225 230 235 240
 Arg Met Glu Phe Phe Trp Thr Ile Leu Lys Pro Asn Asp Ala Ile Asn
 245 250 255
 Phe Glu Ser Asn Gly Asn Phe Ile Ala Pro Glu Asn Ala Tyr Lys Ile
 260 265 270
 Val Lys Lys Gly Asp Ser Thr Ile Met Lys Ser Glu Leu Glu Tyr Gly
 275 280 285
 Asn Cys Asn Thr Lys Cys Gln Thr Pro Ile Gly Ala Ile Asn Ser Ser
 290 295 300
 Met Pro Phe His Asn Ile His Pro Leu Thr Ile Gly Glu Cys Pro Lys
 305 310 315 320
 Tyr Val Lys Ser Asn Arg Leu Val Leu Ala Thr Gly Leu Arg Asn Ser
 325 330 335
 Pro Gln Gly Glu Arg Arg Arg Arg Lys Arg Gly Leu Phe Gly Ala Ile
 340 345 350
 Ala Gly Phe Ile Glu Gly Gly Trp Gln Gly Met Val Asp Gly Trp Tyr
 355 360 365
 Gly Tyr His His Ser Asn Glu Gln Gly Ser Gly Tyr Ala Ala Asp Lys
 370 375 380
 Glu Ser Thr Gln Lys Ala Ile Asp Gly Val Thr Asn Lys Val Asn Ser
 385 390 395 400
 Ile Ile Asp Lys Met Asn Thr Gln Phe Glu Ala Val Gly Arg Glu Phe
 405 410 415
 Asn Asn Leu Glu Arg Arg Ile Glu Asn Leu Asn Lys Lys Met Glu Asp
 420 425 430
 Gly Phe Leu Asp Val Trp Thr Tyr Asn Ala Glu Leu Leu Val Leu Met
 435 440 445
 Glu Asn Glu Arg Thr Leu Asp Phe His Asp Ser Asn Val Lys Asn Leu
 450 455 460
 Tyr Asp Lys Val Arg Leu Gln Leu Arg Asp Asn Ala Lys Glu Leu Gly
 465 470 475 480

381698_1.TXT

Asn Gly Cys Phe Glu Phe Tyr His Arg Cys Asp Asn Glu Cys Met Glu
485 490 495

Ser Val Arg Asn Gly Thr Tyr Asp Tyr Pro Gln Tyr Ser Glu Glu Ala
500 505 510

Arg Leu Lys Arg Glu Glu Ile Ser Gly Val Lys Leu Glu Ser Ile Gly
515 520 525

Thr Tyr Gln Ile Leu Ser Ile Tyr Ser Thr Val Ala Ser Ser Leu Ala
530 535 540

Leu Ala Ile Met Val Ala Gly Leu Ser Leu Trp Met Cys Ser Asn Gly
545 550 555 560

Ser Leu Gln Cys Arg Ile Cys Ile
565

<210> 116
<211> 568
<212> PRT
<213> Influenza A virus

<400> 116

Met Glu Asn Ile Val Leu Leu Leu Ala Ile Val Ser Leu Val Lys Ser
1 5 10 15

Asp Gln Ile Cys Ile Gly Tyr His Ala Asn Asn Ser Thr Glu Gln Val
20 25 30

Asp Thr Ile Met Glu Lys Asn Val Thr Val Thr His Ala Gln Asp Ile
35 40 45

Leu Glu Lys Thr His Asn Gly Lys Leu Cys Asp Leu Asp Gly Val Lys
50 55 60

Pro Leu Ile Leu Arg Asn Cys Ser Val Ala Gly Trp Leu Leu Gly Asn
65 70 75 80

Pro Met Cys Asp Glu Phe Leu Asn Val Pro Glu Trp Ser Tyr Ile Val
85 90 95

Glu Lys Ile Asn Pro Ala Asn Asp Leu Cys Tyr Pro Gly Asn Phe Asn
100 105 110

Asp Tyr Glu Glu Leu Lys His Leu Leu Ser Arg Ile Asn His Phe Glu
115 120 125

Lys Ile Gln Ile Ile Pro Lys Ser Ser Trp Ser Asp His Glu Ala Ser
130 135 140

381698_1.TXT

Ser Gly Val Ser Ser Ala Cys Pro Tyr Gln Gly Arg Ser Ser Phe Phe
 145 150 155 160
 Arg Asn Val Val Trp Leu Ile Lys Lys Asp Asn Ala Tyr Pro Thr Ile
 165 170 175
 Lys Arg Ser Tyr Asn Asn Thr Asn Gln Glu Asp Leu Leu Val Leu Trp
 180 185 190
 Gly Ile His His Pro Asn Asp Ala Ala Glu Gln Thr Arg Leu Tyr Gln
 195 200 205
 Asn Pro Thr Thr Tyr Ile Ser Val Gly Thr Ser Thr Leu Asn Gln Arg
 210 215 220
 Leu Val Pro Lys Ile Ala Thr Arg Ser Lys Val Asn Gly Gln Ser Gly
 225 230 235 240
 Arg Met Glu Phe Phe Trp Thr Ile Leu Lys Pro Asn Asp Ala Ile Asn
 245 250 255
 Phe Glu Ser Asn Gly Asn Phe Ile Ala Pro Glu Asn Ala Tyr Lys Ile
 260 265 270
 Val Lys Lys Gly Asp Ser Thr Ile Met Lys Ser Glu Leu Glu Tyr Gly
 275 280 285
 Asn Cys Asn Thr Lys Cys Gln Thr Pro Ile Gly Ala Ile Asn Ser Ser
 290 295 300
 Met Pro Phe His Asn Ile His Pro Leu Thr Ile Gly Glu Cys Pro Lys
 305 310 315 320
 Tyr Val Lys Ser Asn Arg Leu Val Leu Ala Thr Gly Leu Arg Asn Ser
 325 330 335
 Pro Gln Gly Glu Arg Arg Arg Arg Lys Arg Gly Leu Phe Gly Ala Ile
 340 345 350
 Ala Gly Phe Ile Glu Gly Gly Trp Gln Gly Met Val Asp Gly Trp Tyr
 355 360 365
 Gly Tyr His His Ser Asn Glu Gln Gly Ser Gly Tyr Ala Ala Asp Lys
 370 375 380
 Glu Ser Thr Gln Lys Ala Ile Asp Gly Val Thr Asn Lys Val Asn Ser
 385 390 395 400
 Ile Ile Asp Lys Met Asn Thr Gln Phe Glu Ala Val Gly Arg Glu Phe
 405 410 415

381698_1.TXT

Asn Asn Leu Glu Arg Arg Ile Glu Asn Leu Asn Lys Lys Met Glu Asp
420 425 430

Gly Phe Leu Asp Val Trp Thr Tyr Asn Ala Glu Leu Leu Val Leu Met
435 440 445

Glu Asn Glu Arg Thr Leu Asp Phe His Asp Ser Asn Val Lys Asn Leu
450 455 460

Tyr Asp Lys Val Arg Leu Gln Leu Arg Asp Asn Ala Lys Glu Leu Gly
465 470 475 480

Asn Gly Cys Phe Glu Phe Tyr His Arg Cys Asp Asn Glu Cys Met Glu
485 490 495

Ser Val Arg Asn Gly Thr Tyr Asp Tyr Pro Gln Tyr Ser Glu Glu Ala
500 505 510

Arg Leu Lys Arg Glu Glu Ile Ser Gly Val Lys Leu Glu Ser Ile Gly
515 520 525

Thr Tyr Gln Ile Leu Ser Ile Tyr Ser Thr Val Ala Ser Ser Leu Ala
530 535 540

Leu Ala Ile Met Val Ala Gly Leu Ser Leu Trp Met Cys Ser Asn Gly
545 550 555 560

Ser Leu Gln Cys Arg Ile Cys Ile
565

<210> 117
<211> 568
<212> PRT
<213> Influenza A virus

<400> 117

Met Glu Lys Ile Val Leu Leu Leu Ala Ile Val Ser Leu Val Lys Ser
1 5 10 15

Asp Gln Ile Cys Ile Gly Tyr His Ala Asn Asn Ser Thr Glu Gln Val
20 25 30

Asp Thr Ile Met Glu Lys Asn Val Thr Val Thr His Ala Gln Asp Ile
35 40 45

Leu Glu Lys Thr His Asn Gly Lys Leu Cys Asp Leu Asp Gly Val Lys
50 55 60

Pro Leu Ile Leu Arg Asp Cys Ser Val Ala Gly Trp Leu Leu Gly Asn
65 70 75 80

381698_1.TXT

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

Ala Gly Phe Ile Glu Gly Gly Trp Gln Gly Met Val Asp Gly Trp Tyr
 355 360 365

Gly Tyr His His Ser Asn Glu Gln Gly Ser Gly Tyr Ala Ala Asp Lys
 370 375 380

Glu Ser Thr Gln Lys Ala Ile Asp Gly Val Thr Asn Lys Val Asn Ser
 385 390 395 400

Ile Ile Asp Lys Met Asn Thr Gln Phe Glu Ala Val Gly Arg Glu Phe
 405 410 415

Asn Asn Leu Glu Arg Arg Ile Glu Asn Leu Asn Lys Lys Met Glu Asp
 420 425 430

Gly Phe Leu Asp Val Trp Thr Tyr Asn Ala Glu Leu Leu Val Leu Met
 435 440 445

Glu Asn Glu Arg Thr Leu Asp Phe His Asp Ser Asn Val Lys Asn Leu
 450 455 460

Tyr Asp Lys Val Arg Leu Gln Leu Arg Asp Asn Ala Lys Glu Leu Gly
 465 470 475 480

Asn Gly Cys Phe Glu Phe Tyr His Arg Cys Asp Asn Glu Cys Met Glu
 485 490 495

Ser Val Arg Asn Gly Thr Tyr Asp Tyr Pro Gln Tyr Ser Glu Glu Ala
 500 505 510

Arg Leu Lys Arg Glu Glu Ile Ser Gly Val Lys Leu Glu Ser Ile Gly
 515 520 525

Thr Tyr Gln Ile Leu Ser Ile Tyr Ser Thr Val Ala Ser Ser Leu Ala
 530 535 540

Leu Ala Ile Met Val Ala Gly Leu Ser Leu Trp Met Cys Ser Asn Gly
 545 550 555 560

Ser Leu Gln Cys Arg Ile Cys Ile
 565

<210> 118
 <211> 568
 <212> PRT
 <213> Influenza A virus

<400> 118

Met Glu Lys Ile Val Leu Leu Leu Ala Ile Val Ser Leu Val Lys Ser
 1 5 10 15

Asp Gln Ile Cys Ile Gly Tyr His Ala Asn Asn Ser Thr Glu Gln Val

290

295

Met Pro Phe His Asn Ile His Pro Leu Thr Ile Gly Glu Cys Pro Lys
305 310 315 320

Tyr Val Lys Ser Asn Arg Leu Val Leu Ala Thr Gly Leu Arg Asn Ser
325 330 335

Pro Gln Gly Glu Arg Arg Arg Lys Lys Arg Gly Leu Phe Gly Ala Ile
340 345 350

Ala Gly Phe Ile Glu Gly Gly Trp Gln Gly Met Val Asp Gly Trp Tyr
355 360 365

Gly Tyr His His Ser Asn Glu Gln Gly Ser Gly Tyr Ala Ala Asp Lys
370 375 380

Glu Ser Thr Gln Lys Ala Ile Tyr Gly Val Thr Asn Thr Val Asn Ser
385 390 395 400

Ile Ile Asp Lys Met Asn Thr Gln Phe Glu Ala Val Gly Arg Glu Phe
405 410 415

Asn Asn Leu Glu Arg Arg Ile Glu Asn Leu Asn Lys Lys Met Glu Asp
420 425 430

Gly Phe Leu Asp Val Trp Thr Tyr Asn Ala Glu Leu Leu Val Leu Met
435 440 445

Glu Asn Glu Arg Thr Leu Asp Phe His Asp Ser Asn Val Lys Asn Leu
450 455 460

Tyr Asp Lys Val Arg Leu Gln Leu Arg Asp Asn Ala Lys Glu Leu Gly
465 470 475 480

Asn Gly Cys Phe Glu Phe Tyr His Arg Cys Asp Asn Glu Cys Met Glu
485 490 495

Ser Val Arg Asn Gly Thr Tyr Asp Tyr Pro Gln Tyr Ser Glu Glu Ala
500 505 510

Arg Leu Lys Arg Glu Glu Ile Ser Gly Val Lys Leu Glu Ser Ile Gly
515 520 525

Thr Tyr Gln Ile Leu Ser Ile Tyr Ser Thr Val Ala Ser Ser Leu Ala
530 535 540

Leu Ala Ile Met Val Ala Gly Leu Ser Leu Trp Met Cys Ser Asn Gly
545 550 555 560

Ser Leu Gln Cys Arg Ile Cys Ile

565

<210> 119
 <211> 567
 <212> PRT
 <213> Influenza A virus

<400> 119

Met Glu Lys Ile Val Leu Leu Leu Ala Ile Val Ser Leu Val Lys Ser
 1 5 10 15

Asp Gln Ile Cys Ile Gly Tyr His Ala Asn Asn Ser Thr Glu Gln Val
 20 25 30

Asp Thr Ile Met Glu Lys Asn Val Thr Val Thr His Ala Gln Asp Ile
 35 40 45

Leu Glu Lys Thr His Asn Gly Lys Leu Cys Asp Leu Asp Gly Val Lys
 50 55 60

Pro Leu Ile Leu Arg Asp Cys Ser Val Ala Gly Trp Leu Leu Gly Asn
 65 70 75 80

Pro Met Cys Asp Glu Phe Ile Asn Val Pro Glu Trp Ser Tyr Ile Val
 85 90 95

Glu Lys Ala Asn Pro Ser Asn Asp Leu Cys Tyr Pro Gly Asn Phe Asn
 100 105 110

Asp Tyr Glu Glu Leu Lys His Leu Leu Ser Arg Ile Asn His Phe Glu
 115 120 125

Lys Ile Gln Ile Ile Pro Lys Ser Ser Trp Ser Asp His Glu Ala Ser
 130 135 140

Ser Gly Val Ser Ser Ala Cys Pro Tyr Gln Gly Arg Ser Ser Phe Phe
 145 150 155 160

Arg Asn Val Val Trp Leu Ile Thr Lys Asn Ser Ala Tyr Pro Thr Ile
 165 170 175

Lys Arg Ser Tyr Asn Asn Thr Asn Gln Glu Asp Leu Leu Val Leu Trp
 180 185 190

Gly Ile His His Pro Asn Asp Ala Ala Glu Gln Thr Arg Leu Tyr Gln
 195 200 205

Asn Pro Thr Thr Tyr Ile Ser Val Gly Thr Ser Thr Leu Asn Gln Arg
 210 215 220

Leu Val Pro Lys Ile Ala Thr Arg Ser Lys Val Asn Gly Gln Ser Gly
 225 230 235 240

381698_1.TXT

Arg Met Glu Phe Phe Trp Thr Ile Leu Lys Pro Asn Asp Ala Ile Ser
 245 250 255
 Phe Glu Ser Asn Gly Asn Phe Ile Ala Pro Glu Tyr Ala Tyr Lys Ile
 260 265 270
 Val Lys Lys Gly Asp Ser Ala Ile Met Lys Ser Glu Leu Glu Tyr Gly
 275 280 285
 Asn Cys Asn Thr Lys Cys Gln Thr Pro Met Gly Ala Ile Asn Ser Ser
 290 295 300
 Met Pro Phe His Asn Ile His Pro Leu Thr Ile Gly Glu Cys Pro Lys
 305 310 315 320
 Tyr Val Lys Ser Ser Arg Leu Val Leu Ala Thr Gly Leu Arg Asn Ser
 325 330 335
 Pro Gln Arg Glu Arg Arg Lys Lys Arg Gly Leu Phe Gly Ala Ile Ala
 340 345 350
 Gly Phe Ile Glu Gly Gly Trp Gln Gly Met Val Asp Gly Trp Tyr Gly
 355 360 365
 Tyr His His Ser Asn Glu Gln Gly Ser Gly Tyr Ala Ala Asp Lys Glu
 370 375 380
 Ser Thr Gln Lys Ala Ile Asp Gly Val Thr Asn Lys Val Asn Ser Ile
 385 390 395 400
 Ile Asn Lys Met Asn Thr Gln Phe Glu Ala Val Gly Arg Glu Phe Asn
 405 410 415
 Asn Leu Glu Arg Arg Ile Glu Asn Leu Asn Lys Lys Met Glu Asp Gly
 420 425 430
 Phe Leu Asp Val Trp Thr Tyr Asn Ala Glu Leu Leu Val Leu Met Glu
 435 440 445
 Asn Glu Arg Thr Leu Asp Phe His Asp Ser Asn Val Lys Asn Leu Tyr
 450 455 460
 Asp Lys Val Arg Leu Gln Leu Arg Asp Asn Ala Lys Glu Leu Gly Asn
 465 470 475 480
 Gly Cys Phe Glu Phe Tyr His Arg Cys Asp Asn Glu Cys Ile Glu Ser
 485 490 495
 Val Arg Asn Gly Thr Tyr Asp Tyr Pro Gln Tyr Ser Glu Glu Ala Arg
 500 505 510

381698_1.TXT

Leu Lys Arg Glu Glu Ile Ser Gly Val Lys Leu Glu Ser Ile Gly Thr
515 520 525

Tyr Gln Ile Leu Ser Ile Tyr Ser Thr Val Ala Ser Ser Leu Ala Leu
530 535 540

Ala Ile Met Val Ala Gly Leu Ser Leu Trp Met Cys Ser Asn Gly Ser
545 550 555 560

Leu Gln Cys Arg Ile Cys Ile
565

<210> 120
<211> 566
<212> PRT
<213> Influenza A virus

<400> 120

Met Lys Thr Ile Ile Ala Leu Ser Tyr Ile Leu Cys Leu Val Phe Ala
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Gln Lys Leu Pro Gly Asn Asp Asn Ser Thr Ala Thr Leu Cys Leu Gly
20 25 30

His His Ala Val Pro Asn Gly Thr Leu Val Lys Thr Ile Thr Asn Asp
35 40 45

Gln Ile Glu Val Thr Asn Ala Thr Glu Leu Val Gln Ser Ser Ser Thr
50 55 60

Gly Arg Ile Cys Asp Ser Pro His Arg Ile Leu Asp Gly Lys Asn Cys
65 70 75 80

Thr Leu Ile Asp Ala Leu Leu Gly Asp Pro His Cys Asp Gly Phe Gln
85 90 95

Asn Lys Glu Trp Asp Leu Phe Val Glu Arg Ser Lys Ala Tyr Ser Asn
100 105 110

Cys Tyr Pro Tyr Asp Val Pro Asp Tyr Ala Ser Leu Arg Ser Leu Val
115 120 125

Ala Ser Ser Gly Thr Leu Glu Phe Ile Asn Glu Asp Phe Asn Trp Thr
130 135 140

Gly Val Ala Gln Ser Gly Glu Ser Tyr Ala Cys Lys Arg Gly Ser Val
145 150 155 160

Lys Ser Phe Phe Ser Arg Leu Asn Trp Leu His Glu Ser Glu Tyr Lys
165 170 175

381698_1.TXT

Tyr Pro Ala Leu Asn Val Thr Met Pro Asn Asn Gly Lys Phe Asp Lys
 180 185 190
 Leu Tyr Ile Trp Gly Val His His Pro Ser Thr Asp Arg Glu Gln Thr
 195 200 205
 Lys Leu Tyr Val Arg Ala Ser Gly Arg Val Thr Val Ser Thr Lys Arg
 210 215 220
 Ser Gln Gln Thr Val Ile Pro Asn Ile Gly Ser Arg Pro Trp Val Arg
 225 230 235 240
 Gly Leu Ser Ser Arg Ile Ser Ile Tyr Trp Thr Ile Val Lys Pro Gly
 245 250 255
 Asp Ile Leu Leu Ile Asn Ser Thr Gly Asn Leu Ile Ala Pro Arg Gly
 260 265 270
 Tyr Phe Lys Ile Arg Thr Gly Lys Ser Ser Ile Met Arg Ser Asp Ala
 275 280 285
 Pro Ile Gly Thr Cys Ser Ser Glu Cys Ile Thr Pro Asn Gly Ser Ile
 290 295 300
 Pro Asn Asp Lys Pro Phe Gln Asn Val Asn Arg Ile Thr Tyr Gly Ala
 305 310 315 320
 Cys Pro Arg Tyr Val Lys Gln Asn Thr Leu Lys Leu Ala Thr Gly Met
 325 330 335
 Arg Asn Val Pro Glu Lys Gln Thr Arg Gly Ile Phe Gly Ala Ile Ala
 340 345 350
 Gly Phe Ile Glu Asn Gly Trp Glu Gly Met Val Asn Gly Trp Tyr Gly
 355 360 365
 Phe Arg His Gln Asn Ser Glu Gly Thr Gly Gln Ala Ala Asp Leu Lys
 370 375 380
 Ser Thr Gln Ala Ala Ile Asp Gln Ile Asn Gly Lys Leu Asn Arg Leu
 385 390 395 400
 Ile Glu Lys Thr Asn Glu Lys Phe His Gln Ile Glu Lys Glu Phe Ser
 405 410 415
 Glu Val Glu Gly Arg Ile Gln Asp Leu Glu Lys Tyr Val Glu Asp Thr
 420 425 430
 Lys Ile Asp Leu Trp Ser Tyr Asn Ala Glu Leu Leu Val Ala Leu Glu
 435 440 445

381698_1.TXT

Asn Gln His Thr Ile Asp Leu Thr Asp Ser Glu Met Asn Lys Leu Phe
 450 455 460

Glu Lys Thr Arg Lys Gln Leu Arg Glu Asn Ala Glu Asp Met Gly Asn
 465 470 475 480

Gly Cys Phe Lys Ile Tyr His Lys Cys Asp Asn Ala Cys Ile Gly Ser
 485 490 495

Ile Arg Asn Gly Thr Tyr Asp His Asp Val Tyr Arg Asp Glu Ala Leu
 500 505 510

Asn Asn Arg Phe Gln Ile Lys Gly Val Glu Leu Lys Ser Gly Tyr Lys
 515 520 525

Asp Trp Ile Leu Trp Ile Ser Phe Ala Ile Ser Cys Phe Leu Leu Cys
 530 535 540

Val Val Leu Leu Gly Phe Ile Met Trp Ala Cys Gln Lys Gly Asn Ile
 545 550 555 560

Arg Cys Asn Ile Cys Ile
 565

<210> 121
 <211> 566
 <212> PRT
 <213> Influenza A virus
 <400> 121

Met Lys Thr Ile Ile Ala Leu Ser Tyr Ile Phe Cys Leu Ala Leu Gly
 1 5 10 15

Gln Asp Leu Pro Gly Asn Asp Asn Ser Thr Ala Thr Leu Cys Leu Gly
 20 25 30

His His Ala Val Pro Asn Gly Thr Leu Val Lys Thr Ile Thr Asp Asp
 35 40 45

Gln Ile Glu Val Thr Asn Ala Thr Glu Leu Val Gln Ser Ser Ser Thr
 50 55 60

Gly Lys Ile Cys Asn Asn Pro His Arg Ile Leu Asp Gly Ile Asp Cys
 65 70 75 80

Thr Leu Ile Asp Ala Leu Leu Gly Asp Pro His Cys Asp Val Phe Gln
 85 90 95

Asn Glu Thr Trp Asp Leu Phe Val Glu Arg Ser Lys Ala Phe Ser Asn
 100 105 110

Cys Tyr Pro Tyr Asp Val Pro Asp Tyr Ala Ser Leu Arg Ser Leu Val
 115 120 125
 Ala Ser Ser Gly Thr Leu Glu Phe Ile Thr Glu Gly Phe Thr Trp Thr
 130 135 140
 Gly Val Thr Gln Asn Gly Gly Ser Asn Ala Cys Lys Arg Gly Pro Gly
 145 150 155 160
 Ser Gly Phe Phe Ser Arg Leu Asn Trp Leu Thr Lys Ser Gly Ser Thr
 165 170 175
 Tyr Pro Val Leu Asn Val Thr Met Pro Asn Asn Asp Asn Phe Asp Lys
 180 185 190
 Leu Tyr Ile Trp Gly Ile His His Pro Ser Thr Asn Gln Glu Gln Thr
 195 200 205
 Ser Leu Tyr Val Gln Ala Ser Gly Arg Val Thr Val Ser Thr Arg Arg
 210 215 220
 Ser Gln Gln Thr Ile Ile Pro Asn Ile Gly Ser Arg Pro Trp Val Arg
 225 230 235 240
 Gly Leu Ser Ser Arg Ile Ser Ile Tyr Trp Thr Ile Val Lys Pro Gly
 245 250 255
 Asp Val Leu Val Ile Asn Ser Asn Gly Asn Leu Ile Ala Pro Arg Gly
 260 265 270
 Tyr Phe Lys Met Arg Thr Gly Lys Ser Ser Ile Met Arg Ser Asp Ala
 275 280 285
 Pro Ile Asp Thr Cys Ile Ser Glu Cys Ile Thr Pro Asn Gly Ser Ile
 290 295 300
 Pro Asn Asp Lys Pro Phe Gln Asn Val Asn Lys Ile Thr Tyr Gly Ala
 305 310 315 320
 Cys Pro Lys Tyr Val Lys Gln Asn Thr Leu Lys Leu Ala Thr Gly Met
 325 330 335
 Arg Asn Val Pro Glu Lys Gln Thr Arg Gly Leu Phe Gly Ala Ile Ala
 340 345 350
 Gly Phe Ile Glu Asn Gly Trp Glu Gly Met Ile Asp Gly Trp Tyr Gly
 355 360 365
 Phe Arg His Gln Asn Ser Glu Gly Thr Gly Gln Ala Ala Asp Leu Lys
 370 375 380

381698_1.TXT

Ser Thr Gln Ala Ala Ile Asp Gln Ile Asn Gly Lys Leu Asn Arg Val
385 390 395 400

Ile Glu Lys Thr Asn Glu Lys Phe His Gln Ile Glu Lys Glu Phe Ser
405 410 415

Glu Val Glu Gly Arg Ile Gln Asp Leu Glu Lys Tyr Val Glu Asp Thr
420 425 430

Lys Ile Asp Leu Trp Ser Tyr Asn Ala Glu Leu Leu Val Ala Leu Glu
435 440 445

Asn Gln His Thr Ile Asp Leu Thr Asp Ser Glu Met Asn Lys Leu Phe
450 455 460

Glu Lys Thr Arg Arg Gln Leu Arg Glu Asn Ala Glu Glu Met Gly Asn
465 470 475 480

Gly Cys Phe Lys Ile Tyr His Lys Cys Asp Asn Ala Cys Ile Glu Ser
485 490 495

Ile Arg Asn Gly Thr Tyr Asp His Asp Val Tyr Arg Asp Glu Ala Leu
500 505 510

Asn Asn Arg Phe Gln Ile Lys Gly Val Glu Leu Lys Ser Gly Tyr Lys
515 520 525

Asp Trp Ile Leu Trp Ile Ser Phe Ala Ile Ser Cys Phe Leu Leu Cys
530 535 540

Val Val Leu Leu Gly Phe Ile Met Trp Ala Cys Gln Arg Gly Asn Ile
545 550 555 560

Arg Cys Asn Ile Cys Ile
565

<210> 122
<211> 566
<212> PRT
<213> Influenza A virus

<400> 122

Met Lys Thr Ile Ile Ala Leu Ser His Ile Phe Cys Leu Val Leu Gly
1 5 10 15

Gln Tyr Leu Pro Gly Asn Asp Asn Ser Thr Ala Thr Leu Cys Leu Gly
20 25 30

His His Ala Val Pro Asn Gly Thr Leu Val Lys Thr Ile Thr Asn Asp
35 40 45

Gln Ile Glu Val Thr Asn Ala Thr Glu Leu Val Gln Ser Ser Ser Thr
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50

55

60

Gly Lys Ile Cys Asn Asn Pro His Arg Ile Leu Asp Gly Ile Asp Cys
65 70 75 80

Thr Leu Ile Asp Ala Leu Leu Gly Asp Pro His Cys Asp Gly Phe Gln
85 90 95

Asn Glu Thr Trp Asp Leu Phe Val Glu Arg Ser Lys Ala Phe Ser Asn
100 105 110

Cys Tyr Pro Tyr Asp Val Pro Asp Tyr Ala Ser Leu Arg Ser Leu Val
115 120 125

Ala Ser Ser Gly Thr Leu Glu Phe Ile Thr Glu Gly Phe Thr Trp Thr
130 135 140

Gly Val Thr Gln Asn Gly Gly Ser Asn Ala Cys Lys Arg Gly Pro Gly
145 150 155 160

Ser Gly Phe Phe Ser Arg Leu Asn Trp Leu Thr Lys Ser Glu Ser Thr
165 170 175

Tyr Pro Val Leu Asn Val Thr Met Pro Asn Asn Asp Asn Phe Asp Lys
180 185 190

Leu Tyr Ile Trp Gly Val His His Pro Ser Thr Asn Gln Glu Gln Thr
195 200 205

Ser Leu Tyr Val Gln Ala Ser Gly Arg Val Thr Val Ser Thr Arg Arg
210 215 220

Ser Gln Gln Thr Ile Ile Pro Asn Ile Gly Ser Arg Pro Trp Val Arg
225 230 235 240

Gly Leu Ser Ser Arg Ile Ser Ile Tyr Trp Thr Ile Val Lys Pro Gly
245 250 255

Asp Val Leu Val Ile Asn Ser Asn Ala Asn Leu Ile Ala Pro Arg Gly
260 265 270

Tyr Phe Lys Met Arg Thr Gly Lys Ser Ser Ile Met Arg Ser Asp Ala
275 280 285

Pro Ile Asp Thr Cys Ile Ser Glu Cys Ile Thr Pro Asn Gly Ser Ile
290 295 300

Pro Asn Asp Lys Pro Phe Gln Asn Val Asn Lys Ile Thr Tyr Gly Ala
305 310 315 320

Cys Pro Lys Tyr Val Lys Gln Asn Thr Leu Lys Leu Ala Thr Arg Met
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325

330

335

Arg Asn Val Pro Glu Lys Gln Thr Arg Gly Leu Phe Gly Ala Ile Ala
 340 345 350

Gly Phe Ile Glu Asn Gly Trp Glu Gly Met Ile Asp Gly Trp Tyr Gly
 355 360 365

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

Ser Thr Gln Ala Ala Ile Asp Gln Ile Asn Gly Lys Leu Asn Arg Val
 385 390 395 400

Ile Glu Lys Thr Asn Glu Lys Phe His Gln Ile Glu Lys Glu Phe Ser
 405 410 415

Glu Val Glu Gly Arg Ile Gln Asp Leu Glu Lys Tyr Val Glu Asp Thr
 420 425 430

Lys Ile Asp Leu Trp Ser Tyr Asn Ala Glu Leu Leu Val Ala Leu Glu
 435 440 445

Asn Gln His Thr Ile Asp Leu Thr Asp Ser Glu Met Asn Lys Leu Phe
 450 455 460

Glu Lys Thr Arg Arg Gln Leu Arg Glu Asn Ala Glu Asp Met Gly Asn
 465 470 475 480

Gly Cys Phe Lys Ile Tyr Asp Lys Cys Asp Asn Ala Cys Ile Glu Ser
 485 490 495

Ile Arg Asn Gly Thr Tyr Asp His Asp Val Tyr Arg Asp Glu Ala Leu
 500 505 510

Asn Asn Arg Phe Gln Ile Lys Gly Val Glu Leu Lys Ser Gly Tyr Lys
 515 520 525

Asp Trp Ile Leu Trp Ile Ser Phe Ala Ile Ser Cys Phe Leu Leu Cys
 530 535 540

Val Val Leu Leu Gly Phe Ile Met Trp Ala Cys Gln Arg Gly Asn Ile
 545 550 555 560

Arg Cys Asn Ile Cys Ile
 565

<210> 123
 <211> 566
 <212> PRT
 <213> Influenza A virus

<400> 123

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Met Lys Thr Ile Ile Ala Leu Ser Tyr Ile Phe Cys Leu Ala Leu Gly
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Gln Asp Leu Pro Gly Asn Asp Asn Ser Thr Ala Thr Leu Cys Leu Gly
          20          25          30

His His Ala Val Pro Asn Gly Thr Leu Val Lys Thr Ile Thr Asp Asp
          35          40          45

Gln Ile Glu Val Thr Asn Ala Thr Glu Leu Val Gln Ser Ser Ser Thr
          50          55          60

Gly Lys Ile Cys Asn Asn Pro His Arg Ile Leu Asp Gly Ile Asp Cys
65          70          75          80

Thr Leu Ile Asp Ala Leu Leu Gly Asp Pro His Cys Asp Val Phe Gln
          85          90          95

Asn Glu Thr Trp Asp Leu Phe Val Glu Arg Ser Lys Ala Phe Ser Asn
          100          105          110

Cys Tyr Pro Tyr Asp Val Pro Asp Tyr Ala Ser Leu Arg Ser Leu Val
          115          120          125

Ala Ser Ser Gly Thr Leu Glu Phe Ile Thr Glu Gly Phe Thr Trp Thr
          130          135          140

Gly Val Thr Gln Asn Gly Gly Ser Asn Ala Cys Lys Arg Gly Pro Gly
145          150          155          160

Ser Gly Phe Phe Ser Arg Leu Asn Trp Leu Thr Lys Ser Gly Ser Thr
          165          170          175

Tyr Pro Val Leu Asn Val Thr Met Pro Asn Asn Asp Asn Phe Asp Lys
          180          185          190

Leu Tyr Ile Trp Gly Ile His His Pro Ser Thr Asn Gln Glu Gln Thr
          195          200          205

Ser Leu Tyr Val Gln Ala Ser Gly Arg Val Thr Val Ser Thr Arg Arg
          210          215          220

Ser Gln Gln Thr Ile Ile Pro Asn Ile Gly Ser Arg Pro Trp Val Arg
225          230          235          240

Gly Leu Ser Ser Arg Ile Ser Ile Tyr Trp Thr Ile Val Lys Pro Gly
          245          250          255

Asp Val Leu Val Ile Asn Ser Asn Gly Asn Leu Ile Ala Pro Arg Gly
          260          265          270

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381698_1.TXT

Tyr Phe Lys Met Arg Thr Gly Lys Ser Ser Ile Met Arg Ser Asp Ala
 275 280 285
 Pro Ile Asp Thr Cys Ile Ser Glu Cys Ile Thr Pro Asn Gly Ser Ile
 290 295 300
 Pro Asn Asp Lys Pro Phe Gln Asn Val Asn Lys Ile Thr Tyr Gly Ala
 305 310 315 320
 Cys Pro Lys Tyr Val Lys Gln Asn Thr Leu Lys Leu Ala Thr Gly Met
 325 330 335
 Arg Asn Val Pro Glu Lys Gln Thr Arg Gly Leu Phe Gly Ala Ile Ala
 340 345 350
 Gly Phe Ile Glu Asn Gly Trp Glu Gly Met Ile Asp Gly Trp Tyr Gly
 355 360 365
 Phe Arg His Gln Asn Ser Glu Gly Thr Gly Gln Ala Ala Asp Leu Lys
 370 375 380
 Ser Thr Gln Ala Ala Ile Asp Gln Ile Asn Gly Lys Leu Asn Arg Val
 385 390 395 400
 Ile Glu Lys Thr Asn Glu Lys Phe His Gln Ile Glu Lys Glu Phe Ser
 405 410 415
 Glu Val Glu Gly Arg Ile Gln Asp Leu Glu Lys Tyr Val Glu Asp Thr
 420 425 430
 Lys Ile Asp Leu Trp Ser Tyr Asn Ala Glu Leu Leu Val Ala Leu Glu
 435 440 445
 Asn Gln His Thr Ile Asp Leu Thr Asp Ser Glu Met Asn Lys Leu Phe
 450 455 460
 Glu Lys Thr Arg Arg Gln Leu Arg Glu Asn Ala Glu Glu Met Gly Asn
 465 470 475 480
 Gly Cys Phe Lys Ile Tyr His Lys Cys Asp Asn Ala Cys Ile Glu Ser
 485 490 495
 Ile Arg Asn Gly Thr Tyr Asp His Asp Val Tyr Arg Asp Glu Ala Leu
 500 505 510
 Asn Asn Arg Phe Gln Ile Lys Gly Val Glu Leu Lys Ser Gly Tyr Lys
 515 520 525
 Asp Trp Ile Leu Trp Ile Ser Phe Ala Ile Ser Cys Phe Leu Leu Cys
 530 535 540

381698_1.TXT

Val Val Leu Leu Gly Phe Ile Met Trp Ala Cys Gln Arg Gly Asn Ile
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Arg Cys Asn Ile Cys Ile
565

<210> 124
<211> 566
<212> PRT
<213> Influenza A virus

<400> 124

Met Lys Thr Ile Ile Ala Leu Ser Tyr Ile Phe Cys Leu Val Leu Gly
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Gln Asp Phe Pro Gly Asn Asp Asn Ser Thr Ala Thr Leu Cys Leu Gly
20 25 30

His His Ala Val Pro Asn Gly Thr Leu Val Lys Thr Ile Thr Asn Asp
35 40 45

Gln Ile Glu Val Thr Asn Ala Thr Glu Leu Val Gln Ser Ser Ser Thr
50 55 60

Gly Lys Ile Cys Asn Asn Pro His Arg Ile Leu Asp Gly Ile Asp Cys
65 70 75 80

Thr Leu Ile Asp Ala Leu Leu Gly Asp Pro His Cys Asp Gly Phe Gln
85 90 95

Asn Glu Thr Trp Asp Leu Phe Val Glu Arg Ser Lys Ala Phe Ser Asn
100 105 110

Cys Tyr Pro Tyr Asp Val Pro Asp Tyr Ala Ser Leu Arg Ser Leu Val
115 120 125

Ala Ser Ser Gly Thr Leu Glu Phe Ile Ser Glu Gly Phe Thr Trp Thr
130 135 140

Gly Val Thr Gln Asn Gly Gly Ser Asn Ala Cys Lys Arg Gly Pro Asp
145 150 155 160

Ser Gly Phe Phe Ser Arg Leu Asn Trp Leu Tyr Lys Ser Gly Ser Thr
165 170 175

Tyr Pro Val Leu Asn Val Thr Met Pro Asn Asn Asp Asn Phe Asp Lys
180 185 190

Leu Tyr Ile Trp Gly Val His His Pro Ser Thr Asp Gln Glu Gln Thr
195 200 205

381698_1.TXT

Ser Leu Tyr Val Gln Ala Ser Gly Arg Val Thr Val Ser Thr Lys Arg
 210 215 220
 Ser Gln Gln Thr Ile Ile Pro Asn Ile Gly Ser Arg Pro Trp Val Arg
 225 230 235 240
 Gly Leu Ser Ser Arg Ile Ser Ile Tyr Trp Thr Ile Val Lys Pro Gly
 245 250 255
 Asp Ile Leu Val Ile Asn Ser Asn Gly Asn Leu Ile Ala Pro Arg Gly
 260 265 270
 Tyr Phe Lys Met Arg Thr Gly Lys Ser Ser Ile Met Arg Ser Asp Ala
 275 280 285
 Pro Ile Gly Thr Cys Ile Ser Glu Cys Ile Thr Pro Asn Gly Ser Ile
 290 295 300
 Pro Asn Asp Lys Pro Phe Gln Asn Val Asn Lys Ile Thr Tyr Gly Ala
 305 310 315 320
 Cys Pro Lys Tyr Val Lys Gln Asn Thr Leu Lys Leu Ala Thr Gly Met
 325 330 335
 Arg Asn Val Pro Glu Lys Gln Thr Arg Gly Leu Phe Gly Ala Ile Ala
 340 345 350
 Gly Phe Ile Glu Asn Gly Trp Glu Gly Met Ile Asp Gly Trp Tyr Gly
 355 360 365
 Phe Arg His Gln Asn Ser Glu Gly Thr Gly Gln Ala Ala Asp Leu Lys
 370 375 380
 Ser Thr Gln Ala Ala Ile Asp Gln Ile Asn Gly Lys Leu Asn Arg Val
 385 390 395 400
 Ile Glu Lys Thr Asn Glu Lys Phe His Gln Ile Glu Lys Glu Phe Ser
 405 410 415
 Glu Val Glu Gly Arg Ile Gln Asp Leu Glu Lys Tyr Val Glu Asp Thr
 420 425 430
 Lys Ile Asp Leu Trp Ser Tyr Asn Ala Glu Leu Leu Val Ala Leu Glu
 435 440 445
 Asn Gln His Thr Ile Asp Leu Thr Asp Ser Glu Met Asn Lys Leu Phe
 450 455 460
 Glu Lys Thr Arg Arg Gln Leu Arg Glu Asn Ala Glu Asp Met Gly Asn
 465 470 475 480

381698_1.TXT

Gly Cys Phe Lys Ile Tyr His Lys Cys Asp Asn Ala Cys Ile Gly Ser
485 490 495

Ile Arg Asn Gly Thr Tyr Asp His Asp Val Tyr Arg Asp Glu Ala Leu
500 505 510

Asn Asn Arg Phe Gln Ile Lys Gly Val Glu Leu Lys Ser Gly Tyr Lys
515 520 525

Asp Trp Ile Leu Trp Ile Ser Phe Ala Ile Ser Cys Phe Leu Leu Cys
530 535 540

Val Val Leu Leu Gly Phe Ile Met Trp Ala Cys Gln Lys Gly Asn Ile
545 550 555 560

Arg Cys Asn Ile Cys Ile
565

<210> 125
<211> 566
<212> PRT
<213> Influenza A virus

<400> 125

Met Lys Thr Ile Ile Ala Leu Ser Tyr Ile Leu Cys Leu Val Phe Ala
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Gln Lys Leu Pro Gly Asn Asp Asn Ser Thr Ala Thr Leu Cys Leu Gly
20 25 30

His His Ala Val Ser Asn Gly Thr Leu Val Lys Thr Ile Thr Asn Asp
35 40 45

Gln Ile Glu Val Thr Asn Ala Thr Glu Leu Val Gln Ser Ser Ser Thr
50 55 60

Gly Arg Ile Cys Asp Ser Pro His Gln Ile Leu Asp Gly Glu Asn Cys
65 70 75 80

Thr Leu Ile Asp Ala Leu Leu Gly Asp Pro His Cys Asp Gly Phe Gln
85 90 95

Asn Lys Glu Trp Asp Leu Phe Val Glu Arg Ser Lys Ala Tyr Ser Asn
100 105 110

Cys Tyr Pro Tyr Asp Val Pro Asp Tyr Ala Ser Leu Arg Ser Leu Val
115 120 125

Ala Ser Ser Gly Thr Leu Glu Phe Asn Asn Glu Ser Phe Asn Trp Thr
130 135 140

381698_1.TXT

Gly Val Ala Gln Asn Gly Thr Ser Ser Ala Cys Lys Arg Arg Ser Asn
 145 150 155 160

Lys Ser Phe Phe Ser Arg Leu Asn Trp Leu His Gln Leu Lys Tyr Lys
 165 170 175

Tyr Pro Ala Leu Asn Val Thr Met Pro Asn Asn Glu Lys Phe Asp Lys
 180 185 190

Leu Tyr Ile Trp Gly Val His His Pro Ser Thr Asp Ser Asp Gln Ile
 195 200 205

Ser Ile Tyr Ala Gln Ala Ser Gly Arg Val Thr Val Ser Thr Lys Arg
 210 215 220

Ser Gln Gln Thr Val Ile Pro Asn Ile Gly Ser Ser Pro Trp Val Arg
 225 230 235 240

Gly Val Ser Ser Arg Ile Ser Ile Tyr Trp Thr Ile Val Lys Pro Gly
 245 250 255

Asp Ile Leu Leu Ile Asn Ser Thr Gly Asn Leu Ile Ala Pro Arg Gly
 260 265 270

Tyr Phe Lys Ile Arg Ser Gly Lys Ser Ser Ile Met Arg Ser Asp Ala
 275 280 285

Pro Ile Gly Lys Cys Asn Ser Glu Cys Ile Thr Pro Asn Gly Ser Ile
 290 295 300

Pro Asn Asp Lys Pro Phe Gln Asn Val Asn Arg Ile Thr Tyr Gly Ala
 305 310 315 320

Cys Pro Arg Tyr Val Lys Gln Asn Thr Leu Lys Leu Ala Thr Gly Met
 325 330 335

Arg Asn Val Pro Glu Lys Gln Thr Arg Gly Ile Phe Gly Ala Ile Ala
 340 345 350

Gly Phe Ile Glu Asn Gly Trp Glu Gly Met Val Asp Gly Trp Tyr Gly
 355 360 365

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

Ser Thr Gln Ala Ala Ile Asn Gln Ile Asn Gly Lys Leu Asn Arg Leu
 385 390 395 400

Ile Glu Lys Thr Asn Glu Lys Phe His Gln Ile Glu Lys Glu Phe Ser
 405 410 415

381698_1.TXT

Glu Val Glu Gly Arg Ile Gln Asp Leu Glu Lys Tyr Val Glu Asp Thr
 420 425 430

Lys Ile Asp Leu Trp Ser Tyr Asn Ala Glu Leu Leu Val Ala Leu Glu
 435 440 445

Asn Gln His Thr Ile Asp Leu Thr Asp Ser Glu Met Asn Lys Leu Phe
 450 455 460

Glu Arg Thr Lys Lys Gln Leu Arg Glu Asn Ala Glu Asp Met Gly Asn
 465 470 475 480

Gly Cys Phe Lys Ile Tyr His Lys Cys Asp Asn Ala Cys Ile Gly Ser
 485 490 495

Ile Arg Asn Gly Thr Tyr Asp His Asp Val Tyr Arg Asp Glu Ala Leu
 500 505 510

Asn Asn Arg Phe Gln Ile Lys Gly Val Glu Leu Lys Ser Gly Tyr Lys
 515 520 525

Asp Trp Ile Leu Trp Ile Ser Phe Ala Ile Ser Cys Phe Leu Leu Cys
 530 535 540

Val Val Leu Leu Gly Phe Ile Met Trp Ala Cys Gln Lys Gly Asn Ile
 545 550 555 560

Arg Cys Asn Ile Cys Ile
 565

<210> 126
 <211> 566
 <212> PRT
 <213> Influenza A virus

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 <223> Xaa can be any naturally occurring amino acid

<220>
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 <223> Xaa can be any naturally occurring amino acid

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 <223> Xaa can be any naturally occurring amino acid

<400> 126

Met Lys Thr Ile Ile Ala Leu Ser Tyr Ile Phe Cys Leu Val Phe Ala
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Gln Lys Leu Pro Gly Asn Asp Asn Ser Thr Ala Thr Leu Cys Leu Gly

20

25

30

His His Ala Val Pro Asn Gly Thr Leu Val Lys Thr Ile Thr Asn Asp
 35 40 45

Gln Ile Glu Val Thr Asn Ala Thr Glu Leu Val Gln Ser Ser Ser Thr
 50 55 60

Gly Arg Ile Cys Asp Ser Pro His Arg Ile Leu Asp Gly Lys Asn Cys
 65 70 75 80

Thr Leu Ile Asp Ala Leu Leu Gly Asp Pro His Cys Asp Gly Phe Gln
 85 90 95

Asn Glu Lys Trp Asp Leu Phe Ile Glu Arg Ser Lys Ala Phe Ser Asn
 100 105 110

Cys Tyr Pro Tyr Asp Val Pro Asp Tyr Ala Ser Leu Arg Ser Leu Val
 115 120 125

Ala Ser Ser Gly Thr Leu Glu Phe Ile Asn Glu Gly Phe Asn Trp Thr
 130 135 140

Gly Val Thr Gln Ser Gly Gly Ser Tyr Xaa Cys Lys Arg Gly Ser Val
 145 150 155 160

Asn Ser Phe Phe Ser Arg Leu Asn Trp Leu Tyr Glu Ser Glu Tyr Lys
 165 170 175

Tyr Pro Ala Leu Asn Val Thr Met Pro Asn Asn Gly Lys Phe Asp Lys
 180 185 190

Leu Tyr Ile Trp Gly Val His His Pro Xaa Thr Glu Lys Glu Gln Thr
 195 200 205

Asn Leu Tyr Val Arg Ala Ser Gly Arg Val Thr Val Ser Thr Lys Arg
 210 215 220

Ser Gln Gln Thr Val Ile Pro Asn Ile Gly Ser Xaa Pro Trp Val Arg
 225 230 235 240

Gly Leu Ser Ser Arg Ile Ser Ile Tyr Trp Thr Ile Val Lys Pro Gly
 245 250 255

Asp Ile Leu Leu Ile Asn Ser Thr Gly Asn Leu Ile Ala Pro Arg Gly
 260 265 270

Tyr Phe Lys Ile Arg Thr Gly Lys Ser Ser Ile Met Arg Ser Asp Ala
 275 280 285

Pro Ile Gly Thr Cys Ser Ser Glu Cys Ile Thr Pro Asn Gly Ser Ile

290 295 300
Pro Asn Asp Lys Pro Phe Gln Asn Val Asn Lys Ile Thr Tyr Gly Ala
305 310 315 320
Cys Pro Arg Tyr Val Lys Gln Asn Thr Leu Lys Leu Ala Thr Gly Met
325 330 335
Arg Asn Val Pro Glu Lys Gln Thr Arg Gly Ile Phe Gly Ala Ile Ala
340 345 350
Gly Phe Ile Glu Asn Gly Trp Glu Gly Met Val Asp Gly Trp Tyr Gly
355 360 365
Phe Arg His Gln Asn Ser Glu Gly Thr Gly Gln Ala Ala Asp Leu Lys
370 375 380
Ser Thr Gln Ala Ala Ile Asp Gln Ile Asn Gly Lys Leu Asn Arg Leu
385 390 395 400
Ile Glu Lys Thr Asn Glu Lys Phe His Gln Ile Glu Lys Glu Phe Ser
405 410 415
Glu Val Glu Gly Arg Ile Gln Asp Leu Glu Lys Tyr Val Glu Asp Thr
420 425 430
Lys Ile Asp Leu Trp Ser Tyr Asn Ala Glu Leu Leu Val Ala Leu Glu
435 440 445
Asn Gln Tyr Thr Ile Asp Leu Thr Asp Ser Glu Met Asn Lys Leu Phe
450 455 460
Glu Lys Thr Arg Lys Gln Leu Arg Glu Asn Ala Glu Asp Met Gly Asn
465 470 475 480
Gly Cys Phe Lys Ile Tyr His Lys Cys Asp Asn Ala Cys Ile Gly Ser
485 490 495
Ile Arg Asn Gly Thr Tyr Asp His Asp Val Tyr Arg Asp Glu Ala Leu
500 505 510
Asn Asn Arg Phe Gln Ile Lys Gly Val Glu Leu Lys Ser Gly Tyr Lys
515 520 525
Asp Trp Ile Leu Trp Ile Ser Phe Ala Ile Ser Cys Phe Leu Leu Cys
530 535 540
Val Val Leu Leu Gly Phe Ile Met Trp Ala Cys Gln Lys Gly Asn Ile
545 550 555 560

Arg Cys Asn Ile Cys Ile

565

<210> 127
 <211> 566
 <212> PRT
 <213> Influenza A virus

<400> 127

Met Lys Thr Ile Ile Ala Leu Ser Tyr Ile Leu Cys Leu Val Phe Ala
 1 5 10 15

Gln Lys Leu Pro Gly Asn Asp Asn Ser Thr Ala Thr Leu Cys Leu Gly
 20 25 30

His His Ala Val Pro Asn Gly Thr Leu Val Lys Thr Ile Thr Asn Asp
 35 40 45

Gln Ile Glu Val Thr Asn Ala Thr Glu Leu Val Gln Ser Ser Ser Thr
 50 55 60

Gly Arg Ile Cys Asp Ser Pro His Arg Ile Leu Asp Gly Lys Asn Cys
 65 70 75 80

Thr Leu Ile Asp Ala Leu Leu Gly Asp Pro His Cys Asp Gly Phe Gln
 85 90 95

Asn Lys Glu Trp Asp Leu Phe Val Glu Arg Ser Lys Ala Tyr Ser Asn
 100 105 110

Cys Tyr Pro Tyr Asp Val Pro Asp Tyr Ala Ser Leu Arg Ser Leu Val
 115 120 125

Ala Ser Ser Gly Thr Leu Glu Phe Ile Asn Glu Asp Phe Asn Trp Thr
 130 135 140

Gly Val Ala Gln Ser Gly Glu Ser Tyr Ala Cys Lys Arg Gly Ser Val
 145 150 155 160

Lys Ser Phe Phe Ser Arg Leu Asn Trp Leu His Glu Ser Glu Tyr Lys
 165 170 175

Tyr Pro Ala Leu Asn Val Thr Met Pro Asn Asn Gly Lys Phe Asp Lys
 180 185 190

Leu Tyr Ile Trp Gly Val His His Pro Ser Thr Asp Arg Glu Gln Thr
 195 200 205

Asn Leu Tyr Val Arg Ala Ser Gly Arg Val Thr Val Ser Thr Lys Arg
 210 215 220

Ser Gln Gln Thr Val Ile Pro Asn Ile Gly Ser Arg Pro Trp Val Arg
 225 230 235 240

381698_1.TXT

Gly Leu Ser Ser Arg Ile Ser Ile Tyr Trp Thr Ile Val Lys Pro Gly
 245 250 255
 Asp Ile Leu Leu Ile Asn Ser Thr Gly Asn Leu Ile Ala Pro Arg Gly
 260 265 270
 Tyr Phe Lys Ile Arg Thr Gly Lys Ser Ser Ile Met Arg Ser Asp Ala
 275 280 285
 Pro Ile Gly Thr Cys Ser Ser Glu Cys Ile Thr Pro Asn Gly Ser Ile
 290 295 300
 Pro Asn Asp Lys Pro Phe Gln Asn Val Asn Arg Ile Thr Tyr Gly Ala
 305 310 315 320
 Cys Pro Arg Tyr Val Lys Gln Asn Thr Leu Lys Leu Ala Thr Gly Met
 325 330 335
 Arg Asn Val Pro Glu Lys Gln Thr Arg Gly Ile Phe Gly Ala Ile Ala
 340 345 350
 Gly Phe Ile Glu Asn Gly Trp Glu Gly Met Val Asp Gly Trp Tyr Gly
 355 360 365
 Phe Arg His Gln Asn Ser Glu Gly Thr Gly Gln Ala Ala Asp Leu Lys
 370 375 380
 Ser Thr Gln Ala Ala Ile Asp Gln Ile Asn Gly Lys Leu Asn Arg Leu
 385 390 395 400
 Ile Glu Lys Thr Asn Glu Lys Phe His Gln Ile Glu Lys Glu Phe Ser
 405 410 415
 Glu Val Glu Gly Arg Ile Gln Asp Leu Glu Lys Tyr Val Glu Asp Thr
 420 425 430
 Lys Ile Asp Leu Trp Ser Tyr Asn Ala Glu Leu Leu Val Ala Leu Glu
 435 440 445
 Asn Gln His Thr Ile Asp Leu Thr Asp Ser Glu Met Asn Lys Leu Phe
 450 455 460
 Glu Lys Thr Arg Lys Gln Leu Arg Glu Asn Ala Glu Asp Met Gly Asn
 465 470 475 480
 Gly Cys Phe Lys Ile Tyr His Lys Cys Asp Asn Ala Cys Ile Gly Ser
 485 490 495
 Ile Arg Asn Gly Thr Tyr Asp His Asp Val Tyr Arg Asp Glu Ala Leu
 500 505 510

381698_1.TXT

Asn Asn Arg Phe Gln Ile Lys Gly Val Glu Leu Lys Ser Gly Tyr Lys
515 520 525

Asp Trp Ile Leu Trp Ile Ser Phe Ala Ile Ser Cys Phe Leu Leu Cys
530 535 540

Val Val Leu Leu Gly Phe Ile Met Trp Ala Cys Gln Lys Gly Asn Ile
545 550 555 560

Arg Cys Asn Ile Cys Ile
565

<210> 128
<211> 566
<212> PRT
<213> Influenza A virus

<400> 128

Met Lys Thr Ile Ile Ala Leu Ser Tyr Ile Phe Cys Leu Val Phe Ala
1 5 10 15

Gln Asn Leu Pro Gly Asn Asp Asn Ser Thr Ala Thr Leu Cys Leu Gly
20 25 30

His His Ala Val Pro Asn Gly Thr Leu Val Lys Thr Ile Thr Asn Asp
35 40 45

Gln Ile Glu Val Thr Asn Ala Thr Glu Leu Val Gln Ser Ser Ser Thr
50 55 60

Gly Arg Ile Cys Asp Ser Pro His Arg Ile Leu Asp Gly Lys Asn Cys
65 70 75 80

Thr Leu Ile Asp Ala Leu Leu Gly Asp Pro His Cys Asp Gly Phe Gln
85 90 95

Asn Glu Lys Trp Asp Leu Phe Val Glu Arg Ser Lys Ala Phe Ser Asn
100 105 110

Cys Tyr Pro Tyr Asp Val Pro Asp Tyr Ala Ser Leu Arg Ser Leu Val
115 120 125

Ala Ser Ser Gly Thr Leu Glu Phe Ile Asn Glu Gly Phe Asn Trp Thr
130 135 140

Gly Val Thr Gln Ser Gly Gly Ser Tyr Ala Cys Lys Arg Gly Ser Asp
145 150 155 160

Asn Ser Phe Phe Ser Arg Leu Asn Trp Leu Tyr Glu Ser Glu Ser Lys
165 170 175

381698_1.TXT

Tyr Pro Val Leu Asn Val Thr Met Pro Asn Asn Gly Asn Phe Asp Lys
 180 185 190
 Leu Tyr Ile Trp Gly Val His His Pro Ser Thr Asp Lys Glu Gln Thr
 195 200 205
 Lys Leu Tyr Val Arg Ala Ser Gly Arg Val Thr Val Ser Thr Lys Arg
 210 215 220
 Ser Gln Gln Thr Ile Ile Pro Asn Ile Gly Ser Arg Pro Trp Val Arg
 225 230 235 240
 Gly Leu Ser Ser Gly Ile Ser Ile Tyr Trp Thr Ile Val Lys Pro Gly
 245 250 255
 Asp Ile Leu Leu Ile Asn Ser Asn Gly Asn Leu Ile Ala Pro Arg Gly
 260 265 270
 Tyr Phe Lys Ile Arg Thr Gly Lys Ser Ser Ile Met Arg Ser Asp Ala
 275 280 285
 Pro Ile Gly Thr Cys Ser Ser Glu Cys Ile Thr Pro Asn Gly Ser Ile
 290 295 300
 Pro Asn Asp Lys Pro Phe Gln Asn Val Asn Lys Ile Thr Tyr Gly Ala
 305 310 315 320
 Cys Pro Lys Tyr Val Lys Gln Asn Thr Leu Lys Leu Ala Thr Gly Met
 325 330 335
 Arg Asn Val Pro Glu Lys Gln Thr Arg Gly Ile Phe Gly Ala Ile Ala
 340 345 350
 Gly Phe Ile Glu Asn Gly Trp Glu Gly Met Val Asp Gly Trp Tyr Gly
 355 360 365
 Phe Arg His Gln Asn Ser Glu Gly Thr Gly Gln Ala Ala Asp Leu Lys
 370 375 380
 Ser Thr Gln Ala Ala Ile Asp Gln Ile Asn Gly Lys Leu Asn Arg Val
 385 390 395 400
 Ile Glu Lys Thr Asn Glu Lys Phe His Gln Ile Glu Lys Glu Phe Ser
 405 410 415
 Glu Val Glu Gly Arg Ile Gln Asp Leu Glu Lys Tyr Val Glu Asp Thr
 420 425 430
 Lys Ile Asp Leu Trp Ser Tyr Asn Ala Glu Leu Leu Val Ala Leu Glu
 435 440 445

381698_1.TXT

Asn Gln His Thr Ile Asp Leu Thr Asp Ser Glu Met Asn Lys Leu Phe
450 455 460

Glu Lys Thr Arg Arg Gln Leu Arg Glu Asn Ala Glu Asp Met Gly Asn
465 470 475 480

Gly Cys Phe Lys Ile Tyr His Lys Cys Asp Asn Ala Cys Ile Gly Ser
485 490 495

Ile Arg Asn Gly Thr Tyr Asp His Asp Val Tyr Arg Asp Glu Ala Leu
500 505 510

Asn Asn Arg Phe Gln Ile Lys Gly Val Glu Leu Lys Ser Gly Tyr Lys
515 520 525

Asp Trp Ile Leu Trp Ile Ser Phe Ala Ile Ser Cys Phe Leu Leu Cys
530 535 540

Val Val Leu Leu Gly Phe Ile Met Trp Ala Cys Gln Lys Gly Asn Ile
545 550 555 560

Arg Cys Asn Ile Cys Ile
565

<210> 129
<211> 566
<212> PRT
<213> Influenza A virus
<400> 129

Met Lys Thr Ile Ile Ala Phe Ser Tyr Ile Leu Cys Leu Ile Phe Ala
1 5 10 15

Gln Lys Ile Pro Gly Ser Asp Asn Ser Met Ala Thr Leu Cys Leu Gly
20 25 30

His His Ala Val Pro Asn Gly Thr Leu Val Lys Thr Ile Thr Asp Asp
35 40 45

Gln Ile Glu Val Thr Asn Ala Thr Glu Leu Val Gln Ser Ser Ser Thr
50 55 60

Gly Arg Ile Cys Asn Ser Pro His Gln Ile Leu Asp Gly Lys Asn Cys
65 70 75 80

Thr Leu Ile Asp Ala Leu Leu Gly Asp Pro His Cys Asp Asp Phe Gln
85 90 95

Asn Lys Glu Trp Asp Leu Phe Val Glu Arg Ser Thr Ala Tyr Ser Asn
100 105 110

381698_1.TXT

Cys Tyr Pro Tyr Asp Val Pro Asp Tyr Ala Ser Leu Arg Ser Leu Val
 115 120 125
 Ala Ser Ser Gly Thr Leu Glu Phe Thr Gln Glu Ser Phe Asn Trp Thr
 130 135 140
 Gly Val Ala Gln Asp Gly Thr Ser Ser Ala Cys Lys Arg Gly Ser Val
 145 150 155 160
 Lys Ser Phe Phe Ser Arg Leu Asn Trp Leu His Glu Leu Gly Tyr Lys
 165 170 175
 Tyr Pro Ala Leu Asn Val Thr Met Pro Asn Asn Asp Lys Phe Asp Lys
 180 185 190
 Leu Tyr Ile Trp Gly Val His His Pro Ser Thr Asp Arg Asp Gln Thr
 195 200 205
 Ser Leu Tyr Val Gln Ala Ser Gly Arg Val Thr Val Ser Thr Lys Arg
 210 215 220
 Ser Gln Gln Thr Val Ile Pro Asn Ile Gly Phe Arg Pro Trp Val Arg
 225 230 235 240
 Gly Ile Ser Ser Ile Ile Ser Ile Tyr Trp Thr Ile Val Lys Pro Gly
 245 250 255
 Asp Ile Leu Leu Ile Thr Ser Thr Gly Asn Leu Ile Ala Pro Arg Gly
 260 265 270
 Tyr Phe Lys Ile Arg Ser Gly Lys Ser Ser Ile Met Arg Ser Asp Ala
 275 280 285
 Pro Ile Asp Asn Cys Asn Ser Glu Cys Ile Thr Pro Asn Gly Ser Ile
 290 295 300
 Pro Asn Asp Lys Pro Phe Gln Asn Val Asn Arg Ile Thr Tyr Gly Ala
 305 310 315 320
 Cys Pro Arg Tyr Val Lys Gln Asn Thr Leu Lys Leu Ala Thr Gly Met
 325 330 335
 Arg Asn Val Pro Glu Lys Gln Thr Arg Gly Ile Phe Gly Ala Ile Ala
 340 345 350
 Gly Phe Ile Glu Asn Gly Trp Glu Gly Met Val Asp Gly Trp Tyr Gly
 355 360 365
 Phe Arg His Gln Asn Ser Glu Gly Thr Gly Gln Ala Ala Asp Leu Lys
 370 375 380

Ser Thr Gln Ala Ala Ile Asn Gln Ile Thr Gly Lys Leu Asn Arg Val
385 390 395 400

Ile Lys Lys Thr Asn Glu Lys Phe His Gln Ile Glu Lys Glu Phe Ser
405 410 415

Glu Val Glu Gly Arg Ile Gln Asp Leu Glu Lys Tyr Val Glu Asp Thr
420 425 430

Lys Ile Asp Leu Trp Ser Tyr Asn Ala Glu Leu Leu Val Ala Leu Glu
435 440 445

Asn Gln His Thr Ile Asp Leu Thr Asp Ser Glu Met Asn Lys Leu Phe
450 455 460

Glu Arg Thr Arg Lys Gln Leu Arg Glu Asn Ala Glu Asp Met Gly Asn
465 470 475 480

Gly Cys Phe Lys Ile Tyr His Lys Cys Asp Asn Ala Cys Ile Gly Ser
485 490 495

Ile Arg Asn Gly Thr Tyr Asp His Asp Val Tyr Arg Asp Glu Ala Leu
500 505 510

Asn Asn Arg Phe Gln Ile Lys Gly Val Glu Leu Lys Ser Gly Tyr Lys
515 520 525

Asp Trp Ile Leu Trp Ile Ser Phe Ala Ile Ser Cys Phe Leu Leu Cys
530 535 540

Val Val Leu Leu Gly Phe Ile Met Trp Ala Cys Gln Lys Gly Asn Ile
545 550 555 560

Arg Cys Asn Ile Cys Ile
565

<210> 130

<211> 566

<212> PRT

<213> Influenza A virus

<400> 130

Met Lys Thr Ile Ile Ala Phe Ser Tyr Ile Leu Cys Leu Ile Phe Ala
1 5 10 15

Gln Lys Ile Pro Gly Ser Asp Asn Ser Met Ala Thr Leu Cys Leu Gly
20 25 30

His His Ala Val Pro Asn Gly Thr Leu Val Lys Thr Ile Thr Asp Asp
35 40 45

Gln Ile Glu Val Thr Asn Ala Thr Glu Leu Val Gln Ser Ser Ser Thr

50

55

Gly Arg Ile Cys Asn Ser Pro His Gln Ile Leu Asp Gly Lys Asn Cys
65 70 75 80

Thr Leu Ile Asp Ala Leu Leu Gly Asp Pro His Cys Asp Asp Phe Gln
85 90 95

Asn Lys Glu Trp Asp Leu Phe Val Glu Arg Ser Thr Ala Tyr Ser Asn
100 105 110

Cys Tyr Pro Tyr Asp Val Pro Asp Tyr Ala Ser Leu Arg Ser Leu Val
115 120 125

Ala Ser Ser Gly Thr Leu Glu Phe Thr Gln Glu Ser Phe Asn Trp Thr
130 135 140

Gly Val Ala Gln Asp Gly Thr Ser Ser Ala Cys Lys Arg Gly Ser Val
145 150 155 160

Lys Ser Phe Phe Ser Arg Leu Asn Trp Leu His Glu Leu Gly Tyr Lys
165 170 175

Tyr Pro Ala Leu Asn Val Thr Met Pro Asn Asn Asp Lys Phe Asp Lys
180 185 190

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

Ser Leu Tyr Val Gln Ala Ser Gly Arg Val Thr Val Ser Thr Lys Arg
210 215 220

Ser Gln Gln Thr Val Ile Pro Asn Ile Gly Phe Arg Pro Trp Val Arg
225 230 235 240

Gly Ile Ser Ser Ile Ile Ser Ile Tyr Trp Thr Ile Val Lys Pro Gly
245 250 255

Asp Ile Leu Leu Ile Thr Ser Thr Gly Asn Leu Ile Ala Pro Arg Gly
260 265 270

Tyr Phe Lys Ile Arg Ser Gly Lys Ser Ser Ile Met Arg Ser Asp Ala
275 280 285

Pro Ile Asp Asn Cys Asn Ser Glu Cys Ile Thr Pro Asn Gly Ser Ile
290 295 300

Pro Asn Asp Lys Pro Phe Gln Asn Val Asn Arg Ile Thr Tyr Gly Ala
305 310 315 320

Cys Pro Arg Tyr Val Lys Gln Asn Thr Leu Lys Leu Ala Thr Gly Met

Arg Asn Val Pro Glu Lys Gln Thr Arg Gly Ile Phe Gly Ala Ile Ala
340 345 350

Gly Phe Ile Glu Asn Gly Trp Glu Gly Met Val Asp Gly Trp Tyr Gly
355 360 365

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

Ser Thr Gln Ala Ala Ile Asn Gln Ile Thr Gly Lys Leu Asn Arg Val
385 390 395 400

Ile Lys Lys Thr Asn Glu Lys Phe His Gln Ile Glu Lys Glu Phe Ser
405 410 415

Glu Val Glu Gly Arg Ile Gln Asp Leu Glu Lys Tyr Val Glu Asp Thr
420 425 430

Lys Ile Asp Leu Trp Ser Tyr Asn Ala Glu Leu Leu Val Ala Leu Glu
435 440 445

Asn Gln His Thr Ile Asp Leu Thr Asp Ser Glu Met Asn Lys Leu Phe
450 455 460

Glu Arg Thr Arg Lys Gln Leu Arg Glu Asn Ala Glu Asp Met Gly Asn
465 470 475 480

Gly Cys Phe Lys Ile Tyr His Lys Cys Asp Asn Ala Cys Ile Gly Ser
485 490 495

Ile Arg Asn Gly Thr Tyr Asp His Asp Val Tyr Arg Asp Glu Ala Leu
500 505 510

Asn Asn Arg Phe Gln Ile Lys Gly Val Glu Leu Lys Ser Gly Tyr Lys
515 520 525

Asp Trp Ile Leu Trp Ile Ser Phe Ala Ile Ser Cys Phe Leu Leu Cys
530 535 540

Val Val Leu Leu Gly Phe Ile Met Trp Ala Cys Gln Lys Gly Asn Ile
545 550 555 560

Arg Cys Asn Ile Cys Ile
565

<210> 131

<211> 566

<212> PRT

<213> Influenza A virus

<400> 131

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Met Lys Thr Ile Ile Ala Leu Ser Tyr Ile Leu Cys Leu Val Phe Ala
 1      5      10      15

Gln Lys Leu Pro Gly Asn Asp Asn Ser Thr Ala Thr Leu Cys Leu Gly
      20      25      30

His His Ala Val Pro Asn Gly Thr Leu Val Lys Thr Ile Thr Asn Asp
      35      40      45

Gln Ile Glu Val Thr Asn Ala Thr Glu Leu Val Gln Ser Ser Ser Thr
      50      55      60

Asp Arg Ile Cys Asp Ser Pro His Arg Ile Leu Asp Gly Glu Asn Cys
      65      70      75      80

Thr Leu Ile Asp Ala Leu Leu Gly Asp Pro His Cys Asp Gly Phe Gln
      85      90      95

Asn Lys Glu Trp Asp Leu Phe Val Glu Arg Ser Lys Ala Tyr Ser Asn
      100      105      110

Cys Tyr Pro Tyr Asp Val Gln Asp Tyr Ala Ser Leu Arg Ser Leu Val
      115      120      125

Ala Ser Ser Gly Thr Leu Glu Phe Asn Asn Glu Ser Phe Asn Trp Thr
      130      135      140

Gly Val Ala Gln Asn Gly Thr Ser Tyr Ala Cys Lys Arg Arg Ser Ile
      145      150      155      160

Lys Ser Phe Phe Ser Arg Leu Asn Trp Leu His Gln Leu Lys Tyr Lys
      165      170      175

Tyr Pro Ala Leu Asn Val Thr Met Pro Asn Asn Asp Lys Phe Asp Lys
      180      185      190

Leu Tyr Ile Trp Gly Val His His Pro Ser Thr Asp Ser Asp Gln Thr
      195      200      205

Ser Leu Tyr Ala Gln Ala Ser Gly Arg Val Thr Val Ser Thr Lys Arg
      210      215      220

Ser Gln Gln Thr Val Ile Pro Asn Ile Gly Ser Arg Pro Trp Val Arg
      225      230      235      240

Gly Val Ser Ser Arg Ile Ser Ile Tyr Trp Thr Ile Val Lys Pro Gly
      245      250      255

Asp Ile Leu Leu Ile Asn Ser Thr Gly Asn Leu Ile Ala Pro Arg Gly
      260      265      270

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Tyr Phe Lys Ile Arg Ser Gly Lys Ser Ser Ile Met Arg Ser Asp Ala
 275 280 285
 Pro Ile Gly Lys Cys Asn Ser Glu Cys Ile Thr Pro Asn Gly Ser Ile
 290 295 300
 Pro Asn Asp Lys Pro Phe Gln Asn Val Asn Lys Ile Thr Tyr Gly Ala
 305 310 315 320
 Cys Pro Lys Tyr Val Lys Gln Asn Thr Leu Lys Leu Ala Thr Gly Met
 325 330 335
 Arg Asn Val Pro Glu Lys Gln Thr Arg Gly Ile Phe Gly Ala Ile Ala
 340 345 350
 Gly Phe Ile Glu Asn Gly Trp Glu Gly Met Val Asp Gly Trp Tyr Gly
 355 360 365
 Phe Arg His Gln Asn Ser Glu Gly Thr Gly Gln Ala Ala Asp Leu Lys
 370 375 380
 Ser Thr Gln Ala Ala Ile Asp Gln Ile Asn Gly Lys Leu Asn Arg Val
 385 390 395 400
 Ile Glu Lys Thr Asn Glu Lys Phe His Gln Ile Glu Lys Glu Phe Ser
 405 410 415
 Glu Val Glu Gly Arg Ile Gln Asp Leu Glu Lys Tyr Val Glu Asp Thr
 420 425 430
 Lys Ile Asp Leu Trp Ser Tyr Asn Ala Glu Leu Leu Val Ala Leu Glu
 435 440 445
 Asn Gln His Thr Ile Asp Leu Thr Asp Ser Glu Met Asn Lys Leu Phe
 450 455 460
 Glu Arg Thr Arg Lys Gln Leu Arg Glu Asn Ala Glu Asp Met Gly Asn
 465 470 475 480
 Gly Cys Phe Lys Ile Tyr His Lys Cys Asp Asn Ala Cys Ile Gly Ser
 485 490 495
 Ile Arg Asn Gly Thr Tyr Asp His Asp Val Tyr Arg Asp Glu Ala Leu
 500 505 510
 Asn Asn Arg Phe Gln Ile Lys Gly Val Glu Leu Lys Ser Gly Tyr Lys
 515 520 525
 Asp Trp Ile Leu Trp Ile Ser Phe Ala Ile Ser Cys Phe Leu Leu Cys
 530 535 540

Val Val Leu Leu Gly Phe Ile Met Trp Ala Cys Gln Lys Gly Asn Ile
 545 550 555 560

Arg Cys Asn Ile Cys Ile
 565

<210> 132
 <211> 566
 <212> PRT
 <213> Influenza A virus

<400> 132

Met Lys Thr Ile Ile Ala Leu Ser Tyr Ile Leu Cys Leu Val Phe Ala
 1 5 10 15

Gln Lys Leu Pro Gly Asn Asp Asn Ser Thr Ala Thr Leu Cys Leu Gly
 20 25 30

His His Ala Val Pro Asn Gly Thr Leu Val Lys Thr Ile Thr Asn Asp
 35 40 45

Gln Ile Glu Val Thr Asn Ala Thr Glu Leu Val Gln Ser Ser Ser Thr
 50 55 60

Gly Arg Ile Cys Asp Ser Pro His Arg Ile Leu Asp Gly Lys Asn Cys
 65 70 75 80

Thr Leu Ile Asp Ala Leu Leu Gly Asp Pro His Cys Asp Gly Phe Gln
 85 90 95

Asn Lys Glu Trp Asp Leu Phe Val Glu Arg Ser Lys Ala Tyr Ser Asn
 100 105 110

Cys Tyr Pro Tyr Asp Val Pro Asp Tyr Ala Ser Leu Arg Ser Leu Val
 115 120 125

Ala Ser Ser Gly Thr Leu Glu Phe Thr Asn Glu Gly Phe Asn Trp Thr
 130 135 140

Gly Val Ala Gln Asp Gly Lys Ser Tyr Ala Cys Lys Arg Gly Ser Val
 145 150 155 160

Asn Ser Phe Phe Ser Arg Leu Asn Trp Leu His Lys Leu Glu Tyr Lys
 165 170 175

Tyr Pro Ala Leu Asn Val Thr Met Pro Asn Asn Asp Lys Phe Asp Lys
 180 185 190

Leu Tyr Ile Trp Gly Val His His Pro Ser Thr Asp Ser Asp Gln Thr
 195 200 205

381698_1.TXT

Ser Leu Tyr Val Gln Ala Ser Gly Arg Val Thr Val Ser Thr Lys Arg
 210 215 220
 Ser Gln Gln Thr Val Ile Pro Asn Ile Gly Ser Arg Pro Trp Val Arg
 225 230 235 240
 Gly Ile Ser Ser Arg Ile Ser Ile Tyr Trp Thr Ile Val Lys Pro Gly
 245 250 255
 Asp Ile Leu Leu Ile Asn Ser Thr Gly Asn Leu Ile Ala Pro Arg Gly
 260 265 270
 Tyr Phe Lys Ile Arg Asn Gly Lys Ser Ser Ile Met Arg Ser Asp Ala
 275 280 285
 Pro Ile Asp Asn Cys Asn Ser Glu Cys Val Thr Pro Asn Gly Ser Ile
 290 295 300
 Pro Asn Asp Lys Pro Phe Gln Asn Val Asn Arg Ile Thr Tyr Gly Ala
 305 310 315 320
 Cys Pro Arg Tyr Val Lys Gln Asn Thr Leu Lys Leu Ala Thr Gly Met
 325 330 335
 Arg Asn Val Pro Glu Lys Gln Thr Arg Gly Ile Phe Gly Ala Ile Ala
 340 345 350
 Gly Phe Ile Glu Asn Gly Trp Glu Gly Met Val Asp Gly Trp Tyr Gly
 355 360 365
 Phe Arg His Gln Asn Ser Glu Gly Thr Gly Gln Ala Ala Asp Leu Lys
 370 375 380
 Ser Thr Gln Ala Ala Ile Asn Gln Ile Asn Gly Lys Leu Asn Arg Leu
 385 390 395 400
 Ile Glu Lys Thr Asn Glu Lys Phe His Gln Ile Glu Lys Glu Phe Ser
 405 410 415
 Glu Val Glu Gly Arg Ile Gln Asp Leu Glu Lys Tyr Val Glu Asp Thr
 420 425 430
 Lys Ile Asp Leu Trp Ser Tyr Asn Ala Glu Leu Leu Val Ala Leu Glu
 435 440 445
 Asn Gln His Thr Ile Asp Leu Thr Asp Ser Glu Met Asn Lys Leu Phe
 450 455 460
 Glu Arg Thr Arg Lys Gln Leu Arg Glu Asn Ala Glu Asp Met Gly Asn
 465 470 475 480

381698_1.TXT

Gly Cys Phe Lys Ile Tyr His Lys Cys Asp Asn Ala Cys Ile Gly Ser
485 490 495

Ile Arg Asn Gly Thr Tyr Asn His Asp Val Tyr Arg Asp Glu Ala Leu
500 505 510

Asn Asn Arg Phe Gln Ile Lys Gly Val Glu Leu Lys Ser Gly Tyr Lys
515 520 525

Asp Trp Ile Leu Trp Ile Ser Phe Ala Ile Ser Cys Phe Leu Leu Cys
530 535 540

Val Val Leu Leu Gly Phe Ile Met Trp Ala Cys Gln Lys Gly Asn Ile
545 550 555 560

Arg Cys Asn Ile Cys Ile
565

<210> 133
<211> 566
<212> PRT
<213> Influenza A virus

<220>
<221> misc_feature
<222> (318)..(318)
<223> Xaa can be any naturally occurring amino acid

<400> 133

Met Lys Thr Ile Ile Ala Leu Ser Tyr Ile Phe Cys Leu Val Leu Gly
1 5 10 15

Gln Asp Phe Pro Gly Asn Asp Asn Ser Thr Ala Thr Leu Cys Leu Gly
20 25 30

His His Ala Val Pro Asn Gly Thr Leu Val Lys Thr Ile Thr Asn Asp
35 40 45

Gln Ile Glu Val Thr Asn Ala Thr Glu Leu Val Gln Ser Ser Ser Thr
50 55 60

Gly Lys Ile Cys Asn Asn Pro His Arg Ile Leu Asp Gly Ile Asp Cys
65 70 75 80

Thr Leu Ile Asp Ala Leu Leu Gly Asp Pro His Cys Asp Gly Phe Gln
85 90 95

Asn Glu Thr Trp Asp Leu Phe Val Glu Arg Ser Lys Ala Phe Ser Asn
100 105 110

Cys Tyr Pro Tyr Asp Val Pro Asp Tyr Ala Ser Leu Arg Ser Leu Val
115 120 125

381698_1.TXT

Ala Ser Ser Gly Thr Leu Glu Phe Ile Ser Glu Gly Phe Thr Trp Thr
130 135 140

Gly Val Thr Gln Asn Gly Gly Ser Asn Ala Cys Lys Arg Gly Pro Asp
145 150 155 160

Ser Gly Phe Phe Ser Arg Leu Asn Trp Leu Tyr Lys Ser Gly Ser Thr
165 170 175

Tyr Pro Val Leu Asn Val Thr Met Pro Asn Asn Asp Asn Phe Asp Lys
180 185 190

Leu Tyr Ile Trp Gly Val His His Pro Ser Thr Asp Gln Glu Gln Thr
195 200 205

Ser Leu Tyr Val Gln Ala Ser Gly Arg Val Thr Val Ser Thr Lys Arg
210 215 220

Ser Gln Gln Thr Ile Ile Pro Asn Ile Gly Ser Arg Pro Trp Val Arg
225 230 235 240

Gly Leu Ser Ser Arg Ile Ser Ile Tyr Trp Thr Ile Val Lys Pro Gly
245 250 255

Asp Ile Leu Val Ile Asn Ser Asn Gly Asn Leu Ile Ala Pro Arg Gly
260 265 270

Tyr Phe Lys Met Arg Thr Gly Lys Ser Ser Ile Met Arg Ser Asp Ala
275 280 285

Pro Ile Gly Thr Cys Ile Ser Glu Cys Ile Thr Pro Asn Gly Ser Ile
290 295 300

Pro Asn Asp Lys Pro Phe Gln Asn Val Asn Lys Ile Thr Xaa Gly Ala
305 310 315 320

Cys Pro Lys Tyr Val Lys Gln Asn Thr Leu Lys Leu Ala Thr Gly Met
325 330 335

Arg Asn Val Pro Glu Lys Gln Thr Arg Gly Leu Phe Ser Ala Ile Ala
340 345 350

Gly Phe Ile Glu Asn Gly Trp Glu Gly Met Ile Asp Gly Trp Tyr Gly
355 360 365

Phe Arg His Gln Asn Ser Glu Gly Thr Gly Gln Pro Ala Asp Leu Lys
370 375 380

Ser Thr Gln Ala Ala Ile Asp Gln Ile Asn Gly Lys Leu Asn Arg Val
385 390 395 400

381698_1.TXT

Ile Glu Lys Thr Asn Glu Lys Phe His Gln Ile Glu Lys Glu Phe Ser
405 410 415

Glu Val Glu Gly Arg Ile Gln Asp Leu Glu Lys Tyr Val Glu Asp Thr
420 425 430

Lys Ile Asp Leu Trp Ser Tyr Asn Ala Glu Leu Leu Val Ala Leu Glu
435 440 445

Asn Gln His Thr Ile Asp Leu Thr Asp Ser Glu Met Asn Lys Leu Phe
450 455 460

Glu Lys Thr Ser Arg Gln Leu Arg Glu Asn Ala Glu Asp Met Gly Asn
465 470 475 480

Gly Cys Phe Lys Ile Tyr His Lys Cys Asp Asn Ala Cys Ile Gly Ser
485 490 495

Ile Arg Asn Gly Thr Tyr Asp His Asp Val Tyr Arg Asp Glu Ala Leu
500 505 510

Asn Asn Arg Phe Gln Ile Lys Gly Val Glu Leu Lys Ser Gly Tyr Lys
515 520 525

Asp Trp Ile Leu Trp Ile Ser Phe Ala Ile Ser Cys Phe Leu Leu Cys
530 535 540

Val Val Leu Leu Gly Phe Ile Met Thr Ala Cys Gln Lys Gly Asn Ile
545 550 555 560

Arg Cys Asn Ile Cys Ile
565

<210> 134
<211> 392
<212> PRT
<213> Polyomavirus sp

<400> 134

Met Ala Pro Lys Arg Lys Ser Gly Val Ser Lys Cys Glu Thr Lys Cys
1 5 10 15

Thr Lys Ala Cys Pro Arg Pro Ala Pro Val Pro Lys Leu Leu Ile Lys
20 25 30

Gly Gly Met Glu Val Leu Asp Leu Val Thr Gly Pro Asp Ser Val Thr
35 40 45

Glu Ile Glu Ala Phe Leu Asn Pro Arg Met Gly Gln Pro Pro Thr Pro
50 55 60

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

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Leu Phe Asn Asn Met Leu Pro Gln Val Gln Gly Gln Pro Met Glu Gly
340 345 350

Glu Asn Thr Gln Val Glu Glu Val Arg Val Tyr Asp Gly Thr Glu Pro
355 360 365

Val Pro Gly Asp Pro Asp Met Thr Arg Tyr Val Asp Arg Phe Gly Lys
370 375 380

Thr Lys Thr Val Phe Pro Gly Asn
385 390

<210> 135
<211> 402
<212> PRT
<213> Polyomavirus sp

<400> 135

Met Ala Pro Lys Arg Lys Ser Gly Val Ser Lys Cys Glu Thr Lys Cys
1 5 10 15

Thr Lys Ala Cys Pro Arg Pro Ala Pro Val Pro Lys Leu Leu Ile Lys
20 25 30

Gly Gly Met Glu Val Leu Asp Leu Val Thr Gly Pro Asp Ser Val Thr
35 40 45

Glu Ile Glu Ala Phe Leu Asn Pro Arg Met Gly Gln Pro Pro Thr Pro
50 55 60

Glu Ser Leu Thr Glu Gly Gly Gln Tyr Tyr Gly Trp Ser Arg Gly Ile
65 70 75 80

Asn Leu Ala Thr Ser Ala Pro Ser Thr Asn Gln Glu Gln Thr Ser Leu
85 90 95

Tyr Val Gln Ala Ser Gly Arg Gly Thr Glu Asp Ser Pro Gly Asn Asn
100 105 110

Thr Leu Pro Thr Trp Ser Met Ala Lys Leu Gln Leu Pro Met Leu Asn
115 120 125

Glu Asp Leu Thr Cys Asp Thr Leu Gln Met Trp Glu Ala Val Ser Val
130 135 140

Lys Thr Glu Val Val Gly Ser Gly Ser Leu Leu Asp Val His Gly Phe
145 150 155 160

Asn Lys Pro Thr Asp Thr Val Asn Thr Lys Gly Ile Ser Thr Pro Val
165 170 175

381698_1.TXT

Glu Gly Ser Gln Tyr His Val Phe Ala Val Gly Gly Glu Pro Leu Asp
180 185 190

Leu Gln Gly Leu Val Thr Asp Ala Arg Thr Lys Tyr Lys Glu Glu Gly
195 200 205

Val Val Thr Ile Lys Thr Ile Thr Lys Lys Asp Met Val Asn Lys Asp
210 215 220

Gln Val Leu Asn Pro Ile Ser Lys Ala Lys Leu Asp Lys Asp Gly Met
225 230 235 240

Tyr Pro Val Glu Ile Trp His Pro Asp Pro Ala Lys Asn Glu Asn Thr
245 250 255

Arg Tyr Phe Gly Asn Tyr Thr Gly Gly Thr Thr Thr Pro Pro Val Leu
260 265 270

Gln Phe Thr Asn Thr Leu Thr Thr Val Leu Leu Asp Glu Asn Gly Val
275 280 285

Gly Pro Leu Cys Lys Gly Glu Gly Leu Tyr Leu Ser Cys Val Asp Ile
290 295 300

Met Gly Trp Arg Val Thr Arg Asn Tyr Asp Val His His Trp Arg Gly
305 310 315 320

Leu Pro Arg Tyr Phe Lys Ile Thr Leu Arg Lys Arg Trp Val Lys Asn
325 330 335

Pro Tyr Pro Met Ala Ser Leu Ile Ser Ser Leu Phe Asn Asn Met Leu
340 345 350

Pro Gln Val Gln Gly Gln Pro Met Glu Gly Glu Asn Thr Gln Val Glu
355 360 365

Glu Val Arg Val Tyr Asp Gly Thr Glu Pro Val Pro Gly Asp Pro Asp
370 375 380

Met Thr Arg Tyr Val Asp Arg Phe Gly Lys Thr Lys Thr Val Phe Pro
385 390 395 400

Gly Asn

<210> 136

<211> 392

<212> PRT

<213> Polyomavirus sp

<400> 136

Met Ala Pro Lys Arg Lys Ser Gly Val Ser Lys Cys Glu Thr Lys Cys

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1              5              10              15
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Gly Gly Met Glu Val Leu Asp Leu Val Thr Gly Pro Asp Ser Val Thr
      35      40      45
Glu Ile Glu Ala Phe Leu Asn Pro Arg Met Gly Gln Pro Pro Thr Pro
      50      55      60
Glu Ser Leu Thr Glu Gly Gly Gln Tyr Tyr Gly Trp Ser Arg Gly Ile
      65      70      75      80
Asn Leu Ala Thr Ser Asp Thr Glu Asp Ser Pro Gly Asn Asn Thr Leu
      85      90      95
Pro Thr Trp Ser Met Ala Lys Leu Gln Leu Pro Met Leu Asn Glu Asp
      100      105      110
Leu Thr Cys Asp Thr Leu Gln Met Trp Glu Ala Val Ser Val Lys Thr
      115      120      125
Glu Val Val Gly Ser Gly Ser Leu Leu Asp Val His Gly Phe Asn Lys
      130      135      140
Pro Thr Asp Thr Val Asn Thr Lys Gly Ile Ser Thr Pro Val Glu Gly
      145      150      155      160
Ser Gln Tyr His Val Phe Ala Val Gly Gly Glu Pro Leu Asp Leu Gln
      165      170      175
Gly Leu Val Thr Asp Ala Arg Thr Lys Tyr Lys Glu Glu Gly Val Val
      180      185      190
Thr Ile Lys Thr Ile Thr Lys Lys Asp Met Val Asn Lys Asp Gln Val
      195      200      205
Leu Asn Pro Ile Ser Lys Ala Lys Leu Asp Lys Asp Gly Met Tyr Pro
      210      215      220
Val Glu Ile Trp His Pro Asp Pro Ala Lys Asn Glu Asn Thr Arg Tyr
      225      230      235      240
Phe Gly Asn Tyr Thr Gly Gly Thr Thr Thr Pro Pro Val Leu Gln Phe
      245      250      255
Thr Asn Thr Leu Thr Thr Val Leu Leu Asp Glu Asn Gly Val Gly Pro
      260      265      270
Leu Cys Lys Gly Glu Gly Leu Tyr Leu Ser Cys Val Asp Ile Met Gly

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275

280

285

Trp Arg Val Thr Arg Ser Lys Arg Gly Pro Gly Ser Gly Ala Tyr Asp
 290 295 300

Val His His Trp Arg Gly Leu Pro Arg Tyr Phe Lys Ile Thr Leu Arg
 305 310 315 320

Lys Arg Trp Val Lys Asn Pro Tyr Pro Met Ala Ser Leu Ile Ser Ser
 325 330 335

Leu Phe Asn Asn Met Leu Pro Gln Val Gln Gly Gln Pro Met Glu Gly
 340 345 350

Glu Asn Thr Gln Val Glu Glu Val Arg Val Tyr Asp Gly Thr Glu Pro
 355 360 365

Val Pro Gly Asp Pro Asp Met Thr Arg Tyr Val Asp Arg Phe Gly Lys
 370 375 380

Thr Lys Thr Val Phe Pro Gly Asn
 385 390

<210> 137

<211> 402

<212> PRT

<213> Polyomavirus sp

<400> 137

Met Ala Pro Lys Arg Lys Ser Gly Val Ser Lys Cys Glu Thr Lys Cys
 1 5 10 15

Thr Lys Ala Cys Pro Arg Pro Ala Pro Val Pro Lys Leu Leu Ile Lys
 20 25 30

Gly Gly Met Glu Val Leu Asp Leu Val Thr Gly Pro Asp Ser Val Thr
 35 40 45

Glu Ile Glu Ala Phe Leu Asn Pro Arg Met Gly Gln Pro Pro Thr Pro
 50 55 60

Glu Ser Leu Thr Glu Gly Gly Gln Tyr Tyr Gly Trp Ser Arg Gly Ile
 65 70 75 80

Asn Leu Ala Thr Ser Asp Thr Glu Asp Ser Pro Gly Asn Asn Thr Leu
 85 90 95

Pro Thr Trp Ser Met Ala Lys Leu Gln Leu Pro Met Leu Asn Glu Asp
 100 105 110

Leu Thr Cys Asp Thr Leu Gln Met Trp Glu Ala Val Ser Val Lys Thr
 115 120 125

381698_1.TXT

Glu Val Val Gly Ser Gly Ser Leu Leu Asp Val His Gly Phe Asn Lys
 130 135 140
 Pro Thr Asp Thr Val Asn Thr Lys Gly Ile Ser Thr Pro Val Glu Gly
 145 150 155 160
 Ser Gln Tyr His Val Phe Ala Val Gly Gly Glu Pro Leu Asp Leu Gln
 165 170 175
 Gly Leu Val Thr Asp Ala Arg Thr Lys Tyr Lys Glu Glu Gly Val Val
 180 185 190
 Thr Ile Lys Thr Ile Thr Lys Lys Asp Met Val Asn Lys Asp Gln Val
 195 200 205
 Leu Asn Pro Ile Ser Lys Ala Lys Leu Asp Lys Asp Gly Met Tyr Pro
 210 215 220
 Val Glu Ile Trp His Pro Asp Pro Ala Lys Asn Glu Asn Thr Arg Tyr
 225 230 235 240
 Phe Gly Asn Tyr Thr Gly Gly Thr Thr Thr Pro Pro Val Leu Gln Phe
 245 250 255
 Thr Asn Thr Leu Thr Thr Val Leu Leu Asp Glu Asn Gly Val Gly Pro
 260 265 270
 Leu Cys Lys Gly Glu Gly Leu Tyr Leu Ser Cys Val Asp Ile Met Gly
 275 280 285
 Trp Arg Val Thr Arg Ser Pro Ser Thr Asn Gln Glu Gln Thr Ser Leu
 290 295 300
 Tyr Val Gln Ala Ser Gly Arg Ala Tyr Asp Val His His Trp Arg Gly
 305 310 315 320
 Leu Pro Arg Tyr Phe Lys Ile Thr Leu Arg Lys Arg Trp Val Lys Asn
 325 330 335
 Pro Tyr Pro Met Ala Ser Leu Ile Ser Ser Leu Phe Asn Asn Met Leu
 340 345 350
 Pro Gln Val Gln Gly Gln Pro Met Glu Gly Glu Asn Thr Gln Val Glu
 355 360 365
 Glu Val Arg Val Tyr Asp Gly Thr Glu Pro Val Pro Gly Asp Pro Asp
 370 375 380
 Met Thr Arg Tyr Val Asp Arg Phe Gly Lys Thr Lys Thr Val Phe Pro
 385 390 395 400

Gly Asn

<210> 138

<211> 392

<212> PRT

<213> Polyomavirus sp

<400> 138

Met Ala Pro Lys Arg Lys Ser Gly Val Ser Lys Cys Glu Thr Lys Cys
1 5 10 15

Thr Lys Ala Cys Pro Arg Pro Ala Pro Val Pro Lys Leu Leu Ile Lys
20 25 30

Gly Gly Met Glu Val Leu Asp Leu Val Thr Gly Pro Asp Ser Val Thr
35 40 45

Glu Ile Glu Ala Phe Leu Asn Pro Arg Met Gly Gln Pro Pro Thr Pro
50 55 60

Glu Ser Leu Thr Glu Gly Gly Gln Tyr Tyr Gly Trp Ser Arg Gly Ile
65 70 75 80

Asn Leu Ala Thr Ser Asp Thr Glu Asp Ser Pro Gly Asn Asn Thr Leu
85 90 95

Pro Thr Trp Ser Met Ala Lys Leu Gln Leu Pro Met Leu Asn Glu Asp
100 105 110

Leu Thr Cys Asp Thr Leu Gln Met Trp Glu Ala Val Ser Val Lys Thr
115 120 125

Glu Val Val Gly Ser Gly Ser Leu Leu Asp Val His Gly Phe Asn Lys
130 135 140

Pro Thr Asp Thr Val Asn Thr Lys Gly Ile Ser Thr Pro Val Glu Gly
145 150 155 160

Ser Gln Tyr His Val Phe Ala Val Gly Gly Glu Pro Leu Asp Leu Gln
165 170 175

Gly Leu Val Thr Asp Ala Arg Thr Lys Tyr Lys Glu Glu Gly Val Val
180 185 190

Thr Ile Lys Thr Ile Thr Lys Lys Asp Met Val Asn Lys Asp Gln Val
195 200 205

Leu Asn Pro Ile Ser Lys Ala Lys Leu Asp Lys Asp Gly Met Tyr Pro
210 215 220

381698_1.TXT

Val Glu Ile Trp His Pro Asp Pro Ala Lys Asn Glu Asn Thr Arg Tyr
225 230 235 240

Phe Gly Asn Tyr Thr Gly Gly Thr Thr Thr Pro Pro Val Leu Gln Phe
245 250 255

Thr Asn Thr Leu Thr Thr Val Leu Leu Asp Glu Asn Gly Val Gly Pro
260 265 270

Leu Cys Lys Gly Glu Gly Leu Tyr Leu Ser Cys Val Asp Ile Met Gly
275 280 285

Trp Arg Val Thr Arg Ser Pro Tyr Asn Gly Lys Ser Ser Ala Tyr Asp
290 295 300

Val His His Trp Arg Gly Leu Pro Arg Tyr Phe Lys Ile Thr Leu Arg
305 310 315 320

Lys Arg Trp Val Lys Asn Pro Tyr Pro Met Ala Ser Leu Ile Ser Ser
325 330 335

Leu Phe Asn Asn Met Leu Pro Gln Val Gln Gly Gln Pro Met Glu Gly
340 345 350

Glu Asn Thr Gln Val Glu Glu Val Arg Val Tyr Asp Gly Thr Glu Pro
355 360 365

Val Pro Gly Asp Pro Asp Met Thr Arg Tyr Val Asp Arg Phe Gly Lys
370 375 380

Thr Lys Thr Val Phe Pro Gly Asn
385 390

<210> 139
<211> 402
<212> PRT
<213> Polyomavirus sp

<400> 139

Glu Ala Phe Leu Asn Pro Arg Met Gly Gln Pro Pro Thr Pro Glu Ser
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Leu Thr Glu Gly Gly Gln Tyr Tyr Gly Trp Ser Arg Gly Ile Asn Leu
20 25 30

Ala Thr Ser Asp Thr Glu Asp Ser Pro Gly Asn Asn Thr Leu Pro Thr
35 40 45

Trp Ser Met Ala Lys Leu Gln Leu Pro Met Leu Asn Glu Asp Leu Thr
50 55 60

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

Arg Tyr Val Asp Arg Phe Gly Lys Thr Lys Thr Val Phe Pro Gly Asn
340 345 350

Met Ala Pro Lys Arg Lys Ser Gly Val Ser Lys Cys Glu Thr Lys Cys
355 360 365

Thr Lys Ala Cys Pro Arg Pro Ala Pro Val Pro Lys Leu Leu Ile Lys
370 375 380

Gly Gly Met Glu Val Leu Asp Leu Val Thr Gly Pro Asp Ser Val Thr
385 390 395 400

Glu Ile

<210> 140
<211> 408
<212> PRT
<213> Polyomavirus sp

<400> 140

Met Ala Pro Lys Arg Lys Ser Gly Val Ser Lys Cys Glu Thr Lys Cys
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Thr Lys Ala Cys Pro Arg Pro Ala Pro Val Pro Lys Leu Leu Ile Lys
20 25 30

Gly Gly Met Glu Val Leu Asp Leu Val Thr Gly Pro Asp Ser Val Thr
35 40 45

Glu Ile Glu Ala Phe Leu Asn Pro Arg Met Gly Gln Pro Pro Thr Pro
50 55 60

Glu Ser Leu Thr Glu Gly Gly Gln Tyr Tyr Gly Trp Ser Arg Gly Ile
65 70 75 80

Asn Leu Ala Thr Ser Asp Thr Glu Asp Ser Pro Gly Asn Asn Thr Leu
85 90 95

Pro Thr Trp Ser Met Ala Lys Leu Gln Leu Pro Met Leu Asn Glu Asp
100 105 110

Leu Thr Cys Asp Thr Leu Gln Met Trp Glu Ala Val Ser Val Lys Thr
115 120 125

Glu Val Val Gly Ser Gly Ser Leu Leu Asp Val His Gly Phe Asn Lys
130 135 140

Pro Thr Asp Thr Val Asn Thr Lys Gly Ile Ser Thr Pro Val Glu Gly
145 150 155 160

Ser Gln Tyr His Val Phe Ala Val Gly Gly Glu Pro Leu Asp Leu Gln
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165

170

175

Gly Leu Val Thr Asp Ala Arg Thr Lys Tyr Lys Glu Glu Gly Val Val
 180 185 190

Thr Ile Lys Thr Ile Thr Lys Lys Asp Met Val Asn Lys Asp Gln Val
 195 200 205

Leu Asn Pro Ile Ser Lys Ala Lys Leu Asp Lys Asp Gly Met Tyr Pro
 210 215 220

Val Glu Ile Trp His Pro Asp Pro Ala Lys Asn Glu Asn Thr Arg Tyr
 225 230 235 240

Phe Gly Asn Tyr Thr Gly Gly Thr Thr Thr Pro Pro Val Leu Gln Phe
 245 250 255

Thr Asn Thr Leu Thr Thr Val Leu Leu Asp Glu Asn Gly Val Gly Pro
 260 265 270

Leu Cys Lys Gly Glu Gly Leu Tyr Leu Ser Cys Val Asp Ile Met Gly
 275 280 285

Trp Arg Val Thr Arg Ser Ser Leu Leu Thr Glu Val Glu Thr Pro Ile
 290 295 300

Arg Asn Glu Trp Gly Cys Arg Cys Asn Asp Ser Ser Asp Ala Tyr Asp
 305 310 315 320

Val His His Trp Arg Gly Leu Pro Arg Tyr Phe Lys Ile Thr Leu Arg
 325 330 335

Lys Arg Trp Val Lys Asn Pro Tyr Pro Met Ala Ser Leu Ile Ser Ser
 340 345 350

Leu Phe Asn Asn Met Leu Pro Gln Val Gln Gly Gln Pro Met Glu Gly
 355 360 365

Glu Asn Thr Gln Val Glu Glu Val Arg Val Tyr Asp Gly Thr Glu Pro
 370 375 380

Val Pro Gly Asp Pro Asp Met Thr Arg Tyr Val Asp Arg Phe Gly Lys
 385 390 395 400

Thr Lys Thr Val Phe Pro Gly Asn
 405

<210> 141

<211> 9

<212> PRT

<213> Nocardia aerocolonigenes

<400> 141

Leu Ala Thr Ser Ala Gly Thr Glu Asp
 1 5

<210> 142

<211> 3

<212> PRT

<213> Pseudomonas sp

<400> 142

Gly Thr Thr
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<210> 143

<211> 4

<212> PRT

<213> Pseudomonas sp.

<400> 143

Gly Thr His Val
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<210> 144

<211> 6

<212> PRT

<213> Alcaligenes faecalis

<400> 144

Thr Arg Asn Tyr Asp Val
 1 5

<210> 145

<211> 7

<212> PRT

<213> Alcaligenes faecalis

<400> 145

Thr Arg Ser Ala Tyr Asp Val
 1 5