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SIMIAN ADENOVIRUS NUCLEIC ACID- AND AMINO ACID-SEQUENCES, VECTORS CONTAINING SAME, AND USES THEREOF

The present invention relates to novel adenovirus strains with an improved seroprevalence. In one aspect, the present invention relates to isolated polypeptides of adenoviral capsid proteins such as hexon, penton and fiber protein and fragments thereof and polynucleotides encoding the same. Also provided is a vector comprising the isolated polynucleotide according to the invention and adenoviruses comprising the isolated polynucleotides or polypeptides according to the invention and a pharmaceutical composition comprising said vector, adenovirus, polypeptide and/or polynucleotide. The invention also relates to the use of the isolated polynucleotides, the isolated polypeptides, the vector, the adenoviruses and/or the pharmaceutical composition for the therapy or prophylaxis of a disease.

BACKGROUND OF THE INVENTION

The adenoviruses (Ads) comprise a large family of double-stranded DNA viruses found in amphibians, avians, and mammals which have a nonenveloped icosahedral capsid structure (Straus, Adenovirus infections in humans; *The Adenoviruses*, 451-498, 1984; Hierholzer etal.,J. Infect.Dis.,158 : 804-813,1988; Schnurr and Dondero, *Intervirology*., 36: 79-83,1993 ; Jong et al., *J. Clin. Microbiol*., 37 : 3940-3945: 1999). In contrast to retroviruses, adenoviruses can transduce numerous cell types of several mammalian species, including both dividing and nondividing cells, without integrating into the genome of the host cell.

Generally speaking, adenoviral DNA is typically very stable and remains episomal (e. g., extrachromosomal), unless transformation or tumorigenesis has occurred. In addition, adenoviral vectors can be propagated to high yields in well-defined production systems which are readily amenable to pharmaceutical scale production of clinical grade compositions. These characteristics and their well-characterized molecular genetics make recombinant adenoviral vectors good candidates for use as vaccine carriers. The production of recombinant adenoviral vectors may rely on the use of a packaging cell line which is capable of complementing the functions of adenoviral gene products that have been either deleted or engineered to be nonfunctional.

Presently, two well-characterized human subgroup C adenovirus serotypes (i. e., hAd2 and hAd5) are widely used as the sources of the viral backbone for most of the adenoviral vectors that are used for gene therapy. Replication-defective human adenoviral vectors have also

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been tested as vaccine carriers for the delivery of a variety of immunogens derived from a variety of infectious agents. Studies conducted in experimental animals (e. g. rodents, canines and nonhuman primates) indicate that recombinant replication-defective human adenoviral vectors carrying transgenes encoding immunogens as well as other antigens elicit both humoral and cell-mediated immune responses against the transgene product. Generally speaking, investigators have reported success using human adenoviral vectors as vaccine carriers in nonhuman experimental systems by either using immunization protocols that utilizes high doses of recombinant adenoviral vectors that are predicted to elicit immune responses; or by using immunization protocols which employ the sequential administration of adenoviral vectors that are derived from different serotypes but which carry the same transgene product as boosting immunizations (Mastrangeli, et. al., Human Gene Therapy, 7: 79-87 (1996).

Viral vectors based on human adenovirus type 5 (Ad5) have been developed for different gene therapy and vaccine applications. Although Ad5-based vectors are extremely efficient in animal models, the presence of a pre-existing immunity in humans against Ad5 wild type virus has been demonstrated in clinical trials to reduce the efficiency of gene transduction. In particular, a clear reduction of the immunization efficiency was demonstrated in subjects with titers of neutralizing antibodies over 200 enrolled in vaccine clinical trial based on Ad5 vectors. The most extensive characterization of an Ad5 vectored vaccine was obtained in the HIV vaccine STEP trial conducted by Merck (Moore JP et al. Science. 2008 May 9; 320(5877):753-5). The vaccine study was based on the co-injection of 3 Ad5 vectors expressing different HIV antigens as proof of concept study in subjects with high risk of HIV infection. Surprisingly, the data revealed an increase of HIV infection rate in vaccinated subjects with anti-Ad5 pre-existing immunity rather then a protective effect. Although the mechanism of this paradoxical observation is not clear yet, the results raised additional questions on the safety and efficiency of vectors based on adenovirus of human origin for vaccine application in healthy subjects. Taken together all results obtained so far in different vaccine and gene therapy clinical trials such as the trials with Ad5 vectors increased the need for an adenovirus characterized in a very low or absent pre-existing immunity in humans.

SUMMARY OF THE INVENTION

In a first aspect the present invention provides an isolated polynucleotide that encodes an adenoviral fiber protein or a functional derivative thereof and that is selected from the group consisting of:

(a) a polynucleotide encoding a polypeptide having the amino acid sequence according to any of SEQ ID NOs: 14-19, 50 and 53;

(b) a polynucleotide encoding the functional derivative of a polypeptide according to any of SEQ ID NOs: 14-19, 50 and 53, wherein said functional derivative comprises the deletion, insertion and/or substitution of one or more amino acid residues; and

(c) a polynucleotide encoding a functional derivative having an amino acid sequence which is at least 85% identical over its entire length to the amino acid sequence of any of SEQ ID NOs: 14-19, 50 and 53.

In a further aspect the present invention relates to an isolated polynucleotide that encodes an adenoviral hexon protein or a functional derivative thereof and that is selected from the group consisting of:

(a) a polynucleotide encoding a polypeptide having the amino acid sequence according to any of SEQ ID NOs: 20-25, 51 and 54;

(b) a polynucleotide encoding the functional derivative of a polypeptide according to any of SEQ ID NOs: 20-25, 51 and 54, wherein said functional derivative comprises the deletion, insertion and/or substitution of one or more amino acid residues; and

(c) a polynucleotide encoding a functional derivative having an amino acid sequence which is at least 95% identical over its entire length to the amino acid sequence of any of SEQ ID NOs: 20-25, 51 and 54.

Also provided is an isolated polynucleotide that encodes an adenoviral penton protein or a functional derivative thereof and that is selected from the group consisting of:

(a) a polynucleotide encoding a polypeptide having the amino acid sequence according to any of SEQ ID NOs: 26-31, 52 and 55;

(b) a polynucleotide encoding the functional derivative of a polypeptide according to any of SEQ ID NOs: 26-31, 52 and 55, wherein said functional derivative comprises the deletion, insertion and/or substitution of one or more amino acid residues; and

(c) a polynucleotide encoding a functional derivative having an amino acid sequence which is at least 85% identical over its entire length to the amino acid sequence of any of SEQ ID NOs: 26-31, 52 and 55.

The invention also relates to a polynucleotide comprising at least one of the isolated polynucleotide according to the invention as outlined above. The invention further provides an isolated adenoviral capsid polypeptide encoded by the isolated polynucleotide according to the invention or a functional derivative thereof.

In a further aspect the invention provides a vector comprising the isolated polynucleotide according to the invention.

Also provided is a recombinant adenovirus, preferably a replication-incompetent adenovirus, comprising an isolated polynucleotide according to the invention and/or at least one isolated adenoviral capsid polypeptide according to the invention.

A further aspect of the invention is a composition comprising an adjuvant and at least one of the following (i) through (iv):

(i) one or more isolated adenoviral capsid polypeptides according to the invention;

(ii) an isolated polynucleotide according to the invention;

(iii) a vector according to the invention;

(iv) a recombinant adenovirus according to the invention;

and, optionally, a pharmaceutically acceptable excipient.

The invention further relates to a cell comprising at least one of the following:

(i) one or more isolated adenoviral capsid polypeptides according to the invention;

(ii) an isolated polynucleotide according to the invention;

(iii) a vector according to the invention;

(iv) a recombinant adenovirus according to the invention.

A further aspect of the invention relates to the use of an isolated adenoviral capsid polypeptide according to the invention; an isolated polynucleotide according to the invention; a vector according to the invention; a recombinant adenovirus according to the invention; and/or the composition according to the invention for the therapy or prophylaxis of a disease.

DETAILED DESCRIPTION OF THE INVENTION

Before the present invention is described in detail below, it is to be understood that this invention is not limited to the particular methodology, protocols and reagents described herein as these may vary. It is also to be understood that the terminology used herein is for the purpose of describing particular embodiments only, and is not intended to limit the scope of the present invention which will be limited only by the appended claims. Unless defined otherwise, all technical and scientific terms used herein have the same meanings as commonly understood by one of ordinary skill in the art.

Preferably, the terms used herein are defined as described in "A multilingual glossary of biotechnological terms: (IUPAC Recommendations)", Leuenberger, H.G.W, Nagel, B. and Klbl, H. eds. (1995), Helvetica Chimica Acta, CH-4010 Basel, Switzerland) and as described in "Pharmaceutical Substances: Syntheses, Patents, Applications" by Axel Kleemann and Jurgen Engel, Thieme Medical Publishing, 1999; the "Merck Index: An Encyclopedia of Chemicals, Drugs, and Biologicals", edited by Susan Budavari et al., CRC Press, 1996, and the United States

Pharmacopeia-25/National Formulary-20, published by the United States Pharmcopeial Convention, Inc., Rockville Md., 2001.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated feature, integer or step or group of features, integers or steps but not the exclusion of any other feature, integer or step or group of integers or steps. In the following passages different aspects of the invention are defined in more detail. Each aspect so defined may be combined with any other aspect or aspects unless clearly indicated to the contrary. In particular, any feature indicated as being preferred or advantageous may be combined with any other feature or features indicated as being preferred or advantageous.

Several documents are cited throughout the text of this specification. Each of the documents cited herein (including all patents, patent applications, scientific publications, manufacturer's specifications, instructions, etc.), whether *supra* or *infra*, are hereby incorporated by reference in their entirety. Nothing herein is to be construed as an admission that the invention is not entitled to antedate such disclosure by virtue of prior invention.

In the following, some definitions of terms frequently used in this specification are provided. These terms will, in each instance of its use, in the remainder of the specification have the respectively defined meaning and preferred meanings.

Generally speaking, the adenoviral genome is well characterized. There is general conservation in the overall organization of the adenoviral genome with respect to specific open reading frames being similarly positioned, e.g. the location of the E1A, E1B, E2A, E2B, E3, E4, LI, L2, L3, L4 and L5 genes of each virus. Each extremity of the adenoviral genome comprises a sequence known as an inverted terminal repeat (ITRs), which is necessary for viral replication. The virus also comprises a virus-encoded protease, which is necessary for processing some of the structural proteins required to produce infectious virions. The structure of the adenoviral genome is described on the basis of the order in which the viral genes are expressed following host cell transduction. More specifically, the viral genes are referred to as early (E) or late (L) genes according to whether transcription occurs prior to or after onset of DNA replication. In the early phase of transduction, the E1A, E1B, E2A, E2B, E3 and E4 genes of adenovirus are expressed to prepare the host cell for viral replication. During the late phase of infection, expression of the late genes L1-L5, which encode the structural components of the virus particles are activated.

The following Table 1 provides an overview over the sequences referred to herein:

Table 1

Designation/Strain	SEQ ID NO:	Protein	Polynucleotide
HIV gag	1		HIV gag
TLR9 agonist	2		TLR9 agonist
HVR7 primer1	3		HVR7 primer1
HVR7 primer2	4		HVR7 primer2
HVR1-6fd	5		HVR1-6fd
HVR1-6rev	6		HVR1-6rev
PanAd1 left end P1	7		PanAd1 left end P1
PanAd1 left end P2	8		PanAd1 left end P2
PanAd1 right end P1	9		PanAd1 right end P1
PanAd1 right end P2	10		PanAd1 right end P2
pIX P1	11		pIX P1
pIX P2	12		pIX P2
Bonobo Adenovirus type 1 (PanAd1). Complete genome	13		Bonobo Adenovirus type 1 (PanAd1). Complete genome
ChAd55	14	Fiber	
ChAd73	15	Fiber	
ChAd83	16	Fiber	
ChAd146	17	Fiber	
ChAd147	18	Fiber	
PanAd1	19	Fiber	
ChAd55	20	Hexon	
ChAd73	21	Hexon	
ChAd83	22	Hexon	
ChAd146	23	Hexon	
ChAd147	24	Hexon	
PanAd1	25	Hexon	
ChAd55	26	Penton	
ChAd73	27	Penton	
ChAd83	28	Penton	
ChAd146	29	Penton	
ChAd147	30	Penton	
PanAd1	31	Penton	
ChAd55	32		Fiber
ChAd73	33		Fiber
ChAd83	34		Fiber
ChAd146	35		Fiber
ChAd147	36		Fiber
PanAd1	37		Fiber
ChAd55	38		Hexon
ChAd73	39		Hexon
ChAd83	40		Hexon
ChAd146	41		Hexon
ChAd147	42		Hexon
PanAd1	43		Hexon
ChAd55	44		Penton
ChAd73	45		Penton
ChAd83	46		Penton
ChAd146	47		Penton
ChAd147	48		Penton
PanAd1	49		Penton

PanAd2	50	Fiber	
PanAd2	51	Hexon	
PanAd2	52	Penton	
PanAd3	53	Fiber	
PanAd3	54	Hexon	
PanAd3	55	Penton	
PanAd2	56		Fiber
PanAd2	57		Hexon
PanAd2	58		Penton
PanAd3	59		Fiber
PanAd3	60		Hexon
PanAd3	61		Penton
Bonobo Adenovirus type 2 (PanAd2). Complete genome	62		Bonobo Adenovirus type 2 (PanAd2). Complete genome
Bonobo Adenovirus type 3 (PanAd3). Complete genome	63		Bonobo Adenovirus type 3 (PanAd3). Complete genome
Ad5 E4 ORF6 coding sequence	64		Ad5 E4 ORF6 coding sequence
ChAd83 Complete genome	65		ChAd83 Complete genome

As used herein, the term "isolated" refers to a molecule which is substantially free of other molecules with which it is naturally associated with. An isolated molecule is thus free of other molecules that it would encounter or contact in a living animal in nature, i.e. outside an experimental setting.

As used herein, the term "protein", "peptide", "polypeptide", "peptides" and "polypeptides" are used interchangeably throughout. These terms refers to both naturally occurring peptides, e.g. naturally occurring proteins and synthesized peptides that may include naturally or non-naturally occurring amino acids. Peptides can be also chemically modified by modifying a side chain or a free amino or carboxy-terminus of a natural or non-naturally occurring amino acid. This chemical modification includes the addition of further chemical moieties as well as the modification of functional groups in side chains of the amino acids, such as a glycosylation. A peptide is a polymer preferably having at least 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, or at least 100 amino acids, most preferably at least 8 or at least 30 amino acids. As the polypeptides and proteins disclosed herein are derived from adenovirus, it is preferred that the molecular mass of an isolated polypeptide or protein as used herein does not exceed 200 kDa.

The term "vector" as used herein includes any vectors known to the skilled person including plasmid vectors, cosmid vectors, phage vectors such as lambda phage, viral vectors such as adenovirus (Ad) vectors (e.g., non-replicating Ad5, Ad11, Ad26, Ad35, Ad49, ChAd3, ChAd4, ChAd5, ChAd7, ChAd8, ChAd9, ChAd10, ChAd11, ChAd16, ChAd17, ChAd19,

ChAd20 , ChAd22, ChAd24, ChAd26, ChAd30, ChAd31, ChAd37, ChAd38, ChAd44, ChAd63 and ChAd82 vectors or replication-competent Ad4 and Ad7 vectors known from the prior art, e.g. WO 2005/071093 A2), adeno-associated virus (AAV) vectors (e.g., AAV type 5), alphavirus vectors (e.g., Venezuelan equine encephalitis virus (VEE), sindbis virus (SIN), semliki forest virus (SFV), and VEE-SIN chimeras), herpes virus vectors, measles virus vectors, pox virus vectors (e.g., vaccinia virus, modified vaccinia virus Ankara (MVA), NYVAC (derived from the Copenhagen strain of vaccinia), and avipox vectors: canarypox (ALVAC) and fowlpox (FPV) vectors), and vesicular stomatitis virus vectors, viral like particles, or bacterial spores. A vector also includes expression vectors, cloning vectors and vectors that are useful to generate recombinant adenoviruses in host cells.

The term "expression cassette" refers to a nucleic acid molecule which comprises at least one nucleic acid sequence that is to be expressed, along with its transcription and translation control sequences. Changing the expression cassette will cause the vector in which it is incorporated to direct the expression of a different sequence or combination of sequences. Because of the restriction sites being preferably engineered to be present at the 5' and 3' ends, the cassette can be easily inserted, removed, or replaced with another cassette. Preferably, an expression cassette includes cis-regulating elements for efficient expression of a given gene, such as promoter, initiation-site and/or polyadenylation-site, as further described below.

The term "antibody" refers to both monoclonal and polyclonal antibodies, i.e., any immunoglobulin protein or portion thereof which is capable of binding an antigen or hapten. Antigen-binding portions may be produced by recombinant DNA techniques or by enzymatic or chemical cleavage of intact antibodies. In some embodiments, antigen-binding portions include Fab, Fab', $F(ab')_2$, Fd, Fv, dAb, and complementarity determining region (CDR) variants, single-chain antibodies (scFv), chimeric antibodies, humanized antibodies, diabodies, and polypeptides that contain at least a portion of an antibody that is sufficient to confer specific antigen binding to the polypeptide.

The administration of an immunogen / antigen for inducing/generating an immune response in a mammal in the context of the present invention is termed "priming", and the administration of an immunogen/ antigen for enhancing an immune response against said immunogen/ antigen, e.g. a particular pathogen (such as a virion or a virus pathogen, an antigen of a pathogenic bacterium or a tumorantigen) in a mammal is termed "boosting". The phrase "heterologous prime-boost" means that the vector for inducing/generating an immune response (priming) in a mammal and the vector for enhancing the immune response (boosting) in a mammal are different. "Heterologous prime-boost" is useful if a subject, e.g. patient has developed antibodies against a first vector and a boosting is required. Thus, in a preferred

embodiment of heterologous prime-boost two different adenoviruses may be used, e.g. for vaccination and/or gene therapy. In this context, a first and a second adenovirus are sufficiently different, if the antibody response induced during priming by the first adenovirus does not prevent more than 70% or preferably more than 80% of the second adenovirus particles administered for boosting from entering the nucleus of cells of the animal that has been subjected to priming and boosting.

The term "replication-competent" recombinant adenovirus (AdV) refers to an adenovirus which can replicate in a host cell in the absence of any recombinant helper proteins comprised in the cell. Preferably, a "replication-competent" adenovirus comprises the following intact or functional essential early genes: E1A, E1B, E2A, E2B, E3 and E4. Wild type adenoviruses isolated from a particular animal will be replication competent in that animal.

The term "replication-defective" recombinant AdV refers to an adenovirus that has been rendered to be incapable of replication because it has been engineered to comprise at least a functional deletion, i.e. a deletion which impairs the function of a gene without removing it entirely, e.g. introduction of artificial stop codons, deletion or mutation of active sites or interaction domains, mutation or deletion of a regulatory sequence of a gene etc, or a complete removal of a gene encoding a gene product that is essential for viral replication, such as one or more of the adenoviral genes selected from E1, E2, E3 and E4. The recombinant chimpanzee adenoviral vectors of the invention are preferably replication-defective.

The term "identity" or "identical" in the context of polynucleotide, polypeptide or protein sequences refers to the number of residues in the two sequences that are identical when aligned for maximum correspondence. Specifically, the percent sequence identity of two sequences, whether nucleic acid or amino acid sequences, is the number of exact matches between two aligned sequences divided by the length of the shorter sequence and multiplied by 100. Alignment tools that can be used to align two sequences are well known to the person skilled in the art and can, for example, be obtained on the World Wide Web, e.g., ClustalW (www.ebi.ac.uk/clustalw) or Align (http://www.ebi.ac.uk/emboss/align/index.html). The alignments between two sequences may be carried out using standard settings, for Align EMBOSS::needle preferably: Matrix: Blosum62, Gap Open 10.0, Gap Extend 0.5. Those skilled in the art understand that it may be necessary to introduce gaps in either sequence to produce a satisfactory alignment. The "best sequence alignment" between two polypeptides is defined as the alignment that produces the largest number of aligned identical residues.

Adenoviruses

An adenovirus (Ad) is a non-enveloped, icosahedral virus that has been identified in several avian and mammalian hosts. Human adenoviruses (hAds) belong to the Mastadenovirus genus which includes all known human and many Ads of animal (e. g., bovine, porcine, canine, murine, equine, simian and ovine) origin. Human adenoviruses are generally divided into six subgroups (A-F) based on a number of biological, chemical, immunological and structural criteria which include hemagglutination properties of rat and rhesus monkey erythrocytes, DNA homology, restriction enzyme cleavage patterns, percentage G+C content and oncogenicity (Straus, 1984, in *The Adenoviruses*, ed. H. Ginsberg, pps.451-498, New York : Plenus Press, and Horwitz, 1990; in *Virology*, eds. B. N. Fields and D. M. Knipe, pps. 1679-1721).

The adenoviral virion has an icosahedral symmetry and, depending on the serotype, a diameter of 60-90 nm. The icosahedral capsid comprises three major proteins, hexon (II), penton base (III) and a knobbed fiber (IV) protein (W. C. Russel, J. Gen.Virol., 81: 2573-2604 (2000)). One aspect of the preexisting immunity that is observed in humans is humoral immunity, which can result in the production and persistence of antibodies that are specific for adenoviral proteins. The humoral response elicited by adenovirus is mainly directed against the three major structural proteins: hexon, penton and fiber.

To date, 51 distinct human adenovirus serotypes have been recognized and grouped into subgroups on the basis of their hemagglutination properties and biophysical and biochemical criteria. Published reports have established that titers comprising antibodies against multiple serotypes are common (Dambrosio, E. (1982) J. Hyg. (London) 89: 209-219) and that a substantial portion of the titers have neutralizing activity.

As mentioned, recombinant adenoviruses are useful in gene-therapy and as vaccines. Viral vectors based on chimpanzee adenovirus represent an alternative to the use of human derived Ad vectors for the development of genetic vaccines (Farina SF, J Virol. 2001 Dec;75(23):11603-13.; Fattori E, Gene Ther. 2006 Jul;13(14):1088-96). Adenoviruses isolated from chimpanzees are closely related to adenoviruses isolated from humans as demonstrated by their efficient propagation in cells of human origin. However, since human and chimp adenoviruses are close relatives, a serologic cross reactivity between the two virus species can be expected.

This presumption has been confirmed when chimpanzee adenoviruses were isolated and characterized. Nevertheless, adenovirus isolates from chimpanzees showed a reduced cross reactivity with the common serotypes of human adenovirus epitopes. Thus, a chimpanzee adenovirus (also abbreviated herein as "ChAd" for common chimpanzee adenovirus and "PanAd" for bonobo chimpanzee adenovirus) provides a basis for reducing the adverse effects

associated with the preexisting immunity in humans to common serotypes of human adenoviruses. However, a low to intermediate neutralizing titer against chimp adenoviruses isolated so far is detected in subsets of human sera and, thus, all known serotypes of chimpanzee adenoviruses are still neutralized by human blood sera to some degree.

The present invention comprises the unexpected finding that novel chimpanzee adenovirus strains could be isolated, namely ChAd55, ChAd73, ChAd83, ChAd146, ChAd147 isolated from the Common Chimpanzee (*Pan troglodytes*) and PanAd1, PanAd2 and PanAd3 isolated from bonobos (*Pan paniscus*). All these novel strains show *no* measurable seroprevalence in humans, i.e. these adenovirus strains represent an exception among chimpanzee adenoviruses described so far in that all human sera tested completely negative for the presence of neutralizing antibodies. In this context, a neutralizing antibody refers to an antibody that binds to an epitope of the adenovirus and prevents it from producing a productive infection in a host cell or prevents the transduction of a target cell with a replication incompentent vector expressing a transgene, e.g. the adenovirus DNA is capable of entering a host cell. While neutralizing antibodies were observed for all prior-art chimpanzee-derived adenoviruses, the novel adenovirus types ChAd55, ChAd73, ChAd83, ChAd146, ChAd147 PanAd1, PanAd2 and PanAd3 are characterized by a complete absence of preexisting neutralizing antibody in humans directed against these adenovirus types. Thus, these adenoviruses provide a valuable medical tool that can e.g. be used for immunization and/or gene therapy.

As detailed further below, the invention provides, in one aspect, novel sequences of adenovirus capsid proteins that represent the most surface exposed adenovirus epitopes, namely hexon, penton and fiber protein. As already mentioned, no neutralizing antibodies specific for the viruses according to the invention are comprised in human blood sera. Thus, one advantage of the aforementioned novel chimpanzee hexon, penton and fiber protein sequences is that the sequences of these proteins can be used to enhance prior art adenoviruses, which have been engineered for e.g. medical purposes. For example, the capsid proteins or functional fragments thereof of the present invention can be used to e.g. replace/substitute one or more of the major structural capsid proteins or functional fragments thereof, respectively, of a different adenovirus, e.g. a prior art adenovirus, to obtain improved recombinant adenoviruses with a reduced seroprevalence in humans. As the novel adenoviruses of the invention but also adenoviruses which have been re-engineered as described will not encounter any significant inhibitory immune response in humans when administered, their overall transduction efficiency and infectivity will be enhanced. Thus, such improved adenoviruses are expected to be, e.g., more effective vaccines as the entry into host cells and the expression of the antigen cassette will not

be hampered by any significant titer of neutralizing antibodies. In addition, as shown in the examples, a potent immune response against HIV gag was elicited even in naïve mice vaccinated with a recombinant HIV-gag encoding adenovirus that comprises hexon, penton and fiber proteins of the ChAd55, ChAd73, ChAd83, ChAd146, ChAd147, PanAd1, PanAd2 or PanAd3 isolate. The immune response elicited by ChAd55-gag, ChAd73-gag, ChAd83-gag, ChAd146-gag, ChAd147-gag, PanAd1-gag, PanAd2-gag and PanAd3-gag adenoviruses is comparable with the response observed with the most potent vectors developed so far based on recombinant human Ad5 vector of the prior art expressing HIV gag protein (see data of an ELIspot assay in figure 5A, 5B, 5C).

As mentioned before, the humoral response elicited by an adenovirus is mainly directed against the three major adenoviral structural proteins: hexon, penton and fiber, all of which comprise polypeptide sequences that are part of the adenoviral capsid and that are exposed to the outside of the virus particle (see also: Madisch I, et al., J. Virol. 2005 Dec;79(24):15265-76; and also: Madisch I, et al., J Virol. 2007 Aug;81(15):8270-81; and Pichla-Gollon SL, et al., J. Virol. 2007 Feb;81(4):1680-9).

As depicted in the multiple sequence alignment shown in figure 1, the novel adenovirus isolates of the group of PanAd1, PanAd2, PanAd3, ChAd55, ChAd73, ChAd83, ChAd146 and ChAd147 of the present invention share a very similar hexon protein sequence. In the alignment also the hypervariable regions (HVRs) are labeled which occur in loops at the top of the hexon molecule that lie on the exterior of the virion and cover a large amount of its surface (see Jophn J. Rux et. Al, J. of Virology, Sept 2003, vol. 77, no.17). The sequence relatedness of the further capsid proteins fiber and penton of the novel chimpanzee adenoviruses is provided in figures 2 and 3, respectively. All three structural capsid proteins are expected to contribute to the low seroprevalence and can, thus, be used independently from each other or in combination to suppress the affinity of an adenovirus to preexisting neutralizing antibodies, e.g. to manufacture a recombinant chimeric adenovirus with a reduced seroprevalence.

Thus, in a first aspect the invention provides an isolated polynucleotide that encodes an adenoviral fiber protein or a functional derivative thereof and that is selected from the group consisting of:

(a) a polynucleotide encoding a polypeptide having the amino acid sequence according to any of SEQ ID NOs: 14-19, 50 and 53; i.e. SEQ ID NO: 14, 15, 16, 17, 18 , 19, 50 or 53;

(b) a polynucleotide encoding the functional derivative of a polypeptide according to any of SEQ ID NOs: 14-19, 50 and 53, i.e. SEQ ID NO: 14, 15, 16, 17, 18, 19, 50 o 53; wherein said functional derivative comprises the deletion, insertion and/or substitution of one or more amino acid residues; and

(c) a polynucleotide encoding a functional derivative having an amino acid sequence which is at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98% or at least 99%, more preferably at least 85% and most preferable at least 99% identical over its entire length to the amino acid sequence of any of SEQ ID NOs: 14-19, 50 and 53, i.e. SEQ ID NO: 14, 15, 16, 17, 18, 19, 50 or 53.

By "adenoviral fiber protein" is meant the knobbed fiber (IV) protein comprised in an adenovirus. In a preferred embodiment, the isolated polynucleotide comprised in the first aspect of the invention and preferred embodiments thereof described below encodes a fiber protein or a functional derivative thereof that has the same function as a fiber protein or a fragment thereof in an *infectious* adenovirus virion. Thus, a recombinant adenovirus comprising said fiber or functional fiber derivative preferably as a capsid protein is capable of entering a host cell. It can be easily determined if a recombinant adenovirus can enter a host cell. For example, after contacting a host cell with the adenovirus, the recombinant host cell can be washed and lysed and it can be determined whether adenoviral RNA and/or DNA is found in the host cell using, e.g. an appropriate hybridization probe specific for adenoviral RNA and/or DNA. Alternatively or additionally, the host cell after having been brought into contact with the recombinant adenovirus may be washed, lysed and probed with adenovirus specific antibodies, e.g. using a Western blot. In yet another alternative, it is observed, e.g. *in vivo*, whether the host cell expresses a gene product, for example a fluorescent protein upon infection with a recombinant adenovirus that comprises a suitable expression cassette to express the gene product in the host cell.

It is further preferred that the fiber protein and functional derivative thereof has an affinity to an adenoviral penton protein, such as to SEQ ID NOs: 26-31, 52 and/or 55. The average skilled person is well aware of how to test protein-protein affinities. To determine if a first protein is capable of binding a second protein, such as a penton protein of a chimpanzee derived adenovirus, he may use, for example, a genetic yeast two-hybrid assay or a biochemical assay such as a pull-down, an enzyme-linked immunosorbent assay (ELISA), a fluorescence-activated cell sorting (FACS)-based assay or a Plasmon resonance assay. When using pull-down or Plasmon resonance assays, it is useful to fuse at least one of the proteins to an affinity tag such as HIS-tag, GST-tag or other, as is well known in the art of biochemistry. An adenoviral fiber protein in its glycosylated form is further capable of trimerizing. Thus, it is also preferred that the fiber protein or a fragment thereof encoded by the polynucleotide according to the first aspect of the invention is capable of being glycosylated and/or of forming a trimer.

As used throughout this application, the phrase "functional derivative" of a protein or polypeptide generally refers to a modified version of the protein or polypeptide, e.g. one or more

amino acids of the protein or polypeptide may be deleted, inserted, modified and/or substituted. The derivative is functional, if, as mentioned also above, a chimeric adenovirus comprising the functional derivative in its capsid is capable of infecting a host cell. Furthermore, in the context of a "functional derivative", an insertion refers to the insertion of one or more amino acids into the original polypeptide or protein. It is preferred that a functional derivative does not comprise more than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100 amino acid changes (i.e. deleted, inserted, modified and/or substituted amino acids). In another embodiment, it is preferred that not more than 1%, 2%, 3%, 4%, 5%, 6%, 7%, 8%, 9%, 10%, 15%, or more than 20% (most preferably not more than 5%) of all amino acids of the protein or polypeptide are changed (i.e. are deleted, inserted, modified and/or substituted amino acids). Amino acids of the protein or polypeptide may also be modified, e.g. chemically modified. For example, the side chain or a free amino or carboxy-terminus of an amino acid of the protein or polypeptide may be modified by e.g. glycosylation, amidation, phosphorylation, ubiquitination, e.t.c. The chemical modification can also take place *in vivo*, e.g. in a host-cell, as is well known in the art. For examples, a suitable chemical modification motif, e.g. glycosylation sequence motif present in the amino acid sequence of the protein will cause the protein to be glycosylated. A substitution in a derivative may be a conservative or a non-conservative substitution, preferably a conservative substitution. In some embodiments, a substitution also includes the exchange of a naturally occurring amino acid with a not naturally occurring amino acid. A conservative substitution comprises the substitution of an amino acid with another amino acid having a chemical property similar to the amino acid that is substituted. Preferably, the conservative substitution is a substitution selected from the group consisting of:

(i) a substitution of a basic amino acid with another, different basic amino acid;

(ii) a substitution of an acidic amino acid with another, different acidic amino acid;

(iii) a substitution of an aromatic amino acid with another, different aromatic amino acid;

(iv) a substitution of a non-polar, aliphatic amino acid with another, different non-polar, aliphatic amino acid; and

(v) a substitution of a polar, uncharged amino acid with another, different polar, uncharged amino acid.

A basic amino acid is preferably selected from the group consisting of arginine, histidine, and lysine. An acidic amino acid is preferably aspartate or glutamate. An aromatic amino acid is preferably selected from the group consisting of phenylalanine, tyrosine and tryptophane. A non-polar, aliphatic amino acid is preferably selected from the group consisting of glycine, alanine, valine, leucine, methionine and isoleucine. A polar, uncharged amino acid is preferably selected from the group consisting of serine, threonine, cysteine, proline, asparagine and glutamine. In

contrast to a conservative amino acid substitution, a non-conservative amino acid substitution is the exchange of one amino acid with any amino acid that does not fall under the above-outlined conservative substitutions (i) through (v).

If a functional derivative comprises a deletion, then in the derivative one or several amino acids that are present in the reference polypeptide or protein sequence have been removed. The deletion may, however, not be so extensive that the derivative comprises less than 200 amino acids in total.

Means for determining sequence identity have been described already above. In addition, the determination of percent identity between two sequences can also be determined using the mathematical algorithm of Karlin and Altschul (1993) Proc. Natl. Acad. Sci. USA 90: 5873-5877. Such an algorithm is also incorporated into the BLASTN and BLASTP programs of Altschul et al. (1990) J. Mol. Biol. 215: 403-410. When utilizing BLASTN and BLASTP it is preferred that the default parameters of these programs are used.

As mentioned before, the hyper variable domains of an adenoviral hexon protein are exposed to the outside of the adenovirus. Thus, these regions of the adenoviral capsid can be recognized and bound by neutralizing antibodies. Thus, an adenovirus with a capsid comprising a hexon protein derived from one of the novel adenovirus isolates of the present invention will exhibit an improved, i.e. smaller seroprevalence in humans. Thus, in a second aspect the invention provides an isolated polynucleotide that encodes an adenoviral hexon protein or a functional derivative thereof and that is selected from the group consisting of:

(a) a polynucleotide encoding a polypeptide having the amino acid sequence according to any of SEQ ID NOs: 20-25, 51 and 54, i.e. SEQ ID NO: 20, 21, 22, 23, 24, 25, 51 or 54;

(b) a polynucleotide encoding the functional derivative of a polypeptide according to any of SEQ ID NOs: 20-25, 51 and 54, i.e. SEQ ID NO: 20, 21, 22, 23, 24, 25, 51 or 54 wherein said functional derivative comprises the deletion, insertion and/or substitution of one or more amino acid residues; and

(c) a polynucleotide encoding a functional derivative having an amino acid sequence which is at least 95%, 98%, 99%, 99.5%, 99.9% or at least 99.95%, more preferably at least 98% and most preferable at least 99.95% identical over its entire length to the amino acid sequence of any of SEQ ID NOs: 20-25, 51 and 54, i.e. SEQ ID NO: 20, 21, 22, 23, 24, 25, 51 or 54.

In a preferred embodiment, the isolated polynucleotide comprised in the second aspect of the invention and preferred embodiments thereof described below encodes a hexon protein or a functional derivative thereof that has the same function as a hexon protein or a functional fragment thereof in an *infectious* adenovirus virion. Thus, a recombinant adenovirus comprising

said hexon or functional derivative thereof preferably as a capsid protein is capable of entering a host cell. One suitable method for generating functional derivatives of a hexon protein is described in US Patent 5,922,315, which is incorporated by reference. In this method, at least one loop region of the adenovirus hexon is changed with at least one loop region of another adenovirus serotype. For example, a loop region of a hexon protein of the invention can be used to substitute the corresponding hexon loop of an adenovirus of the prior art to generate an improved hybrid adenovirus. Analogously also derivatives of penton and fiber proteins of the invention can be generated.

In a third aspect, the invention provides an isolated polynucleotide that encodes an adenoviral penton protein or a functional derivative thereof and that is selected from the group consisting of:

(a) a polynucleotide encoding a polypeptide having the amino acid sequence according to any of SEQ ID NOs: 26-31, 52 and 55, i.e. SEQ ID NO: 26, 27, 28, 29, 30, 31, 52 or 55;

(b) a polynucleotide encoding the functional derivative of a polypeptide according to any of SEQ ID NOs: 26-31, 52 and 55, i.e. SEQ ID NO: 26, 27, 28, 29, 30, 31, 52 or 55; wherein said functional derivative comprises the deletion, insertion and/or substitution of one or more amino acid residues; and

(c) a polynucleotide encoding a functional derivative having an amino acid sequence which is at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98% or at least 99%, more preferably at least 85% and most preferable at least 99% identical over its entire length to the amino acid sequence of any of SEQ ID NOs: 26-31, 52 and 55, i.e. SEQ ID NO: 26, 27, 28, 29, 30, 31, 52 or 55.

It is preferred that the penton protein and functional derivative thereof has an affinity to an adenoviral fiber protein, such as to SEQ ID NOs: 14-19, 50 and/or 53. The average skilled person is well aware of how to test protein-protein affinities as described above. By "adenoviral penton protein" is meant the penton base (III) protein comprised in an adenovirus. An adenoviral penton protein is characterized in that it localizes to the corners of the icosahedral symmetry of the capsid. As mentioned, in a preferred embodiment of the polynucleotide of the first, second and/or third aspect of the invention and preferred embodiments thereof described herein below, the polynucleotide encodes one or more polypeptides, wherein a recombinant adenovirus comprising said one or more polypeptides preferably as a capsid protein(s) is capable to infect, i.e. enter a host cell.

In the following, preferred embodiments of the first, second and third aspect of the invention will be specified for each of the novel chimpanzee adenovirus isolates disclosed herein.

Adenovirus ChAd55

In a preferred embodiment of the first aspect of the invention, the isolated polynucleotide encodes an adenoviral fiber protein with an amino acid sequence according to SEQ ID NO: 14 or a functional derivative thereof, wherein the functional derivative (i) does not comprise more than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100, preferably not more than 10 deleted, inserted, modified and/or substituted amino acids or (ii) has an amino acid sequence which is at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98% or at least 99%, more preferably at least 85% and most preferable at least 99% identical over its entire length to the amino acid sequence of SEQ ID NO: 14.

In a preferred embodiment of the second aspect of the invention, the isolated polynucleotide encodes an adenoviral hexon protein with an amino acid sequence according to SEQ ID NO: 20 or a functional derivative thereof, wherein the functional derivative (i) does not comprise more than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100, preferably not more than 10 deleted, inserted, modified and/or substituted amino acids or (ii) has an amino acid sequence which is at least 95%, 98%, 99%, 99.5%, 99.9% or at least 99.95%, more preferably at least 98% identical over its entire length to the amino acid sequence of SEQ ID NO: 20.

In a preferred embodiment of the third aspect of the invention, the isolated polynucleotide encodes an adenoviral penton protein with an amino acid sequence according to SEQ ID NO: 26 or a functional derivative thereof, wherein the functional derivative (i) does not comprise more than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100, preferably not more than 10 deleted, inserted, modified and/or substituted amino acids or (ii) has an amino acid sequence which is at least 98%, 99%, 99.5%, 99.9% or at least 99.95%, more preferably at least 98% and most preferable at least 99.9% identical over its entire length to the amino acid sequence of SEQ ID NO: 26.

In a further aspect the invention relates to a polynucleotide comprising the first, the second, the third, the first and second, the first and third, the second and third or the first, second and third aspect. It is preferred that the polynucleotide comprising this or these polynucleotide(s) comprises other adenoviral genes and nucleotide segments, which are adjacent to the hexon, penton and/or fiber gene in the adenovirus genome, e.g. using the Ad5 genome as a reference. It is preferred that the polynucleotide also comprises sequences required for packaging of the polynucleotide into an adenoviral particle.

Adenovirus ChAd73

In a preferred embodiment of the first aspect of the invention, the isolated polynucleotide encodes an adenoviral fiber protein with an amino acid sequence according to SEQ ID NO: 15 or a functional derivative thereof, wherein the functional derivative (i) does not comprise more than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100, preferably not more than 10 deleted, inserted, modified and/or substituted amino acids or (ii) has an amino acid sequence which is at least 98%, 99% or at least 99.9% more preferably at least 99% and most preferable at least 99.9% identical over its entire length to the amino acid sequence of SEQ ID NO: 15.

In a preferred embodiment of the second aspect of the invention, the isolated polynucleotide encodes an adenoviral hexon protein with an amino acid sequence according to SEQ ID NO: 21 or a functional derivative thereof, wherein the functional derivative (i) does not comprise more than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100, preferably not more than 10 deleted, inserted, modified and/or substituted amino acids or (ii) has an amino acid sequence which is at least 95%, 98%, 99%, 99.5%, 99.9% or at least 99.95%, more preferably at least 98% identical over its entire length to the amino acid sequence of SEQ ID NO: 21.

In a preferred embodiment of the third aspect of the invention, the isolated polynucleotide encodes an adenoviral penton protein with an amino acid sequence according to SEQ ID NO: 27 or a functional derivative thereof, wherein the functional derivative (i) does not comprise more than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100, preferably not more than 10 deleted, inserted, modified and/or substituted amino acids or (ii) has an amino acid sequence which is at least 98%, 99%, 99.5%, 99.9% or at least 99.95%, more preferably at least 98% and most preferable at least 99% identical over its entire length to the amino acid sequence of SEQ ID NO: 27.

In a further aspect the invention relates to a polynucleotide comprising the first, the second, the third, the first and second, the first and third, the second and third or the first, second and third aspect. It is preferred that the polynucleotide comprising this or these polynucleotide(s) comprises other adenoviral genes and nucleotide segments, which are adjacent to the hexon, penton and/or fiber gene in the adenovirus genome, e.g. using the Ad5 genome as a reference. It is preferred that the polynucleotide also comprises sequences required for packaging of the polynucleotide into an adenoviral particle.

Adenovirus ChAd83

In a preferred embodiment of the first aspect of the invention, the isolated polynucleotide encodes an adenoviral fiber protein with an amino acid sequence according to SEQ ID NO: 16 or a functional derivative thereof, wherein the functional derivative (i) does not comprise more than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100, preferably not more than 10 deleted, inserted, modified and/or substituted amino acids or (ii) has the amino acid sequence of SEQ ID NO: 16.

In a preferred embodiment of the second aspect of the invention, the isolated polynucleotide encodes an adenoviral hexon protein with an amino acid sequence according to SEQ ID NO: 22 or a functional derivative thereof, wherein the functional derivative (i) does not comprise more than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100, preferably not more than 10 deleted, inserted, modified and/or substituted amino acids or (ii) has an amino acid sequence which is at least 95%, 98%, 99%, 99.5%, 99.9% or at least 99.95%, more preferably at least 98% identical over its entire length to the amino acid sequence of SEQ ID NO: 22.

In a preferred embodiment of the third aspect of the invention, the isolated polynucleotide encodes an adenoviral penton protein with an amino acid sequence according to SEQ ID NO: 28 or a functional derivative thereof, wherein the functional derivative (i) does not comprise more than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100, preferably not more than 10 deleted, inserted, modified and/or substituted amino acids or (ii) has an amino acid sequence which is at least 98%, 99%, 99.5%, 99.9% or at least 99.95%, more preferably at least 98% and most preferable at least 99% identical over its entire length to the amino acid sequence of SEQ ID NO: 28.

In a most preferred embodiment, the polynucleotide of the invention consists of or comprises a polynucleotide which is at least 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98% identical and most preferably at least 99% or 100% identical over its entire length to a sequence that consists of SEQ ID NO: 65 or to a sequence that consists of SEQ ID NO: 65 but lacks any of the genomic regions E1A, E1B, E2A, E2B, E3 and/or E4 of SEQ ID NO: 65, most preferably that lacks the genomic regions E1, E3 and E4 of SEQ ID NO: 65.

In a further aspect the invention relates to a polynucleotide comprising the first, the second, the third, the first and second, the first and third, the second and third or the first, second and third aspect. It is preferred that the polynucleotide comprising this or these polynucleotide(s) comprises other adenoviral genes and nucleotide segments, which are adjacent to the hexon, penton and/or fiber gene in the adenovirus genome, e.g. using the ChAd83 genome as set out in

SEQ ID NO: 65. It is preferred that the polynucleotide also comprises sequences required for packaging of the polynucleotide into an adenoviral particle.

Adenovirus ChAd146

In a preferred embodiment of the first aspect of the invention, the isolated polynucleotide encodes an adenoviral fiber protein with an amino acid sequence according to SEQ ID NO: 17 or a functional derivative thereof, wherein the functional derivative (i) does not comprise more than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100, preferably not more than 10 deleted, inserted, modified and/or substituted amino acids or (ii) has the amino acid sequence of SEQ ID NO: 17.

In a preferred embodiment of the second aspect of the invention, the isolated polynucleotide encodes an adenoviral hexon protein with an amino acid sequence according to SEQ ID NO: 23 or a functional derivative thereof, wherein the functional derivative (i) does not comprise more than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100, preferably not more than 10 deleted, inserted, modified and/or substituted amino acids or (ii) has an amino acid sequence which is at least 95%, 98%, 99%, 99.5%, 99.9% or at least 99.95%, more preferably at least 98% identical over its entire length to the amino acid sequence of SEQ ID NO: 23.

In a preferred embodiment of the third aspect of the invention, the isolated polynucleotide encodes an adenoviral penton protein with an amino acid sequence according to SEQ ID NO: 29 or a functional derivative thereof, wherein the functional derivative (i) does not comprise more than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100, preferably not more than 10 deleted, inserted, modified and/or substituted amino acids or (ii) has an amino acid sequence which is at least 98%, 99%, 99.5%, 99.9% or at least 99.95%, more preferably at least 98% and most preferable at least 99% identical over its entire length to the amino acid sequence of SEQ ID NO: 29.

In a further aspect the invention relates to a polynucleotide comprising the first, the second, the third, the first and second, the first and third, the second and third or the first, second and third aspect. It is preferred that the polynucleotide comprising this or these polynucleotide(s) comprises other adenoviral genes and nucleotide segments, which are adjacent to the hexon, penton and/or fiber gene in the adenovirus genome, e.g. using the Ad5 genome as a reference. It is preferred that the polynucleotide also comprises sequences required for packaging of the polynucleotide into an adenoviral particle.

Adenovirus ChAd147

In a preferred embodiment of the first aspect of the invention, the isolated polynucleotide encodes an adenoviral fiber protein with an amino acid sequence according to SEQ ID NO: 18 or a functional derivative thereof, wherein the functional derivative (i) does not comprise more than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100, preferably not more than 10 deleted, inserted, modified and/or substituted amino acids or (ii) has an amino acid sequence which is at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98% or at least 99%, more preferably at least 85% and most preferable at least 90% identical over its entire length to the amino acid sequence of SEQ ID NO: 18.

In a preferred embodiment of the second aspect of the invention, the isolated polynucleotide encodes an adenoviral hexon protein with an amino acid sequence according to SEQ ID NO: 24 or a functional derivative thereof, wherein the functional derivative (i) does not comprise more than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100, preferably not more than 10 deleted, inserted, modified and/or substituted amino acids or (ii) has an amino acid sequence which is at least 95%, 98%, 99%, 99.5%, 99.9% or at least 99.95%, more preferably at least 98% identical over its entire length to the amino acid sequence of SEQ ID NO: 24.

In a preferred embodiment of the third aspect of the invention, the isolated polynucleotide encodes an adenoviral penton protein with an amino acid sequence according to SEQ ID NO: 30 or a functional derivative thereof, wherein the functional derivative (i) does not comprise more than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100, preferably not more than 10 deleted, inserted, modified and/or substituted amino acids or (ii) has an amino acid sequence which is at least 98%, 99%, 99.5%, 99.9% or at least 99.95%, more preferably at least 98% and most preferable at least 99% identical over its entire length to the amino acid sequence of SEQ ID NO: 30.

In a further aspect the invention relates to a polynucleotide comprising the first, the second, the third, the first and second, the first and third, the second and third or the first, second and third aspect. It is preferred that the polynucleotide comprising this or these polynucleotide(s) comprises other adenoviral genes and nucleotide segments, which are adjacent to the hexon, penton and/or fiber gene in the adenovirus genome, e.g. using the Ad5 genome as a reference. It is preferred that the polynucleotide also comprises sequences required for packaging of the polynucleotide into an adenoviral particle.

Adenovirus PanAd1

In a preferred embodiment of the first aspect of the invention, the isolated polynucleotide encodes an adenoviral fiber protein with an amino acid sequence according to SEQ ID NO: 19 or a functional derivative thereof, wherein the functional derivative (i) does not comprise more than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100, preferably not more than 10 deleted, inserted, modified and/or substituted amino acids or (ii) has an amino acid sequence which is at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98% or at least 99%, more preferably at least 85% and most preferable at least 99% identical over its entire length to the amino acid sequence of SEQ ID NO: 19.

In a preferred embodiment of the second aspect of the invention, the isolated polynucleotide encodes an adenoviral hexon protein with an amino acid sequence according to SEQ ID NO: 25 or a functional derivative thereof, wherein the functional derivative (i) does not comprise more than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100, preferably not more than 10 deleted, inserted, modified and/or substituted amino acids or (ii) has an amino acid sequence which is at least 95%, 98%, 99%, 99.5%, 99.9% or at least 99.95%, more preferably at least 98% and most preferably at least 99% identical over its entire length to the amino acid sequence of SEQ ID NO: 25.

In a preferred embodiment of the third aspect of the invention, the isolated polynucleotide encodes an adenoviral penton protein with an amino acid sequence according to SEQ ID NO: 31 or a functional derivative thereof, wherein the functional derivative (i) does not comprise more than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100, preferably not more than 10 deleted, inserted, modified and/or substituted amino acids or (ii) has an amino acid sequence which is at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98% or at least 99%, more preferably at least 85% and most preferable at least 90% identical over its entire length to the amino acid sequence of SEQ ID NO: 31.

In a most preferred embodiment, the polynucleotide of the invention consists of or comprises a polynucleotide which is at least 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98% identical and most preferably at least 99% or 100% identical over its entire length to a sequence that consists of SEQ ID NO: 13 or to a sequence that consists of SEQ ID NO: 13 but lacks any of the genomic regions E1A, E1B, E2A, E2B, E3 and/or E4 of SEQ ID NO: 13, most preferably that lacks the genomic regions E1, E3 and E4 of SEQ ID NO: 13.

In a further aspect the invention relates to a polynucleotide comprising the first, the second, the third, the first and second, the first and third, the second and third or the first, second and third aspect. It is preferred that the polynucleotide comprising this or these polynucleotide(s) comprises other adenoviral genes and nucleotide segments, which are adjacent to the hexon,

penton and/or fiber gene in the adenovirus genome, e.g. using the PanAd1 genome as set out in SEQ ID NO: 13. It is preferred that the polynucleotide also comprises sequences required for packaging of the polynucleotide into an adenoviral particle.

Adenovirus PanAd2

In a preferred embodiment of the first aspect of the invention, the isolated polynucleotide encodes an adenoviral fiber protein with an amino acid sequence according to SEQ ID NO: 50 or a functional derivative thereof, wherein the functional derivative (i) does not comprise more than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100, preferably not more than 10 deleted, inserted, modified and/or substituted amino acids or (ii) has an amino acid sequence which is at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98% or at least 99%, more preferably at least 85% and most preferable at least 99% identical over its entire length to the amino acid sequence of SEQ ID NO: 50.

In a preferred embodiment of the second aspect of the invention, the isolated polynucleotide encodes an adenoviral hexon protein with an amino acid sequence according to SEQ ID NO: 51 or a functional derivative thereof, wherein the functional derivative (i) does not comprise more than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100, preferably not more than 10 deleted, inserted, modified and/or substituted amino acids or (ii) has an amino acid sequence which is at least 95%, 98%, 99%, 99.5%, 99.9% or at least 99.95%, more preferably at least 98% and most preferably at least 99% identical over its entire length to the amino acid sequence of SEQ ID NO: 51.

In a preferred embodiment of the third aspect of the invention, the isolated polynucleotide encodes an adenoviral penton protein with an amino acid sequence according to SEQ ID NO: 52 or a functional derivative thereof, wherein the functional derivative (i) does not comprise more than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100, preferably not more than 10 deleted, inserted, modified and/or substituted amino acids or (ii) has an amino acid sequence which is at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98% or at least 99%, more preferably at least 85% and most preferable at least 90% identical over its entire length to the amino acid sequence of SEQ ID NO: 52.

In a most preferred embodiment, the polynucleotide of the invention consists of or comprises a polynucleotide which is at least 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98% identical and most preferably at least 99% or 100% identical over its entire length to a sequence that consists of SEQ ID NO: 62 or to a sequence that consists of SEQ ID NO: 62 but lacks any of the genomic regions E1A, E1B, E2A, E2B, E3 and/or E4 of SEQ ID NO: 62, most preferably that lacks the genomic regions E1, E3 and E4 of SEQ ID NO: 62.

In a further aspect the invention relates to a polynucleotide comprising the first, the second, the third, the first and second, the first and third, the second and third or the first, second and third aspect. It is preferred that the polynucleotide comprising this or these polynucleotide(s) comprises other adenoviral genes and nucleotide segments, which are adjacent to the hexon, penton and/or fiber gene in the adenovirus genome, e.g. using the PanAd1 genome as set out in SEQ ID NO: 62. It is preferred that the polynucleotide also comprises sequences required for packaging of the polynucleotide into an adenoviral particle.

Adenovirus PanAd3

In a preferred embodiment of the first aspect of the invention, the isolated polynucleotide encodes an adenoviral fiber protein with an amino acid sequence according to SEQ ID NO: 53 or a functional derivative thereof, wherein the functional derivative (i) does not comprise more than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100, preferably not more than 10 deleted, inserted, modified and/or substituted amino acids or (ii) has an amino acid sequence which is at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98% or at least 99%, more preferably at least 85% and most preferable at least 99% identical over its entire length to the amino acid sequence of SEQ ID NO: 53.

In a preferred embodiment of the second aspect of the invention, the isolated polynucleotide encodes an adenoviral hexon protein with an amino acid sequence according to SEQ ID NO: 54 or a functional derivative thereof, wherein the functional derivative (i) does not comprise more than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100, preferably not more than 10 deleted, inserted, modified and/or substituted amino acids or (ii) has an amino acid sequence which is at least 95%, 98%, 99%, 99.5%, 99.9% or at least 99.95%, more preferably at least 98% and most preferably at least 99% identical over its entire length to the amino acid sequence of SEQ ID NO: 54.

In a preferred embodiment of the third aspect of the invention, the isolated polynucleotide encodes an adenoviral penton protein with an amino acid sequence according to SEQ ID NO: 55 or a functional derivative thereof, wherein the functional derivative (i) does not comprise more than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100, preferably not more than 10 deleted, inserted, modified and/or substituted amino acids or (ii) has an amino acid sequence which is at least 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98% or at least 99%, more preferably at least 85% and most preferable at least 90% identical over its entire length to the amino acid sequence of SEQ ID NO: 55.

In a most preferred embodiment, the polynucleotide of the invention consists of or comprises a polynucleotide which is at least 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%

identical and most preferably at least 99% or 100% identical over its entire length to a sequence that consists of SEQ ID NO: 63 or to a sequence that consists of SEQ ID NO: 63 but lacks any of the genomic regions E1A, E1B, E2A, E2B, E3 and/or E4 of SEQ ID NO: 63, most preferably that lacks the genomic regions E1, E3 and E4 of SEQ ID NO: 63.

In a further aspect the invention relates to a polynucleotide comprising the first, the second, the third, the first and second, the first and third, the second and third or the first, second and third aspect and most preferably the first, second and third aspect of the invention. It is preferred that the polynucleotide comprising this or these polynucleotide(s) comprises other adenoviral genes and nucleotide segments, which are adjacent to the hexon, penton and/or fiber gene in the adenovirus genome, e.g. using the PanAd1 genome as set out in SEQ ID NO: 63. It is preferred that the polynucleotide also comprises sequences required for packaging of the polynucleotide into an adenoviral particle.

In a recombinant adenovirus, a fiber, hexon and penton protein according to the first, second and third aspect of the invention, and according to the respective preferred embodiments disclosed herein, contributes each individually to reduce the interaction of said recombinant adenovirus with human and/or rodent neutralizing antibodies. Accordingly, polynucleotides which encode said fiber, hexon and/or penton protein of the present invention are useful to construct enhanced recombinant adenoviruses. Thus, in a further, fourth aspect the invention provides a polynucleotide comprising at least one, preferably at least two and most preferably three isolated polynucleotides selected from the group of polynucleotides consisting of a polynucleotide according to the first aspect of the invention, the second aspect of the invention and the third aspect of the invention. Thus, most preferably, the fourth aspect is an isolated polynucleotide comprising the first, second and third aspect of the invention. In a preferred embodiment, the polynucleotide according to the fourth aspect of the invention is a polynucleotide selected from the group consisting of:

(i) a polynucleotide comprising one polynucleotide according to the first, second or third aspect of the invention;

(ii) a polynucleotide comprising a polynucleotide according to the first aspect of the invention and a polynucleotide according to the second aspect of the invention;

(iii) a polynucleotide comprising a polynucleotide according to the first aspect of the invention and a polynucleotide according to the third aspect of the invention;

(iv) a polynucleotide comprising a polynucleotide according to the second aspect of the invention and a polynucleotide according to the third aspect of the invention; and

(v) a polynucleotide comprising a polynucleotide according to the first, second and third aspect of the invention;

wherein it is preferred that said polynucleotides comprised in the polynucleotide according to (i) through (v) are selected from the *same* adenovirus isolate, e.g. all three polynucleotides encoding fiber, hexon and penton protein or functional derivative thereof, respectively, are from only one of the following adenoviruses: ChAd55, ChAd73, ChAd83, ChAd146, ChAd147 PanAd1, PanAd2 or PanAd3. Furthermore, it is preferred that in the fourth aspect of the invention or in a preferred embodiment thereof, e.g. as outlined above, each "functional derivative" does not comprise more than 10, more than 5 or more than 3 amino acid changes (i.e. deleted, inserted, modified and/or substituted amino acids).

Table 2 below lists a number of particularly preferred embodiments of the polynucleotide of the fourth aspect of invention outlined above. Preferred is a polynucleotide selected from polynucleotides A1 through AF1 shown in Table 2, wherein the polynucleotide comprises three polynucleotides according to alternative (c) of the first, second and third aspect of the invention, each of which respectively encodes an adenoviral fiber, hexon and penton protein or a functional derivative thereof. Table 2 below shows the minimal sequence identity (i.e. at least the indicated sequence identity) which each of said three encoded proteins has to have over its entire length to the amino acid sequence according to the SEQ ID NO which is also shown in Table 2:

Table 2

	Fiber Protein		Hexon Protein		Penton Protein	
Preferred embodiment	Minimal %-Identity	to SEQ ID NO:	Minimal %-Identity	to SEQ ID NO:	Minimal %-Identity	to SEQ ID NO:
A1 – ChAd55	85%	14	95%	20	98%	26
B1 – ChAd73	98%	15	95%	21	98%	27
C1 – ChAd83	100%	16	95%	22	98%	28
D1 – ChAd146	100%	17	95%	23	98%	29
E1 – ChAd147	85%	18	95%	24	98%	30
F1 – PanAd1	85%	19	95%	25	98%	31
G1 – ChAd55	90%	14	95%	20	100%	26
H1 – ChAd73	90%	15	95%	21	98%	27
I1 – ChAd83	90%	16	95%	22	98%	28
J1 – ChAd146	90%	17	95%	23	98%	29
K1 – ChAd147	90%	18	95%	24	98%	30
L1 – PanAd1	90%	19	95%	25	90%	31
M1 – ChAd55	98%	14	98%	20	98%	26
N1 – ChAd73	98%	15	98%	21	98%	27
O1 – ChAd83	98%	16	98%	22	98%	28
P1 – ChAd146	98%	17	98%	23	98%	29
Q1 – ChAd147	98%	18	98%	24	98%	30
R1 – PanAd1	98%	19	98%	25	98%	31
S1 – ChAd55	99%	14	99%	20	99%	26
T1 – ChAd73	99%	15	99%	21	99%	27
U1 – ChAd83	99%	16	99%	22	99%	28
V1 – ChAd146	99%	17	99%	23	99%	29

W1 – ChAd147	99%	18	99%	24	99%	30
X1 – PanAd1	99%	19	99%	25	99%	31
Y1 – PanAd2	80%	50	95%	51	85%	52
Z1 – PanAd2	90%	50	95%	51	90%	52
AA1 – PanAd2	98%	50	98%	51	98%	52
AB1 – PanAd2	99%	50	99%	51	99%	52
AC1 – PanAd3	75%	53	95%	54	85%	55
AD1 – PanAd3	90%	53	95%	54	90%	55
AE1 – PanAd3	98%	53	98%	54	98%	55
AF1 – PanAd3	99%	53	99%	54	99%	55

For example, preferred polynucleotide A1 as shown in Table 1 above comprises:

(i) a polynucleotide encoding a polypeptide having an amino acid sequence which is at least 85% identical over its entire length to SEQ ID NO: 14;

(ii) a polynucleotide encoding a polypeptide having an amino acid sequence which is at least 95% identical over its entire length to SEQ ID NO: 20; and

(iii) a polynucleotide encoding a polypeptide having an amino acid sequence which is at least 98% identical over its entire length to SEQ ID NO: 26;

As mentioned above it is most preferred that said "functional derivative" of a polynucleotide listen in table 2 does not comprise more than 10 amino acid changes (i.e. deleted, inserted, modified and/or substituted amino acids).

Table 3 below lists further preferred embodiments of the polynucleotide of the fourth aspect of the invention. Preferred is a polynucleotide selected from polynucleotides A2 through J2 selected from Table 3, wherein the polynucleotide comprises three polynucleotides designated, "Polynucleotide 1", "Polynucleotide 2" and "Polynucleotide 3", wherein each respective polynucleotide has at least the indicated sequence identity over its entire length to the corresponding polynucleotide according to the SEQ ID NO shown in Table 3:

Table 3

	Polynucleotide 1		Polynucleotide 2		Polynucleotide 3	
Preferred embodiment	Minimal %-Identity	to SEQ ID NO: (polynucleotide encoding Fiber protein)	Minimal %-Identity	to SEQ ID NO: (polynucleotide encoding Hexon protein)	Minimal %-Identity	to SEQ ID NO: (polynucleotide encoding Penton protein)
A2 – ChAd55	98%	32	98%	38	98%	44
B2 – ChAd73	98%	33	98%	39	98%	45
C2 – ChAd83	98%	34	98%	40	98%	46
D2 – ChAd146	98%	35	98%	41	98%	47
E2 – ChAd147	98%	36	98%	42	98%	48

F2 – PanAd1	98%	37	98%	43	98%	49
G2 – ChAd55	99%	32	99%	38	99%	44
H2 – ChAd73	99%	33	99%	39	99%	45
I2 – ChAd83	99%	34	99%	40	99%	46
J2 – ChAd146	99%	35	99%	41	99%	47
K2 – ChAd147	99%	36	99%	42	99%	48
L2 – PanAd1	99%	37	99%	43	99%	49
G2 – PanAd2	98%	56	98%	57	98%	58
H2 – PanAd2	99%	56	99%	57	99%	58
I2 – PanAd3	98%	59	98%	60	98%	61
J2 – PanAd3	99%	59	99%	60	99%	61

Thus, as an example, preferred embodiment A2 ("A2 – ChAd55") of Table 3 above is a polynucleotide comprising:

(i) a polynucleotide that is at least 98% identical to SEQ ID NO: 32 over its entire length;

(ii) a polynucleotide that is at least 98% identical to SEQ ID NO: 38 over its entire length; and

(iii) a polynucleotide that is at least 98% identical to SEQ ID NO: 44 over its entire length.

Table 4 below lists a number of further particularly preferred embodiments of the polynucleotide of the fourth aspect of invention outlined above. Preferred is a polynucleotide selected from polynucleotides A3 through H3 shown in Table 4, wherein the polynucleotide encodes an adenoviral fiber, hexon and penton protein according to the indicated SEQ ID NO or a functional derivative thereof, wherein all three proteins and/or encoded functional derivatives in total comprises equal or less than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 or more than 100, preferably not more than 20 deleted, inserted, modified and/or substituted amino acids:

Table 4

	Fiber Protein	Hexon Protein	Penton Protein
Preferred embodiment	according to SEQ ID NO:	according to SEQ ID NO:	according to SEQ ID NO:
A3 – ChAd55	14	20	26
B3 – ChAd73	15	21	27
C3 – ChAd83	16	22	28
D3 – ChAd146	17	23	29
E3 – ChAd147	18	24	30
F3 – PanAd1	19	25	31
G3 – PanAd2	50	51	52
H3 – PanAd3	53	54	55

In another embodiment of the polynucleotide of the fourth aspect of invention, the polynucleotide encodes an adenoviral fiber and hexon protein of the same strain according to the respective SEQ ID NO as shown in Table 4 or functional derivatives thereof. In a further embodiment of the polynucleotide of the fourth aspect of invention, the polynucleotide encodes

an adenoviral fiber and penton protein of the same strain according to the respective SEQ ID NO as shown in Table 4 or functional derivatives thereof. In a further embodiment of the polynucleotide of the fourth aspect of invention, the polynucleotide encodes an adenoviral hexon and penton protein of the same strain according to the respective SEQ ID NO as shown in Table 4 or functional derivatives thereof. In this context, said functional derivative comprises in each instance less than 1, 2, 3, 4, 5, 6, 7, 8, 9 or less than 10, most preferably less than 3 deleted, inserted, modified and/or substituted amino acids.

In a further preferred embodiment of the fourth aspect of the invention, the polynucleotide consists of or comprises a polynucleotide which is at least 90%, 91%, 92%, 94%, 95%, 96%, 97%, 98%, 99%, 99.9% or 100%, preferably 98% identical over its entire length to a sequence that (i) consists of any one of SEQ ID NO: 13, 62, 63 or 65 or to (ii) a sequence that consists of any one of SEQ ID NO: 13, 62 63 or 65 that lacks one or more of the genomic regions E1A, E1B, E2A, E2B, E3 ORF1, E3 ORF2, E3 ORF3, E3 ORF4, E3 ORF5, E3 ORF6, E3 ORF7, E3 ORF8, E3 ORF9, E4 ORF7, E4 ORF6, E4 ORF5, E4 ORF4, E4 ORF3, E4 ORF2 and/or E4 ORF1. Thus, the aforementioned one or more genomic regions will preferably not be considered in the alignment when determining the percent identity. In another preferred embodiment of the isolated polynucleotide of the invention, the polynucleotide comprises or consists of SEQ ID NO: 13, 62, 63 or 65, wherein one or more of the genomic regions E1A, E1B, E2A, E2B, E3 ORF1, E3 ORF2, E3 ORF3, E3 ORF4, E3 ORF5, E3 ORF6, E3 ORF7, E3 ORF8, E3 ORF9, E4 ORF7, E4 ORF6, E4 ORF5, E4 ORF4, E4 ORF3, E4 ORF2 and E4 ORF1 are deleted from SEQ ID NO: 13, 62, 63 or 65, respectively, or substituted with a transgene or an expression cassette encoding a heterologous protein as described herein. In a most preferred embodiment adenoviral regions E1, E3 and/or E4 are deleted as also exemplified in example 2. The aforementioned preferred polynucleotides, which lack one or more of the indicated genomic regions may further comprise a polynucleotide sequence encoding for a heterologous protein or an expression cassette comprising such a polynucleotide sequence encoding for a heterologous protein. Said polynucleotide sequence encoding for a heterologous protein and said expression cassette comprising such a polynucleotide sequence encoding for a heterologous protein may be inserted into e.g. the deleted regions of the polynucleotide of the invention as is well known in the art and also described in the examples below. Said heterologous protein may be a molecule for delivery into a target cell such as described herein, e.g. a polynucleotide encoding an antigenic protein or a fragment thereof, preferably an antigenic protein or a fragment of a pathogen such as HIV gag protein, a tumour antigen or a protein of the herpes simplex virus as described in the examples. Thus, in a preferred embodiment, the isolated polynucleotide according to the invention further comprises a polynucleotide encoding an antigen selected from the group consisting of a virus

antigen, an antigen of a pathogenic bacterium and a tumorantigen. In one embodiment, said heterologous protein can thus be an antigen selected from the group consisting of an RNA virus antigen, an antigen of a pathogenic bacterium and a tumorantigen. An antigen refers to any protein or peptide capable of eliciting an immune response in a mammal. An antigen comprises preferably at least 8 amino acids and most preferably comprises between 8 and 12 amino acids. Thus, when determining the sequence identity, the genomic regions E1A, E1B, E2A, E2B, E3 and/or E4 are preferably not considered in the alignment, i.e. the alignment is done using a sequence that consists of the entire sequence SEQ ID NO: 13, 62 63 or 65 but excluding the genomic regions E1A, E1B, E2A, E2B, E3, E4 and/or any polynucleotide encoding a heterologous polypeptide or expression cassette comprising such polynucleotide. As also mentioned above, it is preferred that the polynucleotide according to the fourth aspect of the invention and all its preferred embodiments encodes functional hexon, penton and/or fiber capsid proteins or functional derivatives thereof, e.g. the encoded proteins have the same function as the respective capsid proteins or fragments thereof in an *infectious* adenovirus virion. Thus, a recombinant adenovirus comprising in its capsid said encoded recombinant penton, hexon and/or fiber proteins or functional derivatives thereof is capable of entering a host cell. It is further preferred that the capsid proteins or functional derivatives thereof according to the invention or encoded by polynucleotides of the invention have no seroprevalence in human.

The invention further provides an isolated protein encoded by the isolated polynucleotide according to the invention, i.e. an isolated adenoviral capsid polypeptide encoded by the isolated polynucleotide according to the first, second and/or third aspect of the invention or a functional derivative thereof. In this context, the "functional derivative" in one embodiment does not comprise more than 5, 10 or not more than 25 amino acid changes (i.e. deleted, inserted, modified and/or substituted amino acids).

The invention further relates to a vector comprising an isolated polynucleotide according to the invention.

Preferably, the vector does not comprise a gene in a genomic region selected from the group of genomic regions consisting of E1A, E1B, E2A, E2B, E3 and E4, and/or comprises at least one gene of a genomic region selected from the group of E1A, E1B, E2A, E2B, E3 and E4, wherein said at least one gene comprises a deletion and/or mutation which renders the at least one gene non-functional. One possibility to render one of these gene products non-functional is to introduce one or more artificial stop-codons (e.g. TAA) into the open reading frame of these genes. Methods of rendering the virus replication-defective are well known in the art (see e.g. Brody et al, 1994 Ann NY Acad Sci., 716: 90-101).

In some embodiments the polynucleotide of the invention comprises a polynucleotide encoding a hexon protein; penton protein; fiber protein; hexon protein and penton protein; hexon protein and fibre protein; penton protein and fibre protein; or hexon protein, penton protein and fibre protein of the invention and further comprises additional adenoviral polynucleotides. Thus, in one preferred embodiment, the isolated polynucleotide according to the invention comprises at least one of the following:

(a) an adenoviral 5'-inverted terminal repeat (ITR);

(b) an adenoviral Ela region, or a fragment thereof selected from among the 13S, 12S and 9S regions;

(c) an adenoviral Elb region, or a fragment thereof selected from among the group consisting of the small T, large T and IX regions;

(d) an adenoviral E2b region; or a fragment thereof selected from among the group consisting of the small pTP, Polymerase and IVa2 regions;

(e) an adenoviral L1 region, or a fragment thereof, said fragment encoding an adenoviral protein selected from the group consisting of the 28.1 kD protein, polymerase, agnoprotein, 52/55 kDa protein, and IIIa protein;

(f) an adenoviral L2 region or a L2 region comprising a polynucleotide encoding the penton protein of the invention, or a fragment thereof, said fragment encoding an adenoviral protein selected from the group consisting of a penton protein or the penton protein of the invention, VII, V, and Mu protein;

(g) an adenoviral L3 region or a L3 region comprising a polynucleotide encoding the hexon protein of the invention, or a fragment thereof, said fragment encoding an adenoviral protein selected from the group consisting of the VI protein, hexon protein or the hexon protein of the invention and endoprotease;

(h) an adenoviral E2a region;

(i) an adenoviral L4 region, or a fragment thereof said fragment encoding an adenoviral protein selected from the group consisting of the 100 kD protein, the 33 kD homolog, and protein VIII;

(j) an adenoviral E3 region, or a fragment thereof selected from the group consisting of E3 ORF1, E3 ORF2, E3 ORF3, E3 ORF4, E3 ORF5, E3 ORF6, E3 ORF7, E3 ORF8, and E3 ORF9;

(k) an adenoviral L5 region or a L5 region comprising a polynucleotide encoding the fibre protein of the invention, or a fragment thereof said fragment encoding the fiber protein or the fiber protein of the invention;

(l) an adenoviral E4 region, or a fragment thereof selected from the group consisting of E4 ORF7, E4 ORF6, E4 ORF5, E4 ORF4, E4 ORF3, E4 ORF2, and E4 ORF1; in particular ORF6 of said E4 region;
and /or

(m) an adenoviral 3'-ITR.

In some embodiments of the aforementioned polynucleotide it may be desirable as also described above that preferably, the polynucleotide does not comprise an ORF of a genomic region as outlined above (such as e.g. region E3 and/or E4 as defined in example 2) and/or comprises an adenoviral gene which comprises a deletion and/or mutation which renders the at least one gene non-functional. In these preferred embodiments the suitable adenoviral regions will be modified to not include the aforementioned gene(s) or to render the selected gene(s) non-functional. Any adenoviral gene deletions will make space to insert transgenes such as a minigene cassette as described herein. Furthermore, gene deletions can be used to generate adenoviral vectors which are incapable to replicate without the use of a packaging cell line or a helper virus as is well known in the art. Thus, the final recombinant adenovirus comprising a polynucleotide as outlined above which comprises one or more of the specified gene / region deletions or loss-of-function mutations can provide a safer recombinant adenovirus for e.g. gene therapy or vaccination.

In a particularly preferred embodiment, the polynucleotide of the invention comprises at least one of the following:

(a) the 5'-inverted terminal repeat (ITR) region of any one of SEQ ID NO: 13, 62, 63 or 65;

(b) the adenovirus Ela region of any one of SEQ ID NO: 13, 62, 63 or 65, or a fragment thereof selected from among the 13S, 12S and 9S regions;

(c) the adenovirus Elb region of any one of SEQ ID NO: 13, 62, 63 or 65, or a fragment thereof selected from among the group consisting of the small T, large T and IX regions;

(d) the adenovirus E2b region of any one of SEQ ID NO: 13, 62, 63 or 65; or a fragment thereof selected from among the group consisting of the small pTP, Polymerase and IVa2 regions;

(e) the adenovirus L1 region of any one of SEQ ID NO: 13, 62, 63 or 65, or a fragment thereof, said fragment encoding an adenoviral protein selected from the group consisting of the 28.1 kD protein, polymerase, agnoprotein, 52/55 kDa protein, and IIIa protein;

(f) the adenovirus L2 region of any one of SEQ ID NO: 13, 62, 63 or 65, or a fragment thereof, said fragment encoding an adenoviral protein selected from the group consisting of the penton protein with the amino acid sequence of SEQ ID NO: 31, 52 or 55, VII, V, and Mu protein;

(g) the adenovirus L3 region of any one of SEQ ID NO: 13, 62, 63 or 65, or a fragment thereof, said fragment encoding an adenoviral protein selected from the group consisting of the VI protein, hexon protein with the amino acid sequence of SEQ ID NO: 25, 51 or 54 and endoprotease;

(h) the adenovirus E2a region of any one of SEQ ID NO: 13, 62, 63 or 65;

(i) the adenovirus L4 region of any one of SEQ ID NO: 13, 62, 63 or 65, or a fragment thereof said fragment encoding an adenoviral protein selected from the group consisting of the 100 kD protein, the 33 kD homolog, and protein VIII;

(j) the adenovirus E3 region of any one of SEQ ID NO: 13, 62, 63 or 65, or a fragment thereof selected from the group consisting of E3 ORF1, E3 ORF2, E3 ORF3, E3 ORF4, E3 ORF5, E3 ORF6, E3 ORF7, E3 ORF8, and E3 ORF9;

(k) the adenovirus L5 region of any one of SEQ ID NO: 13, 62, 63 or 65, or a fragment thereof said fragment encoding the fiber protein with the amino acid sequence of SEQ ID NO:19, 50 or 53;

(l) the adenovirus E4 region of any one of SEQ ID NO: 13, 62, 63 or 65, or a fragment thereof selected from the group consisting of E4 ORF7, E4 ORF6, E4 ORF5, E4 ORF4, E4 ORF3, E4 ORF2, and E4 ORF1; or ORF6 of Ad5 E4 region (SEQ ID NO: 64); and

(m) the 3'-ITR of any one of SEQ ID NO: 13, 62, 63 or 65.

In one embodiment the isolated polynucleotide of the invention further encodes one or more, preferably all of the following adenoviral proteins: protein VI, protein VIII, protein IX, protein IIIa and protein IVa2. Preferably these proteins are encoded by from the respective open reading frames of the PanAd1, PanAd2 or PanAd3 genomic sequence disclosed herein. An average person skilled in the art of recombinant adenoviruses is well aware of how to determine the open reading frames that encode for the above specified adenoviral proteins. He is also aware of the structure of adenoviral genomes and can map, without undue burden, the individual adenoviral regions and ORFs outlined herein to e.g. any of the novel adenoviral genomes PanAd1, PanAd2 or PanAd3 of the invention.

In order to express a polynucleotide, preferably a cDNA, encoding one or more adenoviral proteins of the invention, one can subclone said polynucleotide into an expression vector that contains a strong promoter to direct transcription, a transcription/translation terminator, and a ribosome-binding site for translational initiation. Suitable bacterial promoters are well known in the art, e.g., E. coli, Bacillus sp., and Salmonella, and kits for such expression systems are commercially available. Similarly eukaryotic expression systems for mammalian cells, yeast, and insect cells are well known in the art and are also commercially available.

In addition to the promoter, the expression vector typically contains a transcription unit or expression cassette that contains all the additional elements required for the expression of the adenoviral protein-encoding nucleic acid in host cells. A typical expression cassette thus contains a promoter operatively linked to the nucleic acid sequence encoding the adenoviral protein/polypeptide and signals required for efficient polyadenylation of the transcript, ribosome binding sites, and translation termination. Additional elements of the cassette may include, for example enhancers. An expression cassette should also contain a transcription termination region downstream of the structural gene to provide for efficient termination. The termination region may be obtained from the same gene as the promoter sequence or may be obtained from different genes.

The particular expression vector used to transport the genetic information into the cell is not particularly critical. Any of the conventional vectors used for expression in eukaryotic or prokaryotic cells may be used. Standard bacterial expression vectors include plasmids such as pBR322 based plasmids, pSKF, pET23D, and fusion expression systems such as GST and LacZ, but there are many more known in the art to the skilled person that can be usefully employed.

Expression vectors containing regulatory elements from eukaryotic viruses are typically used in eukaryotic expression vectors, e.g. SV40 vectors, papilloma virus vectors, and vectors derived from Epstein-Barr virus. Other exemplary eukaryotic vectors include pMSG, pAV009/A.sup.+, pMTO10/A.sup.+, pMAMneo-5, baculovirus pDSVE, pcDNA3.1, pIRES and any other vector allowing expression of proteins under the direction of e.g. the HCMV immediate-early promoter, SV40 early promoter, SV40 late promoter, metallothionein promoter, murine mammary tumor virus promoter, Rous sarcoma virus promoter, polyhedrin promoter, or other promoters shown effective for expression in eukaryotic cells.

Some expression systems have markers that provide gene amplification such as thymidine kinase, hygromycin B phosphotransferase, and dihydrofolate reductase. Alternatively, high yield expression systems not involving gene amplification are also suitable.

The elements that may also be included in expression vectors include a replicon that functions in E. coli, a gene encoding drug resistance to permit selection of bacteria that harbor recombinant plasmids, and unique restriction sites in nonessential regions of the plasmid to allow insertion of eukaryotic sequences. The particular drug resistance gene chosen is not critical - any of the many drug resistance genes known in the art are suitable. The prokaryotic sequences are optionally chosen such that they do not interfere with the replication of the DNA in eukaryotic cells, if necessary.

Standard transfection methods can be used to produce bacterial, mammalian, yeast or insect cell lines. Any of the well-known procedures for introducing foreign polynucleotide

sequences into host cells may be used. For example, commercially available liposome-based transfection kits such as Lipofectamine™ (Invitrogen), commercially available lipid-based transfection kits such as Fugene (Roche Diagnostics), polyethylene glycol-based transfection, calcium phosphate precipitation, gene gun (biolistic), electroporation, or viral infection and any of the other well known methods for introducing cloned genomic DNA, cDNA, synthetic DNA or other foreign genetic material into a host cell may be used. It is only necessary that the particular genetic engineering procedure used be capable of successfully introducing at least one gene into the host cell capable of expressing the receptor.

An expressed adenoviral protein can be optionally purified using standard techniques. For example, the cells may be lysed either mechanically or by osmotic shock before being subject to precipitation and chromatography steps, the nature and sequence of which will depend on the particular recombinant material to be recovered. Alternatively, the recombinant protein may be secreted and recovered from the culture medium in which the recombinant cells had been cultured as is known in the art of protein expression.

In one preferred embodiment the vector of the invention is a plasmid vector, e.g. an expression vector. A plasmid vector according to the invention can also be used to generate a recombinant adenovirus.

Thus, a further aspect of the present invention is a recombinant adenovirus, preferably a replication-incompetent adenovirus, comprising an isolated polynucleotide according to the invention and/or at least one isolated adenoviral capsid polypeptide according to the invention. Preferably the recombinant adenovirus of the invention comprises a hexon a fiber and a penton protein of the present invention, e.g. a combination as outlined in Table 2 above. In a preferred embodiment, the recombinant adenovirus is characterized in that it is capable of infecting a human cell - preferably capable of infecting a human cell after said adenovirus was incubated for one hour in a human blood serum derived from a human that has not previously been exposed to a chimpanzee adenovirus.

As the sequence information of the novel hexon, penton and fiber proteins of the invention are provided, said recombinant adenovirus is obtainable e.g. by constructing a recombinant adenovirus which is composed of the usual adenoviral proteins but which has a capsid that comprises at least one isolated adenoviral capsid polypeptide according to the invention or a functional derivative thereof. In this regard it is preferred that the recombinant adenovirus comprises an L2 region which comprises a polynucleotide sequence encoding the penton protein of the invention, an L3 region which comprises a polynucleotide sequence encoding the hexon protein of the invention and/or an L5 region which comprises a polynucleotide sequence encoding the fiber protein of the invention. Most preferably said

recombinant adenovirus comprises an L2 region, an L3 region and an L5 region encoding, respectively, at least for the penton, hexon and fiber protein of the invention.

Methods for the construction of recombinant adenoviruses are well known in the art. Useful techniques for the preparation of recombinant adenoviruses are, for example, reviewed in Graham & Prevec, 1991 In Methods in Molecular Biology: Gene Transfer and Expression Protocols, (Ed. Murray, EJ.), p. 109; and Hitt et al., 1997 "Human Adenovirus Vectors for Gene Transfer into Mammalian Cells" Advances in Pharmacology 40:137-206. Further methods are described in WO 2006/086284. For the preparation of replication deficient adenoviruses, one or several of the E1A, E1B, E2A, E2B, E3 and E4 gene products may be expressed in a complementing cell line that can be used for the propagation and rescue of recombinant adenoviruses that are replication-incompetent, because they lack e.g. one of the aforementioned gene products. The use of such cell-lines is also described in the references outlined above.

In one embodiment, the polynucleotides of the invention (or vectors comprising said polynucleotides of the invention as described herein) are used to produce recombinant adenoviral particles. The recombinant adenoviruses are preferably functionally deleted as mentioned above in one or more adenoviral regions such as e.g. the Ela or Elb regions, and optionally bearing other mutations, e. g., temperature-sensitive mutations or deletions in other adenoviral genes. In other embodiments, it is desirable to retain an intact Ela and/or Elb region in the recombinant adenoviruses. Such an intact El region may be located in its native location in the adenoviral genome or placed in the site of a deletion in the native adenoviral genome (e.g., in the E3 region).

In the construction of adenovirus vectors for delivery of a gene to a host, e.g. human (or other mammalian) cell, a range of adenovirus nucleic acid sequences can be employed in the vectors of the invention. For example, all or a portion of the adenovirus delayed early gene E3 may be eliminated from the adenovirus sequence which forms a part of the recombinant virus. The function of simian E3 is believed to be irrelevant to the function and production of the recombinant virus particle. In some embodiments, adenovirus vectors may also be constructed having a deletion of at least the ORF6 region of the E4 gene, and more desirably because of the redundancy in the function of this region, the entire E4 region. Still another vector of this invention contains a deletion in the delayed early gene E2a. Deletions may also be made in any of the late genes L1 through L5 of the simian adenovirus genome. Similarly, deletions in the intermediate genes IX and IVa2 may be useful for some purposes. Other deletions may be made in the other structural or non-structural adenovirus genes. The above discussed deletions may be used individually, i. e., an adenovirus sequence for use in the present invention may contain deletions in only a single region. Alternatively, deletions of entire genes or portions thereof

effective to destroy their biological activity may be used in any combination. For example, in one exemplary vector according to the invention, the adenovirus sequence may have deletions of the El and the E4 region, or of the El, E2a and E3 region, or of the E1 and E3 regions, or of El, E2a and E4 regions, with or without deletion of E3, and so on. As discussed above, such deletions may be used in combination with other adenoviral gene mutations, such as temperature-sensitive mutations, to achieve a desired result.

An adenoviral vector lacking any essential adenoviral sequences (e. g., a region selected from Ela, Elb, E2a, E2b, E4 ORF6, L1 or L4) may be cultured in the presence of the missing adenoviral gene products which are required for viral infectivity and propagation of an adenoviral particle. These helper functions may be provided by culturing the adenoviral vector in the presence of one or more helper constructs (e. g. , a plasmid or virus) or a packaging host cell (complementing cell line as also described above). See, for example, the examples included herein and the techniques described for preparation of a "minimal" human adenovirus vector in International Patent Application WO96/13597 published May 9, 1996, and incorporated herein by reference.

Useful helper viruses contain selected adenovirus gene sequences that complement the respective genes that are deleted in preferred embodiments of the adenovirus vector of the invention and/or that are not expressed by the packaging cell line in which the vector is transfected. In one embodiment, the helper virus is replication-defective and contains a variety of adenovirus genes in addition to the sequences described above.

Helper viruses may also be formed into poly-cation conjugates as described in Wu et al, J. Biol. Chem., 264: 16985-16987 (1989); K. J. Fisher and J. M. Wilson, Biochem. J., 299: 49 (April 1, 1994). A helper virus may optionally contain a second reporter minigene. A number of such reporter genes are known to the art. The presence of a reporter gene on the helper virus which is different from the transgene on the adenovirus vector allows both the Ad vector and the helper virus to be independently monitored. This second reporter may be used to facilitate separation between the resulting recombinant virus and the helper virus upon purification.

To generate recombinant adenoviruses (Ad) deleted in any of the genes described in the context of preferred embodiments herein, the function of the deleted gene region, if essential to the replication and infectivity of the virus, is preferably supplied to the recombinant virus by a helper virus or cell line, i. e. , a complementation or packaging cell line. In many circumstances, a cell line expressing the human E1 can be used to transcomplement the vector used to generate recombinant adenoviruses. This is particularly advantageous because, due to the diversity between the polynucleotide sequences of the invention and the human adenoviral E1 sequences found in currently available packaging cells, the use of the current human E1-containing cells

will prevent the generation of replication-competent adenoviruses during the replication and production process. However, in certain circumstances, it will be desirable to utilize a cell line which expresses the E1 gene products for the production of an E1-deleted recombinant adenovirus.

If desired, one may utilize the sequences provided herein to generate a packaging cell or cell line that expresses, at a minimum, the adenovirus E1 gene from a ChAd55, ChAd73, ChAd83, ChAd146, ChAd147, PanAd1, PanAd2 or PanAd3 adenovirus under the transcriptional control of a promoter for expression in a selected parent cell line, such as e.g. a HeLa cell. Inducible or constitutive promoters may be employed for this purpose. Examples of promoters are provided e.g. in the examples described herein. Such E1-expressing cell lines are useful in the generation of recombinant adenovirus E1 deleted vectors. Additionally, or alternatively, the invention provides cell lines that express one or more adenoviral gene products, e. g., Ela, Elb, E2a, and/or E4 ORF6, preferably Ad5 E4 ORF6 (see also the examples below), which can be constructed using essentially the same procedures for use in the generation of recombinant adenoviral vectors. Such cell lines can be utilized to transcomplement adenovirus vectors deleted in essential genes that encode those products, or to provide helper functions necessary for packaging of a helper- dependent virus (e. g., adeno-associated virus).

Generally, when delivering a vector of the invention comprising e.g. a minigene by transfection, the vector is delivered in an amount from about 0.1 μg to about 100 μg DNA, and preferably about 10 to about 50 μg DNA to about 1 x 10^4 cells to about 1 x 10^3 cells, and preferably about 10^5 cells. However, the relative amounts of vector DNA to host cells may be adjusted, taking into consideration such factors as the selected vector, the delivery method and the host cells selected. Introduction of the vector into a host cell may be achieved by any means known in the art or as disclosed herein, including transfection, and infection, e. g. using $CaPO_4$ transfection or electroporation.

For the construction and assembly of the desired minigene-containing recombinant adenovirus, the vector can in one example be transfected *in-vitro* in the presence of a helper virus into the packaging cell line, allowing homologous recombination to occur between the helper and the vector sequences, which permits the adenovirus-transgene sequences in the vector to be replicated and packaged into virion capsids, resulting in the recombinant viral vector particles as is well known in the art. A recombinant adenoviruses of the invention is useful e.g. in transferring a selected transgene into a selected host cell.

In a preferred embodiment of the adenovirus of the invention, the adenovirus has a seroprevalence of less than 5% in human subjects and preferably no seroprevalence in human subjects, most preferably no seroprevalence in human subjects that have not previously been in

contact with a chimpanzee adenovirus. In this context it is preferred that the human subjects belong to an ethnic group selected from Europeans, indigenous people of Africa, Asians, indigenous people of America and indigenous people of Oceania. Methods for the identification of the ethnic origin of a human subject are comprised in the art (see e.g. WO2003/102236).

In a further preferred embodiment of the recombinant adenovirus according to the invention, the adenovirus DNA is capable of entering a mammalian target cell, i.e. it is infectious. An infectious recombinant adenoviruses of the invention can be used as a vaccine and for gene therapy as also described below. Thus, in another embodiment it is preferred that the recombinant adenovirus comprises a molecule for delivery into a target cell. Preferably, the target cell is a mammalian cell, e.g. a chimpanzee cell, a rodent cell or a human cell. For example, the molecule for delivery into a target cell can be an expression cassette as defined herein. Methods to introduce an expression cassette into the genome of an adenovirus are well known in the art (see for example the literature citations provided above). In one example a recombinant adenovirus of the present invention that comprises an expression cassette, encoding e.g. a minigene or an antigene, can be generated by replacing a genomic region of the adenovirus selected from E1A, E1B, E2A, E2B, E3 and E4 with said expression cassette. The genomic regions E1A, E1B, E2A, E2B, E3 and E4 of the adenoviruses of the invention can easily be identified by an alignment with known and annotated adenoviral genomes such as from human Ad5 (see: Birgitt Täuber and Thomas Dobner, Oncogene (2001) 20, p. 7847 – 7854; and also: Andrew J. Davison, et al., "Genetic content and evolution of adenoviruses", Journal of General Virology (2003), 84, p. 2895–2908). Non-limiting examples of how to generate modified adenoviruses comprising a molecule for delivery into a target cell are also provided in examples 1 and 2 and figure 4 below.

The molecule for delivery into a target cell is preferably a polynucleotide but may also be a polypeptide or a small chemical compound, preferably having a therapeutic or diagnostic activity. In one particularly preferred embodiment, the molecule for delivery into a target cell is a polynucleotide that comprises an adenovirus 5' inverted terminal repeat sequence (ITR), a gene, e.g. SEQ ID NO: 1 and a 3' ITR. It will be evident to the skilled person that the molecular size of the molecule has to be chosen such that the capsid can form around and package the molecule, when the recombinant adenovirus is produced, e.g. in a packaging cell line. Thus, preferably the gene is a minigene which can have e.g. up to 7000 and maximally up to 8000 base pairs.

In a preferred embodiment, the molecule for delivery into a target cell comprised in the recombinant adenovirus according to the invention is a polynucleotide encoding an antigenic protein or a fragment thereof. An antigenic protein or fragment thereof is capable of eliciting an immune response in a mammal and may be in a particularly preferred embodiment the gag

protein of HIV as shown in the examples and being encoded by a polynucleotide according to SEQ ID NO: 1.

In a particularly preferred embodiment, the recombinant adenovirus of the invention is an adenovirus that has been deposited at ECACC (European Collection of Cell Culture, Porton Down, Salisbury, SP4 OJG, UK) and has a deposit number selected from the group consisting of 08110601 (ChAd83), 08110602 (ChAd73), 08110603 (ChAd55), 08110604 (ChAd147) and 08110605 (ChAd146). The deposits of the aforementioned adenoviral strains (Latin name: *Mastadenovirus, Adenoviridae*) have been made on November 6, 2008 by Okairos AG, Elisabethenstr. 3, 4051 Basel, Switzerland.

These deposits will be maintained under the terms of the Budapest Treaty on the International Recognition of the Deposit of Microorganisms for the Purposes of Patent Procedure. These deposits were made merely as a convenience for those of skill in the art and are not an admission that a deposit is required under 35 U. S. C. 112. All restrictions on the availability to the public of the deposited material will be irrevocably removed, except for the requirements specified in 37 C. F. R. 1. 808 (b), upon the granting of a patent.

Another preferred embodiment of the recombinant adenovirus of the invention is an adenovirus derived from an adenovirus selected from the group consisting of 08110601 (ChAd83), 08110602 (ChAd73), 08110603 (ChAd55), 08110604 (ChAd147) and 08110605 (ChAd146). Preferably the adenovirus derived of one of the aforementioned deposited adenoviruses has been altered by introducing a functional deletion, deletion or modification in its genome, e.g. to obtain a replication incompetent adenovirus and/or an adenovirus that is capable of expressing a transgene in a host cell. For example, one or more genes selected from the group consisting of E1A, E1B, E2A, E2B, E3 and E4 gene can be deleted, rendered non-functional, and/or can be replaced by an expression cassette as outlined above. Additionally, one or more genes of another adenovirus may be introduced, preferably for a deleted gene. A skilled person is well aware of how to introduce these genomic alterations in the deposited strains. In this respect, methods of generating modified adenoviruses comprising a molecule for delivery into a target cell, which is a preferred modification of the deposited strains, have been described above.

In a further aspect a composition is provided that comprises an immunological adjuvant and at least one of the following (i) through (iv):

(i) an isolated protein according to the invention;

(ii) an isolated polynucleotide according to the invention;

(iii) a vector according to the invention;

(iv) a recombinant adenovirus according to the invention;

and, optionally, a pharmaceutically acceptable excipient.

A composition according to the invention that comprises an adjuvant can be used as a vaccine, e.g. for human subjects. The immunological adjuvant also referred to herein in short as "adjuvant", accelerates, prolongs and/or enhances the quality and/or strength of an immune response to an antigen/immunogen, in comparison to the administration of the antigen alone, thus, reducing the quantity of antigen/immunogen necessary in any given vaccine, and/or the frequency of injection necessary in order to generate an adequate immune response to the antigen/immunogen of interest.

Examples of adjuvants that may be used in the context of the composition according to the present invention are gel-like precipitates of aluminum hydroxide (alum); $AlPO_4$; alhydrogel; bacterial products from the outer membrane of Gram-negative bacteria, in particular monophosphoryl lipid A (MPLA), lipopolysaccharides (LPS), muramyl dipeptides and derivatives thereof; Freund's incomplete adjuvant; liposomes, in particular neutral liposomes, liposomes containing the composition and optionally cytokines; non-ionic block copolymers; ISCOMATRIX adjuvant (Drane et al., 2007); unmethylated DNA comprising CpG dinucleotides (CpG motif), in particular CpG ODN with a phosphorothioate (PTO) backbone (CpG PTO ODN) or phosphodiester (PO) backbone (CpG PO ODN); synthetic lipopeptide derivatives, in particular Pam_3Cys; lipoarabinomannan; peptidoglycan; zymosan; heat shock proteins (HSP), in particular HSP 70; dsRNA and synthetic derivatives thereof, in particular Poly I:poly C; polycationic peptides, in particular poly-L-arginine; taxol; fibronectin; flagellin; imidazoquinoline; cytokines with adjuvant activity, in particular GM-CSF, interleukin- (IL-)2, IL-6, IL-7, IL-18, type I and II interferons, in particular interferon-gamma, TNF-alpha; 25-dihydroxyvitamin D3 (calcitriol); and synthetic oligopeptides, in particular MHCII-presented peptides. Non-ionic block polymers containing polyoxyethylene (POE) and polyoxypropylene (POP), such as POE-POP-POE block copolymers may be used as an adjuvant (Newman et al., 1998). This type of adjuvant is particularly useful for compositions comprising nucleic acids as active ingredient.

Optionally, various pharmaceutically acceptable excipients may be used. Preferred pharmaceutically acceptable excipients are mentioned below when discussing the uses according to the invention.

Activation of specific receptors can stimulate an immune response. Such receptors are known to the skilled artisan and comprise, for example, cytokine receptors, in particular type I cytokine receptors, type II cytokine receptors, TNF receptors; and vitamin D receptor acting as transcription factor; and the Toll-like receptors 1 (TLR1), TLR-2, TLR 3, TLR4, TLR5, TLR-6, TLR7, and TLR9. Agonists to such receptors have adjuvant activity, i.e., are immunostimulatory. In a preferred embodiment, the adjuvant of the composition of the present invention may be one

or more Toll-like receptor agonists. In a more preferred embodiment, the adjuvant is a Toll-like receptor 4 agonist. In a particular preferred embodiment, the adjuvant is a Toll-like receptor 9 agonist, preferably being encoded by the nucleotide tccatgacgttcctgacgtt (SEQ ID NO: 2).

In a further aspect the invention provides a cell, preferably a non-simian cell, comprising at least one of the following:

(i) an isolated protein according to the invention;

(ii) an isolated polynucleotide according to the invention;

(iii) a vector according to the invention;

(iv) a recombinant adenovirus according to the invention;

The cell may be selected of a bacterial cell such as an *E. coli* cell, a yeast cell such as *Saccharomyces cerevisiae* or *Pichia pastoris*, a plant cell, an insect cell such as SF9 or Hi5 cells, or a mammalian cell. Preferred examples of mammalian cells are Chinese hamster ovary (CHO) cells, human embryonic kidney (HEK 293) cells, HELA cells, human hepatoma cells (e.g. Huh7.5), Hep G2 human hepatoma cells, Hep 3B human hepatoma cells and the like.

If the cell comprises an isolated polyucleotide according to (ii), this polynucleotide may be present in the cell either (i) freely dispersed as such, or (ii) integrated into the host cell genome or mitochondrial DNA.

In a further preferred embodiment, the cell is a host cell, preferably a 293 cell or a PER.C6™ cell, that expresses at least one adenoviral gene selected from the group consisting of E1a, E1b, E2a, E2b, E4, L1, L2, L3, L4 and L5.

Also provided is the use of the isolated polynucleotide according to the invention, the isolated protein according to the invention, the vector according to the invention, the recombinant adenovirus according to the invention and/or the pharmaceutical composition according to the invention for the therapy or prophylaxis of a disease.

Adenoviral vectors have demonstrated great potential as vaccine vectors. Preclinical and clinical studies have demonstrated the feasibility of vector design, robust antigen expression and protective immunity using this system. Thus, a preferred embodiment is the use according to the invention, wherein the therapy or prophylaxis is a vaccination, e.g. for human subjects. Detailed instructions of how adenoviruses are used and prepared for vaccination are provided as ample literature comprised in the art and known to the skilled person.

If the use is a vaccination, a recombinant adenovirus of the invention can be administered in an immunologically and/or prophylactically effective dose which is preferably 1×10^8 to 1×10^{11} viral particles (i.e., 1×10^8, 5×10^8, 1×10^9, 5×10^9, 1×10^{10}, 2.5×10^{10} or 5×10^{10} particles). Furthermore, for a vaccination which requires a boosting, it is preferred to apply a "heterologous prime-boost" methodology, as defined above. Furthermore, when using the

isolated polynucleotide according to the invention, the isolated protein according to the invention, the vector according to the invention, the recombinant adenovirus according to the invention and/or the pharmaceutical composition according to the invention in a vaccine, it is preferred that the vaccine comprises an adjuvant. Preferred immunological adjutants have been mentioned herein and can be used in such vaccine.

A recombinant adenovirus prepared using a polynucleotide or recombinant adenoviral protein or fragment thereof according to the invention can be used to transduce a host cell with a polynucleotide, e.g. DNA. Thus, a preferably replication deficient, albeit infectious, i.e. capable of entering a host cell, adenovirus can be prepared to express any custom protein or polypeptide in a host cell. Thus, in a preferred embodiment, the therapy recited in the use according to the invention is gene therapy. If an isolated polynucleotide, an isolated protein, a vector, a recombinant adenovirus and/or a pharmaceutical composition according to the invention is used for gene therapy and is administered to a subject to be treated, it is preferred that it is administered in a sufficiently large dose such that the treatment results in one or more cells of the patient being transfected, i.e. transduced. If a recombinant adenovirus and/or a pharmaceutical composition according to the invention is administered by any of the preferred means of administrations disclosed herein, it is preferred that an effective dose which is preferably 1×10^8 to 5×10^{11} viral particles (i.e., 1×10^8, 5×10^8, 1×10^9, 5×10^9, 1×10^{10}, 2.5×10^{10}, 5×10^{10}, 1×10^{11} or, most preferably, 5×10^{11} particles) is administered. In preferred embodiments, the preferably heterologous polynucleotide that is comprised in the recombinant adenovirus of the invention is capable of expressing a protein or polypeptide in a host cell of the subject, wherein the protein or polypeptide comprises a signal peptide which effects secretion of the protein or polypeptide from said host cell. For example, a patient in need of a certain protein can be treated using an adenovirus of the present invention which comprises a cDNA that encodes a secretable form of that protein.

In a further embodiment of the use of the present invention, the isolated polynucleotide, isolated protein, vector, adenovirus and/or pharmaceutical composition according to the invention (in the following referred to as pharmaceutical according to the invention) is formulated to further comprise one or more pharmaceutically acceptable diluents; carriers; excipients, including fillers, binders, lubricants, glidants, disintegrants, and adsorbents; and/or preservatives.

The pharmaceutical according to the invention can be administered by various well known routes, including oral, rectal, intragastrical and parenteral administration, e.g. intravenous, intramuscular, intranasal, intradermal, subcutaneous and similar administration routes. Parenteral-, intramuscular- and intravenous administration is preferred. Preferably the

pharmaceutical according to the invention is formulated as syrup, an infusion or injection solution, a tablet, a capsule, a capslet, lozenge, a liposome, a suppository, a plaster, a band-aid, a retard capsule, a powder, or a slow release formulation. Preferably the diluent is water, a buffer, a buffered salt solution or a salt solution and the carrier preferably is selected from the group consisting of cocoa butter and vitebesole.

Particular preferred pharmaceutical forms for the administration of the pharmaceutical according to the invention during the use of the present invention are forms suitable for injectable use and include sterile aqueous solutions or dispersions and sterile powders for the extemporaneous preparation of sterile injectable solutions or dispersion. Typically, such a solution or dispersion will include a solvent or dispersion medium, containing, for example, water-buffered aqueous solutions, e.g. biocompatible buffers, ethanol, polyol, such as glycerol, propylene glycol, polyethylene glycol, suitable mixtures thereof, surfactants or vegetable oils.

Infusion or injection solutions can be accomplished by any number of art recognized techniques including but not limited to addition of preservatives like anti-bacterial or anti-fungal agents, e.g. parabene, chlorobutanol, phenol, sorbic acid or thimersal. Further, isotonic agents, such as sugars or salts, in particular sodium chloride may be incorporated in infusion or injection solutions.

Preferred diluents of the present invention are water, physiological acceptable buffers, physiological acceptable buffer salt solutions or salt solutions. Preferred carriers are cocoa butter and vitebesole. Excipients which can be used with the various pharmaceutical forms of the pharmaceutical according to the invention can be chosen from the following non-limiting list:

a) binders such as lactose, mannitol, crystalline sorbitol, dibasic phosphates, calcium phosphates, sugars, microcrystalline cellulose, carboxymethyl cellulose, hydroxyethyl cellulose, polyvinyl pyrrolidone and the like;
b) lubricants such as magnesium stearate, talc, calcium stearate, zinc stearate, stearic acid, hydrogenated vegetable oil, leucine, glycerids and sodium stearyl fumarates,
c) disintegrants such as starches, croscaramellose, sodium methyl cellulose, agar, bentonite, alginic acid, carboxymethyl cellulose, polyvinyl pyrrolidone and the like.

Other suitable excipients can be found in the Handbook of Pharmaceutical Excipients, published by the American Pharmaceutical Association, which is herein incorporated by reference.

Certain amounts of the pharmaceutical according to the invention are preferred for the therapy or prophylaxis of a disease. It is, however, understood that depending on the severity of the disease, the type of the disease, as well as on the respective patient to be treated, e.g. the general health status of the patient, etc., different doses of the pharmaceutical according to the

invention are required to elicit a therapeutic or prophylactic effect. The determination of the appropriate dose lies within the discretion of the attending physician.

If the pharmaceutical according to the invention is to be used prophylactically, it may be formulated as a vaccine. In this case the pharmaceutical according to the invention is preferably administered in above outlined preferred and particular preferred doses. Preferably, the administration of the vaccine is repeated at least two, three, four, five, six, seven, eight nine or at least 10 times over the course of a defined period of time, until the vaccinated subject has generated sufficient antibodies against the pharmaceutical according to the invention so that the risk of developing the respective disease has lessened. The period of time in this case is usually variable depending on the antigenicity of the vaccine. Preferably the period of time is not more than four weeks, three months, six months or three years. In one embodiment, if an adenovirus according to the invention is used for vaccination purposes, at least one of the hyper variable domains of the hexon protein can be replaced by an immunogenic epitope of the respective disease agent that the vaccination is directed against. Vaccines typically contain one or more adjuvants as outlined above. A detailed summary of the use of adenoviruses for vaccination and methods pertaining thereto is provided in: Bangari DS and Mittal SK (2006) Vaccine, 24(7), p. 849-862; see also: Zhou D, et al., Expert Opin Biol Ther. 2006 Jan;6(1):63-72; and: Folgori A, et al., Nat Med. 2006 Feb;12(2):190-7.; see also: Draper SJ, et al., Nat Med. 2008 Aug;14(8):819-21. Epub 2008 Jul 27.

Various modifications and variations of the invention will be apparent to those skilled in the art without departing from the scope of the invention. Although the invention has been described in connection with specific preferred embodiments, it should be understood that the invention as claimed should not be unduly limited to such specific embodiments. Indeed, various modifications of the described modes for carrying out the invention which are obvious to those skilled in the relevant fields are intended to be covered by the present invention.

The following figures are merely illustrative of the present invention and should not be construed to limit the scope of the invention as indicated by the appended claims in any way.

BRIEF DESCRIPTION OF THE FIGURES

Fig. 1 Multiple sequence alignment between hexon proteins of various adenovirus isolates of the invention, using Clustal-W with default settings. Hexon proteins of said novel chimpanzee adenovirus isolates are shown (designated as PanAd1, PanAd2, PanAd3, ChAd55, ChAd73, ChAd83, ChAd146 and ChAd147). The hypervariable domains 1 through 7 are designated as "HVR 1-6" and "HVR 7", respectively.

Fig. 2 Multiple sequence alignment between fiber proteins of adenovirus ChAd55 and of further novel chimpanzee adenovirus isolates (designated as PanAd1, PanAd2, PanAd3, ChAd73, ChAd83, ChAd146 and ChAd147), using Clustal-W with default settings.

Fig. 3 Multiple sequence alignment between penton proteins of adenovirus ChAd55 and of further novel chimpanzee adenovirus isolates (designated as PanAd1, PanAd2, PanAd3, ChAd73, ChAd83, ChAd146 and ChAd147), using Clustal-W with default settings.

Fig. 4 Diagram of construction of a replication-defective adenovirus vector by homologous recombination with wild type viral genome and the corresponding shuttle plasmid. See also example 2 .

Fig. 5 Cell-mediated immune response in mice vaccinated with recombinant adenoviruses comprising an expression cassette for the expression of HIV gag protein (SEQ ID NO:1). The vaccination potency of recombinant human Ad5 and chimpanzee ChAd55 (Fig. 5A), of recombinant human Ad5 and bonobo PanAd1, PanAd2 and PanAd3 adenovirus (Fig. 5B) and of recombinant ChAd55, ChAd73, ChAd83, ChAd146 and ChAd147 was compared (Fig. 5C). The immune response was measured by Interferon-γ ELIspot assay by incubating the cells with a CD8 HIV gag epitope mapped in Balb/C mice. The results are reported as spot forming cells per 10^6 splenocytes.

Fig. 6 The seroprevalence of novel adenovirus vectors was evaluated on a panel of human sera of European origin. The seroprevalence of human adenovirus type 5 (Ad5) and of chimpanzee adenoviruses ChAd55, ChAd73, ChAd83, ChAd146, ChAd147, PanAd1, PanAd2, PanAd3 and CV-68 were evaluated in parallel on the same panel. The data are expressed as % of subjects showing an immunoprevalence. Neutralizing antibodies were only detected against Ad5 and CV-68 adenoviruses but not for any of the novel adenoviruses of the present invention.

Fig. 7 PanAd HSV immunization of BALB/c mice is shown in Fig. 7A and PanAd cancer Ag immunization of BALB/c mice is shown in Fig. 7B.

Fig. 8 PanAd HIV gag immunization of *Macaca fascicularis* is shown in a priming/boosting vaccination experiment.

EXAMPLES

Example 1: Adenovirus isolation and characterization

ChAd55, ChAd73, ChAd83, ChAd146, ChAd147 are a group of chimpanzee adenoviruses obtained from healthy animals housed in different European and US facilities. ChAd55, ChAd73, ChAd83, ChAd146, ChAd147 have the property of no detectable reactivity with human

sera. PanAd1, PanAd2 and PanAd3 are new adenovirus isolated from healthy bonobos (*Pan Paniscus*) housed in different European and US facilities. PanAd1, PanAd2 and PanAd3 have the property of no detectable reactivity with human sera.

The common chimpanzee and bonobo adenovirus stocks were cloned by infecting 293 cells seeded in 96-well plates, after the first passage of amplification. The virus cloning was performed by limiting dilution of the cell lysate obtained at the first passage of the virus amplification. 5 isolated clones were picked up and serially propagated. After 3-4 serial passages of amplification, a large-scale preparation of adenovirus was performed on cells planted on 5 two-layer cell-factories (NUNC) (200 millions of cells/cell factory). Purified viral particles were obtained from cell lysate by two ultra-centrifugation steps on cesium chloride density gradients.

Genomic DNA was isolated from 3 X 10^{12} pp of purified virus preparation by digestion with Proteinase K (0.5 mg/ml) in 1% SDS-TEN (2 hrs at 55°C). After a Phenol-Chloroform extraction and Ethanol precipitation, the genomic DNA was resuspended in water and submitted for genomic sequencing.

An initial classification of the new isolates was obtained by sequence analysis of the hypervariable region 7 (HVR7) of the hexon gene. To this end two primers were designed on the highly conserved regions flanking HVR7: TGTCCTACCARCTCTTGCTTGA (SEQ ID NO. 3) and GTGGAARGGCACGTAGCG (SEQ ID NO. 4). The HVR7 was amplified by PCR using purified viral DNA or crude 293 lysate as template and then sequenced. More detailed information about the isolate was obtained by sequencing the hypervariable regions 1 to 6. The DNA region containing HVR1-6 was amplified by PCR using oligonucleotides HVR1-6fd, CAYGATGTGACCACCGACCG (SEQ ID NO. 5) and HVR1-6rev, GTGTTYCTGTCYTGCAAGTC (SEQ ID NO. 6). Based on HVRs sequence analysis the new isolated viruses were classified into subgroup E (ChAd55, ChAd73, ChAd83, ChAd146, ChAd147) and subgroup C (PanAd1, PanAd2 and PanAd3) of human Ad virus classification (Horowitz, MS (1990), Adenoviridae and their replication. In Virology B.N. Fields and D.M. Knipe, eds (raven Press, New York) pp.1679-1740).

A phylogenetic tree was obtained by alignment of human and chimp adenovirus hexon amino acid sequences. The results are consistent with the initial classification based on nucleotide sequence alignment limited to hexon HVR1-6 and 7 by using Align X program (Informax, Inc) demonstrating a close phylogenetic relationship of ChAd55, ChAd73, ChAd83, ChAd146, ChAd147 isolates with human Ad4 (subgroup E) while bonobo adenovirus isolate PanAd1, PanAd2 and PanAd3 are related to human Ad1, 2, 5, 6 (subgroup C).

Example 2: Vector construction

The PanAd1, PanAd2 and PanAd3 and ChAd55, ChAd73, ChAd83, ChAd146, ChAd147 virus genomes were cloned in a plasmid vector following the strategy detailed below. All manipulations of the vector genome were performed in *E.coli* following standard techniques. Vector systems were developed by deleting E1 and E3 regions from ChAd and PanAd backbones. The E1 region was substituted with expression cassettes based on human CMV IE promoter and BGHpA signal containing HCV non structural region (HCV NS) and HIV gag (SEQ ID NO: 1) genes for the evaluation of the immunological potency in animal models. In addition, ChAd and PanAd vectors expressing the secreted alkaline phosphatase gene (SEAP) were constructed for the neutralization assay. The vectors were propagated in 293 cells and purified by CsCl gradients following standard protocols.

The construction of PanAd1, PanAd2 and PanAd3 ΔE1 vectors proceeded through the steps provided below.

I. Construction of PanAd Shuttle Vector

PanAd1 genome was used to construct a shuttle vector for cloning by homologous recombination the entire genome of PanAd1, PanAd2 and PanAd3. Briefly, the shuttle vector used to clone bonobo adenovirus 1 referred to herein as pBAd1RLD_EGFP was constructed as follows:

PanAd1 left end (nt 1-450) was amplified by PCR with oligonucleotides 5'- ATCTGGAATTCGTTTAAACCATCATCAATAATATACCTTATTTTG-3' (SEQ ID NO: 7) and 5'- TCAGGAACTAGTTCCGTATACCTATAATAATAAAACGGAGACTTTG-3' (SEQ ID NO: 8) digested with SpeI and EcoRI then ligated into a plasmid vector already containing HCMV-EGFP-bgh polyA cassette by generating pBAd1-L. PanAd1 right end (nt 37362-37772) was then amplified by PCR with oligonucleotides 5'-TCCAGCGGCGCGCCAGACCCGAGTCTTACCAGGA-3' (SEQ ID NO: 9) and 5'-ATTCAGGATCCGAATTCGTTTAAACCATCATCAATAATATACCTTATTTTG-3' (SEQ ID NO: 10), and cloned in pBAd1-L thus generating plasmid pBAd1-RL.

A PanAd1 DNA fragment (nt 3498-4039) containing pIX coding region was subsequently amplified by PCR with the oligonucleotides 5'-TATTCTGCGATCGCTGAGGTGGGTGAGTGGGCG -3' (SEQ ID NO: 11) and 5'-TTACTGGCGCGCCTGCCTCGAGTAAACGGCATTTGCAGGAGAAG-3' (SEQ ID NO: 12) then cloned into pBAd1-RL obtaining the plasmid pBAd1RLD EGFP shuttle. Shuttle plasmids containing the expression cassettes for secreted alkaline phosphatase (SEAP), HIV gag, HCV

non structural region (NS) genes were also constructed by substituting the EGFP gene in pBAd1RLD EGFP shuttle.

The HIV gag HCV NS region , SEAP and EGFP expression cassette based on human cytomegalovirus (HCMV) promoter and bovine growth hormone polyadenylation signal (Bgh polyA) were constructed as described in Emini et al., International Publication Number WO 03/031588. The viral DNA cassette was designed to contain restriction enzyme sites (PmeI) that are present only at the end of both ITRs to allow the release of viral DNA from plasmid DNA.

II. Construction of ΔE1 PanAd1, PanAd2 and PanAd3 Vector

PanAd1, PanAd2 and PanAd3 vectors were constructed by homologous recombination in E. coli strain BJ5183. BJ5183 cells were co-transformed with PanAd1, 2 and 3 purified viral DNAs and pBAd1RLD-EGFP or pBAd1RLD-Gag. Homologous recombination between pIX genes, right ITR DNA sequences present at the ends of linearized pBAd1RLD-EGFP or pBAd1RLD-Gag and viral genomic DNAs allowed its insertion in the plasmid vector, by deleting at the same time the E1 region that was substituted by the expression cassette. This strategy allowed for the construction of the preadeno plasmids pPanAd1, pPanAd2 and pPanAd3 expressing EGFP or HIV gag transgenes. SEAP or HCV-NS expression cassettes were then cloned into pPanAd 1, 2 and 3 vectors by replacing either EGFP or Gag expression cassettes.

III. E3 Region Deletion

A deletion of the E3 region was introduced in PanAd1, PanAd2 and PanAd3 vector backbones by using a strategy involving several steps of cloning and homologous recombination in *E.coli*. PanAd1 E3 deletion spans from nucleotide 28636 to nucleotide 32596 of genomic PanAd1 sequence (SEQ ID NO.: 13); PanAd2 E3 deletion spans from nucleotide 28653 to nucleotide 32599 of genomic PanAd2 sequence (SEQ ID NO.: 62); PanAd3 E3 deletion spans from nucleotide 28684 to nucleotide 32640 of genomic PanAd3 sequence (SEQ ID NO.: 63).

IV. E4 region Deletion

The native E4 region of PanAd1, PanAd2 and PanAd3 was deleted and replaced with Ad5 E4 ORF6 coding sequence (SEQ ID NO.: 64). The coordinates of the E4 deletion introduced in the PanAd 1, 2 and 3 backbones are the following:

PanAd1 E4 deletion spans from nucleotide 34690 to 37369 (SEQ ID NO.: 13);

PanAd2 E4 deletion spans from nucleotide 34696 to 37400. (SEQ ID NO.: 62);

PanAd3 E4 deletion spans from nucleotide 34690-37369 (SEQ ID NO.: 63).

The deleted region contains all PanAd E4 orfs while the E4 native promoter and polyadenylation signal were not deleted

The HIV gag and HCV NS region expression cassette based on human cytomegalovirus (HCMV) promoter and bovine growth hormone polyadenylation signal (Bgh polyA) was constructed as described in Emini et al., International Publication Number WO 03/031588 and inserted into PanAd1, 2 and 3 ΔE1 EGFP vector by homologous recombination in E. coli strain BJ5183 exploiting the homologies between HCMV and Bgh polyA DNA sequences.

V. ChAd55 DE1 Expression Vector Construction and Rescue

Construction of Shuttle Vector for ChAd55 cloning

ChAd55 shuttle was constructed by following the same strategy described above for PanAd vectors then used for the cloning of the ChAd55 viral genomes. To this end, the shuttle vector pARS ChAd55 containing the right end as well as the left end of viral genome (left end from the ITR to the pIX gene with the E1 region deleted and substituted with the expression cassette) was linearized with AscI restriction enzyme and co-transformed into *E.coli* strain BJ5183 with ChAd55 purified viral DNA. Homologous recombination between DNA sequences from pIX genes and right ITR present at the ends of linearized pARS ChAd55 and ChAd55, ChAd73, ChAd83, ChAd146 and ChAd147 purified viral genomic DNAs allowed their insertion into the plasmid vector by deleting at the same time the E1 region. A diagram of the chimp adenovirus 55 (ChAd55) genome cloning strategy is provided in figure 4.

Expression cassettes based on human cytomegalovirus (HCMV) promoter and bovine growth hormone poly-adenylation signal (Bgh polyA) were constructed to express secreted alkaline phosphatase (SEAP), EGFP, HIV gag , HCV NS genes. All expression cassettes were inserted into the single SnaBI site of pARS ChAd55 vector to be transferred by homologous recombination into the ΔE1 adenovirus pre-plasmids.

Example 3: Immunization experiments.

The efficiency of ChAd55, ChAd73, ChAd83, ChAd146, ChAd147, PanAd1, PanAd2 and PanAd3 vectors as potential recombinant vaccine was evaluated in mice with vectors expressing HIV gag transgene. The vector potency of ChAd55 gag was compared with human Ad5 gag in immunization experiments performed in parallel. Groups of 10 animals were injected in the quadriceps with a dose of the vector of 10^8 vp/mouse for Ad5gag or ChAd55gag (Fig. 5A). In a separate experiment a group of 5 animals were injected with a dose of the vector of 10^8 vp/mouse for Ad5gag or PanAd1gag, PanAd2gag and PanAd3gag (Fig. 5B). The potency of

ChAd73 gag, ChAd83 gag, ChAd146 gag and Chad147gag was also determined by immunizing groups of 5 mice with a dose of vector of 10^8 vp/mouse in parallel with ChAd55 gag (Fig. 5C). The immune response elicited against HIV gag was measured by Interferon-γ Elispot assay on splenocytes. The results of immunization experiments with ChAd55, ChAd73, ChAd83, ChAd146, ChAd147 and PanAd1, PanAd2 and PanAd3 in comparison with human Ad5 gag vector show that the novel adenoviruses of the invention are at least as effective in eliciting a specific immune response as the prior art recombinant adenovirus Ad5.

Example 4: Neutralization Studies

Neutralization assays were carried out in order to evaluate the prevalence in human sera of neutralizing antibodies against the common chimpanzee adenovirus 55, 73, 83, 146, 147 and the Bonobo adenovirus type 1, 2 and 3. The assay evaluated the effects of serum preincubation on the ability of ChAd55, ChAd73, ChAd83, ChAd146, ChAd147, PanAd1, PanAd2 and PanAd3 carrying the gene for secreted alkaline phosphatase (SEAP) to transduce human 293 cells. The neutralization titer is defined as the dilution of serum giving a 50% reduction of the SEAP activity observed in the positive control with the virus in absence of serum. Each serum sample was tested at various dilutions (five 4-fold increments starting from 1/18 dilution through 1:4608). Samples were pre-incubated for one hour at 37°C and then added to 293 cells seeded into 96-well plates ($3x10^4$ cells/well). A panel of human sera was tested for neutralization activity. In parallel the same panel was tested on Ad5 and on chimp and bonobo Ad SEAP vectors. The results are provided in Figure 6. The results indicate that the seroprevalence on chimpanzee adenoviruses is lower than human adenovirus Ad5. However, in general the presence of neutralizing antibodies against already described ChAds (CV-68) can be detected in a subset of subjects. On the contrary, all human sera tested so far failed to neutralize ChAd55 and PanAd1, PanAd2 and PanAd3 even at very low titer. The same was observed for ChAd73, ChAd83, ChAd146 and ChAd147. Therefore, the novel adenovirus isolates ChAd55, ChAd73, ChAd83, ChAd146, ChAd147 and PanAd1, PanAd2 and PanAd3 represent the ideal solution to the problem of the pre-existing anti-human Ad immunity that limits the administration of viral vectors based on common human Ad serotypes such as Ad5.

Example 5: Immunization efficiency of PanAd1 and 3 vectors in comparison with Ad5 vectors

The efficiency of PanAd1 and PanAd3 vectors as potential recombinant vaccines was evaluated in BALB/c mice with vectors expressing herpes simplex virus (HSV) antigen and with vectors

expressing a cancer antigen. The vector potency of PanAd1 and 3 expressing HSV Ag and the cancer Ag was compared with the corresponding vectors based on human Ad5.

To evaluate the antiviral potency, 9 groups of BALB/c mice were injected in the quadriceps with increasing doses of the vectors starting from 10^7 vp/mouse up to 10^9 vp/mouse in parallel with PanAd1-HSV, PanAd3-HSV and Ad5-HSV (see Fig. 7A). The immune response elicited against the HSV antigen was measured by Interferon-γ Elispot assay on mouse splenocytes incubated with a peptide pool covering the entire amino acid sequence of the antigen. The results of immunization experiments with PanAd1, PanAd2 and PanAd3 in comparison with human Ad5 vector reported in Figure 7 showed that the novel adenoviruses of the invention are more effective in eliciting a specific immune response than the prior art recombinant adenovirus Ad5 at each concentration tested. This is clearly demonstrated by the higher frequency of antigen-specific T-cell observed in mice immunized with PanAd1 and PanAd3 vectors.

The efficiency in eliciting anti-tumoral T-cell response by PanAd vectors was evaluated by immunizing groups of BALB/c mice by injecting in the quadriceps increasing doses of the vectors starting from 10^7 vp/mouse up to 10^9 vp/mouse. Two groups of BALB/C mice were injected with Ad5 vector expressing the tumor antigen at 10^7 vp/mouse and 10^9 vp/mouse. In parallel 3 groups of BALB/c mice were immunized with 10^7, 10^8 ,10^9 vp of PanAd1 or PanAd3 vectors carrying the same tumor antigen. The T cell response was measured by Interferon-γ Elispot assay on splenocytes using a single peptide representing a mapped CD8 epitope. The results shown in Figure 7B demonstrated a higher frequency of responding animals at the lowest dose of the vaccine as well as a higher frequency of antigen-specific T-cell in the groups of animals immunized with the PanAd vectors in comparison with those immunized with Ad5 vector.

Example 6: Immunization of Macaca fascicularis with PanAd vectors

Two groups of 3 macaques were immunized by intramuscular injection of CsCl-purified PanAd1 and PanAd3 in a heterologous prime/boost regimen. Each animal in the group 1 received a dose of 10^8 vp while the animals in the group 2 received a dose of 10^{10} vp of PanAd3 Gag vector in the deltoid muscle at week 0. All animals in both groups were than boosted with a single dose of PanAd1 Gag of 10^{10} vp at week 13.

CMI was measured at different time points by IFN-γ ELISPOT assay. This assays measure HIV antigen-specific CD8+ and CD4+ T lymphocyte responses. Peptides based on the amino acid sequence of HIV Gag protein were prepared for use in these assays to measure immune responses in adenovirus vector vaccinated monkeys. The individual peptides are overlapping 20-mers, offset by 10 amino acids.

The IFNγ-ELISPOT assay provides a quantitative determination of antigen-specific T lymphocyte responses. PBMC are serially diluted and placed in microplate wells coated with anti-rhesus IFN-γ antibody (MD-1 U-Cytech). They are cultured with a HIV Gag peptide pool for 20 hours, resulting in the restimulation of the precursor cells and secretion of IFN-γ. The cells are washed away, leaving the secreted IFN bound to the antibody-coated wells in concentrated areas where the cells were sitting. The captured IFN is detected with biotinylated anti-rhesus IFN antibody (detector Ab U-Cytech) followed by alkaline phosphatase-conjugated streptavidin (Pharmingen 13043E). The addition of insoluble alkaline phosphatase substrate results in dark spots in the wells at the sites where the cells were located, leaving one spot for each T cell that secreted IFN-γ.

The number of spots per well is directly related to the precursor frequency of antigen-specific T cells. Gamma interferon was selected as the cytokine visualized in this assay (using specific anti-gamma interferon monoclonal antibodies) because it is the most common, and one of the most abundant cytokines synthesized and secreted by activated T lymphocytes. For this assay, the number of spot forming cells (SFC) per million PBMCs is determined for samples in the presence and absence (media control) of peptide antigens. Data from macaques on PBMC obtained at different time points post dose 1 and post dose 2 are shown in Figure 8. All animals primed with PanAd3 at both doses showed a T cell response against HIV Gag, efficiently boosted by the second injection of PanAd1 demonstrating that, as already suggested by the hexon, penton and fiber sequence alignment, PanAd1 and PanAd3 are distinct serotypes that can be combined in a heterologous prime-boost immunization regimen. Thus, in another aspect the invention provides the use of two recombinant adenoviruses of the invention for a heterologous prime-boost immunization wherein the two recombinant adenoviruses of the invention are of distinct adenoviral serotypes, most preferably of PanAd1 and PanAd3 as described herein.

Applicant's or agent's file reference 578-13 PCT 2	International application No. PCT/EP2010/000 616

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Date of deposit	Accession Number
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C. ADDITIONAL INDICATIONS *(leave blank if not applicable)* — This information is continued on an additional sheet ☐

ChAd55 - Mastadenovirus, Adenoviridae

Additional Request:
The applicant hereby declares that the availability of the bilogical material as stated above shall be effected only by the issue of a sample to an expert.

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ChAd73 - Mastadenovirus, Adenoviridae

Additional Request:
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ChAd83 - Mastadenovirus, Adenoviridae

Additional Request:
The applicant hereby declares that the availability of the bilogical material as stated above shall be effected only by the issue of a sample to an expert.

D. DESIGNATED STATES FOR WHICH INDICATIONS ARE MADE *(if the indications are not for all designated States)*

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ChAd146 - Mastadenovirus, Adenoviridae

Additional Request:
The applicant hereby declares that the availability of the bilogical material as stated above shall be effected only by the issue of a sample to an expert.

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C. ADDITIONAL INDICATIONS *(leave blank if not applicable)* — This information is continued on an additional sheet [ ]

ChAd147 - Mastadenovirus, Adenoviridae

Additional Request:
The applicant hereby declares that the availablility of the bilogical material as stated above shall be effected only by the issue of a sample to an expert.

D. DESIGNATED STATES FOR WHICH INDICATIONS ARE MADE *(if the indications are not for all designated States)*

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CLAIMS

1. An isolated polynucleotide that encodes an adenoviral fiber protein or a functional derivative thereof and that is selected from the group consisting of:
   (a) a polynucleotide encoding a polypeptide having the amino acid sequence according to any of SEQ ID NOs: 14-19, 50 and 53;
   (b) a polynucleotide encoding the functional derivative of a polypeptide according to any of SEQ ID NOs: 14-19, 50 and 53, wherein said functional derivative comprises the deletion, insertion and/or substitution of one or more amino acid residues; and
   (c) a polynucleotide encoding a functional derivative having an amino acid sequence which is at least 85% identical over its entire length to the amino acid sequence of any of SEQ ID NOs: 14-19, 50 and 53.

2. An isolated polynucleotide that encodes an adenoviral hexon protein or a functional derivative thereof and that is selected from the group consisting of:
   (a) a polynucleotide encoding a polypeptide having the amino acid sequence according to any of SEQ ID NOs: 20-25, 51 and 54;
   (b) a polynucleotide encoding the functional derivative of a polypeptide according to any of SEQ ID NOs: 20-25, 51 and 54, wherein said functional derivative comprises the deletion, insertion and/or substitution of one or more amino acid residues; and
   (c) a polynucleotide encoding a functional derivative having an amino acid sequence which is at least 95% identical over its entire length to the amino acid sequence of any of SEQ ID NOs: 20-25, 51 and 54.

3. An isolated polynucleotide that encodes an adenoviral penton protein or a functional derivative thereof and that is selected from the group consisting of:
   (a) a polynucleotide encoding a polypeptide having the amino acid sequence according to any of SEQ ID NOs: 26-31, 52 and 55;
   (b) a polynucleotide encoding the functional derivative of a polypeptide according to any of SEQ ID NOs: 26-31, 52 and 55, wherein said functional derivative comprises the deletion, insertion and/or substitution of one or more amino acid residues; and

(c) a polynucleotide encoding a functional derivative having an amino acid sequence which is at least 85% identical over its entire length to the amino acid sequence of any of SEQ ID NOs: 26-31, 52 and 55.

4. A polynucleotide comprising at least one isolated polynucleotide according to any of claims 1, 2 and 3.

5. The isolated polynucleotide according to any of claims 1-4, wherein the polynucleotide comprises at least one of the following:

(a) an adenoviral 5'-end, preferably an adenoviral 5' inverted terminal repeat;

(b) an adenoviral Ela region, or a fragment thereof selected from among the 13S, 12S and 9S regions;

(c) an adenoviral Elb region, or a fragment thereof selected from among the group consisting of the small T, large T and IX regions;

(d) an adenoviral E2b region; or a fragment thereof selected from among the group consisting of the small pTP, Polymerase and IVa2 regions;

(e) an adenoviral L1 region, or a fragment thereof, said fragment encoding an adenoviral protein selected from the group consisting of the 28.1 kD protein, polymerase, agnoprotein, 52/55 kDa protein, and IIIa protein;

(f) an adenoviral L2 region, or a fragment thereof, said fragment encoding an adenoviral protein selected from the group consisting of the penton protein according to claim 3, VII, V, and Mu protein;

(g) an adenoviral L3 region, or a fragment thereof, said fragment encoding an adenoviral protein selected from the group consisting of the VI protein, hexon protein according to claim 2 and endoprotease;

(h) an adenoviral E2a region;

(i) an adenoviral L4 region, or a fragment thereof said fragment encoding an adenoviral protein selected from the group consisting of the 100 kD protein, the 33 kD homolog, and protein VIII;

(j) an adenoviral E3 region, or a fragment thereof selected from the group consisting of E3 ORF1, E3 ORF2, E3 ORF3, E3 ORF4, E3 ORF5, E3 ORF6, E3 ORF7, E3 ORF8, and E3 ORF9;

(k) an adenoviral L5 region, or a fragment thereof said fragment encoding the fiber protein according to claim 1;

(l) an adenoviral E4 region, or a fragment thereof selected from the group consisting of E4 ORF7, E4 ORF6, E4 ORF5, E4 ORF4, E4 ORF3, E4 ORF2, and E4 ORF1 ; and /or

(m) an adenoviral 3'-end, preferably an adenoviral 3' inverted terminal repeat.

6. The isolated polynucleotide according to claim 4, wherein the polynucleotide consists of or comprises a polynucleotide which is at least 90% identical over its entire length to a sequence that essentially consists of any one of SEQ ID NO: 13, 62, 63 or 65 or to a sequence that consists of any one of SEQ ID NO: 13, 62, 63 or 65 but lacks the genomic regions E1A, E1B, E2A, E2B, E3 and/or E4 of SEQ ID NO: 13, 62, 63 or 65.

7. An isolated adenoviral capsid polypeptide encoded by the isolated polynucleotide according to any of claims 1-3, or a functional derivative thereof.

8. A vector comprising the isolated polynucleotide according to any of claims 1-6.

9. The vector according to claim 8, wherein the vector does not comprise a gene in a genomic region selected from the group of genomic regions consisting of E1A, E1B, E2A, E2B, E3 and E4, and/or comprises at least one gene of a genomic region selected from the group of E1A, E1B, E2A, E2B, E3 and E4, wherein said at least one gene comprises a deletion and/or mutation which renders the at least one gene non-functional.

10. A recombinant adenovirus, preferably a replication-incompetent adenovirus, comprising an isolated polynucleotide according to any of claims 1-6 and/or at least one isolated adenoviral capsid polypeptide according to claim 7.

11. The recombinant adenovirus of claim 10, wherein the recombinant adenovirus comprises a molecule for delivery into a target cell.

12. The recombinant adenovirus according to claim 10 or 11, wherein the adenovirus has a seroprevalence of less than 5% in human subjects and preferably no seroprevalence in human subjects.

13. The recombinant adenovirus according to any of claims 10-12, wherein the adenovirus is capable of infecting a mammalian cell.

14. The recombinant adenovirus according to any of claims 11-13, wherein the molecule for delivery into a target cell is a polynucleotide encoding an antigenic protein or a fragment thereof.

15. The recombinant adenovirus of any of claims 10-14, wherein the adenovirus is an adenovirus that has been deposited and has a deposit number selected from the group consisting of 08110601 (ChAd83), 08110602 (ChAd73), 08110603 (ChAd55), 08110604 (ChAd147) and 08110605 (ChAd146).

16. A composition comprising an adjuvant and at least one of the following (i) through (iv):

(i) one or more isolated adenoviral capsid polypeptides according to claim 7;

(ii) an isolated polynucleotide according to any of claims 1-6;

(iii) a vector according to any of claims 8-9;

(iv) a recombinant adenovirus according to any of claims 10-15;

and, optionally, a pharmaceutically acceptable excipient

17. The composition according to claim 16, wherein the adjuvant is an agonist for a receptor selected from the group consisting of type I cytokine receptors, type II cytokine receptors, TNF receptors, vitamin D receptor acting as transcription factor, and the Toll-like receptors 1 (TLR1), TLR-2, TLR 3, TLR4, TLR5, TLR-6, TLR7 and TLR9.

18. The composition according to claim 17, wherein the adjuvant is a Toll-like receptor 4 or 9 agonist.

19. A cell comprising at least one of the following:

(i) one or more isolated adenoviral capsid polypeptides according to claim 7;

(ii) an isolated polynucleotide according to any of claims 1-6;

(iii) a vector according to any of claims 8-9;

(iv) a recombinant adenovirus according to any of claims 10-15;

20. The cell according to claim 18, wherein the cell is a host cell that expresses at least one adenoviral gene selected from the group consisting of E1a, E1b, E2a, E2b, E4, L1, L2, L3, L4 and L5.

21. Use of an isolated adenoviral capsid polypeptides according to claim 7; an isolated polynucleotide according to any of claims 1-6; a vector according to any of claims 8-9; a recombinant adenovirus according to any of claims 10-15; and/or the composition according to claim 18 for the therapy or prophylaxis of a disease.

22. Use according to claim 21, wherein the therapy or prophylaxis is a vaccination.

23. Use according to claim 21, wherein the therapy is gene therapy.

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tctcaaagcg tcgaggcgac acctggcgtc aggatgtatg tagactccgt cttgcaccgc 36060
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gcgcagcaaa atcccagtaa gcaactccct gatattaaga tgaaccatgc caaaaatctg 36480
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ccgcacgcgg aggtacagca aaacggtccc cataggagga atcacaaaat tagtaggaga 37260
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caaaacaaca taaagcgctt ccacaggagc agccatgaca aagacccgag tcttaccagg 37380
aaaattttaa aaaagattcc tcaacgcagc accagcacca acacctgtca gtgtaaaatg 37440
ccaagcgccg agcgagtata tataggaata aaaagtgacg taaacggtta aagtccagaa 37500
aacgcccaga aaaaccgcac gcgaacctac gccccgaaac gaaagccaaa aaacagtgaa 37560
cacgcccttt cggcgtcaac ttccgctttc ccacggtacg tcacttccgc atatagtaaa 37620
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cccgcgccgc cgctcctccc cgccccgccc cgctccgccc acctcattat catattggct 37740
tcaatccaaa ataaggtata ttattgatga tg 37772

<210> 14
<211> 440
<212> PRT
<213> Adenoviridae - Mastadenovirus

<400> 14

Met Ser Lys Lys Arg Val Arg Val Asp Asp Asp Phe Asp Pro Val Tyr
1 5 10 15

Pro Tyr Asp Ala Asp Asn Ala Pro Thr Val Pro Phe Ile Asn Pro Pro
20 25 30

Phe Val Ser Ser Asp Gly Phe Gln Glu Lys Pro Leu Gly Val Leu Ser
35 40 45

Leu Arg Leu Ala Asp Pro Val Thr Thr Lys Asn Gly Glu Ile Thr Leu
50 55 60

Lys Leu Gly Glu Gly Val Asp Leu Asp Asp Ser Gly Lys Leu Ile Ser
65 70 75 80

Lys Asn Ala Thr Lys Ala Thr Ala Pro Leu Ser Ile Ser Asn Ser Thr
85 90 95

Ile Ser Leu Asn Met Asp Ala Pro Leu Tyr Asn Asn Asn Gly Lys Leu
100 105 110

Gly Ile Arg Ile Gly Ala Pro Leu Lys Val Val Asp Leu Leu Asn Thr
115 120 125

Leu Ala Val Ala Tyr Gly Ser Gly Leu Gly Leu Lys Asn Asn Ala Leu
130 135 140

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

Lys Ile Asn Leu Gly Asn Gly Pro Leu Thr Val Ala Ala Asn Arg Leu
165 170 175

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

Leu Glu Ser Asn Ile Ser Trp Ala Lys Gly Ile Arg Phe Glu Gly Asn
195 200 205

Ala Ile Ala Ala Asn Ile Gly Lys Gly Leu Glu Phe Gly Thr Thr Ser
210 215 220

Ser Glu Ser Asp Val Ser Asn Ala Tyr Pro Ile Gln Val Lys Leu Gly
225 230 235 240

Thr Gly Leu Thr Phe Asp Ser Thr Gly Ala Ile Val Ala Trp Asn Lys
245 250 255

Glu Asp Asp Lys Leu Thr Leu Trp Thr Thr Ala Asp Pro Ser Pro Asn
260 265 270

Cys His Ile Tyr Ser Asp Lys Asp Ala Lys Leu Thr Leu Cys Leu Thr
275 280 285

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Lys Cys Gly Ser Gln Ile Leu Gly Thr Val Ser Leu Ile Ala Val Asp
290                 295                 300

Thr Gly Ser Leu Asn Pro Ile Thr Gly Gln Val Thr Thr Ala Leu Val
305                 310                 315                 320

Ser Leu Lys Phe Asp Ala Asn Gly Val Leu Gln Thr Ser Ser Thr Leu
                325                 330                 335

Asp Lys Glu Tyr Trp Asn Phe Arg Lys Gly Asp Val Thr Pro Ala Glu
            340                 345                 350

Pro Tyr Thr Asn Ala Ile Gly Phe Met Pro Asn Ile Lys Ala Tyr Pro
        355                 360                 365

Lys Asn Thr Asn Ser Ala Ala Lys Ser His Ile Val Gly Lys Val Tyr
    370                 375                 380

Leu His Gly Glu Val Ser Lys Pro Leu Asp Leu Ile Ile Thr Phe Asn
385                 390                 395                 400

Glu Thr Ser Asn Glu Thr Cys Thr Tyr Cys Ile Asn Phe Gln Trp Gln
                405                 410                 415

Trp Gly Thr Asp Lys Tyr Lys Asn Glu Thr Leu Ala Val Ser Ser Phe
            420                 425                 430

Thr Phe Ser Tyr Ile Ala Gln Glu
        435                 440


<210>  15
<211>  443
<212>  PRT
<213>  Adenoviridae - Mastadenovirus

<400>  15

Met Ser Lys Lys Arg Val Arg Val Asp Asp Asp Phe Asp Pro Val Tyr
1               5                   10                  15

Pro Tyr Asp Ala Asp Asn Ala Pro Thr Val Pro Phe Ile Asn Pro Pro
            20                  25                  30

Phe Val Ser Ser Asp Gly Phe Gln Glu Lys Pro Leu Gly Val Leu Ser
        35                  40                  45

Leu Arg Leu Ala Asp Pro Val Thr Thr Lys Asn Gly Glu Ile Thr Leu
    50                  55                  60

Lys Leu Gly Glu Gly Val Asp Leu Asp Asp Ser Gly Lys Leu Ile Ser
65                  70                  75                  80
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Lys Asn Ala Thr Lys Ala Thr Ala Pro Leu Ser Ile Ser Asn Ser Thr
85 90 95

Ile Ser Leu Asn Met Ala Ala Pro Phe Tyr Asn Asn Asn Gly Thr Leu
100 105 110

Ser Leu Asn Val Ser Thr Pro Leu Ala Val Phe Pro Thr Phe Asn Thr
115 120 125

Leu Gly Ile Ser Leu Gly Asn Gly Leu Gln Thr Ser Asn Lys Leu Leu
130 135 140

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

Val Lys Thr Asp Lys Gly Leu Tyr Ile Asn Ser Ser Gly Asn Arg Gly
165 170 175

Leu Glu Ala Asn Ile Ser Leu Lys Arg Gly Leu Ile Phe Asp Gly Asn
180 185 190

Ala Ile Ala Thr Tyr Leu Gly Ser Gly Leu Asp Tyr Gly Ser Tyr Asp
195 200 205

Ser Asp Gly Lys Thr Arg Pro Ile Ile Thr Lys Ile Gly Ala Gly Leu
210 215 220

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

Ser Phe Asp Ser Ala Gly Ala Leu Thr Ala Gly Asn Lys Glu Asp Asp
245 250 255

Lys Leu Thr Leu Trp Thr Thr Pro Asp Pro Ser Pro Asn Cys Gln Leu
260 265 270

Leu Ser Asp Arg Asp Ala Lys Phe Thr Leu Cys Leu Thr Lys Cys Gly
275 280 285

Ser Gln Ile Leu Gly Thr Val Ala Val Ala Ala Val Thr Val Ser Ser
290 295 300

Ala Leu Asn Pro Ile Asn Asp Thr Val Lys Ser Ala Ile Val Phe Leu
305 310 315 320

Arg Phe Asp Ser Asp Gly Val Leu Met Ser Asn Ser Ser Met Val Gly
325 330 335

Asp Tyr Trp Asn Phe Arg Glu Gly Gln Thr Thr Gln Ser Val Ala Tyr
340 345 350

Thr Asn Ala Val Gly Phe Met Pro Asn Leu Gly Ala Tyr Pro Lys Thr
355 360 365

Gln Ser Lys Thr Pro Lys Asn Ser Ile Val Ser Gln Val Tyr Leu Asn
370 375 380

Gly Glu Thr Thr Met Pro Met Thr Leu Thr Ile Thr Phe Asn Gly Thr
385 390 395 400

Asp Glu Lys Asp Thr Thr Pro Val Ser Thr Tyr Ser Met Thr Phe Thr
405 410 415

Trp Gln Trp Thr Gly Asp Tyr Lys Asp Lys Asn Ile Thr Phe Ala Thr
420 425 430

Asn Ser Phe Thr Phe Ser Tyr Met Ala Gln Glu
435 440

<210> 16
<211> 425
<212> PRT
<213> Adenoviridae - Mastadenovirus

<400> 16

Met Ser Lys Lys Arg Val Arg Val Asp Asp Asp Phe Asp Pro Val Tyr
1 5 10 15

Pro Tyr Asp Ala Asp Asn Ala Pro Thr Val Pro Phe Ile Asn Pro Pro
20 25 30

Phe Val Ser Ser Asp Gly Phe Gln Glu Lys Pro Leu Gly Val Leu Ser
35 40 45

Leu Arg Leu Ala Asp Pro Val Thr Thr Lys Asn Gly Glu Ile Thr Leu
50 55 60

Lys Leu Gly Glu Gly Val Asp Leu Asp Ser Ser Gly Lys Leu Ile Ser
65 70 75 80

Asn Thr Ala Thr Lys Ala Ala Ala Pro Leu Ser Phe Ser Asn Asn Thr
85 90 95

Ile Ser Leu Asn Met Asp His Pro Phe Tyr Thr Lys Asp Gly Lys Leu
100 105 110

Ala Leu Gln Val Ser Pro Pro Leu Asn Ile Leu Arg Thr Ser Ile Leu
115 120 125

Asn Thr Leu Ala Leu Gly Phe Gly Ser Gly Leu Gly Leu Arg Gly Ser
130 135 140

Ala Leu Ala Val Gln Leu Val Ser Pro Leu Thr Phe Asp Thr Asp Gly

145 150 155 160

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

Ala Ile Glu Ser Asn Ile Ser Trp Ala Lys Gly Leu Lys Phe Glu Asp
180 185 190

Gly Ala Ile Ala Thr Asn Ile Gly Asn Gly Leu Glu Phe Gly Ser Ser
195 200 205

Ser Thr Glu Thr Gly Val Asp Asp Ala Tyr Pro Ile Gln Val Lys Leu
210 215 220

Gly Ser Gly Leu Ser Phe Asp Ser Thr Gly Ala Ile Met Ala Gly Asn
225 230 235 240

Lys Glu Asp Asp Lys Leu Thr Leu Trp Thr Thr Pro Asp Pro Ser Pro
245 250 255

Asn Cys Gln Ile Leu Ala Glu Asn Asp Ala Lys Leu Thr Leu Cys Leu
260 265 270

Thr Lys Cys Gly Ser Gln Ile Leu Ala Thr Val Ser Val Leu Val Val
275 280 285

Gly Ser Gly Asn Leu Asn Pro Ile Thr Gly Thr Val Ser Ser Ala Gln
290 295 300

Val Phe Leu Arg Phe Asp Ala Asn Gly Val Leu Leu Thr Glu His Ser
305 310 315 320

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

Thr Pro Tyr Val Asn Ala Val Gly Phe Met Pro Asn Leu Lys Ala Tyr
340 345 350

Pro Lys Ser Gln Ser Ser Thr Thr Lys Asn Asn Ile Val Gly Gln Val
355 360 365

Tyr Met Asn Gly Asp Val Ser Lys Pro Met Leu Leu Thr Ile Thr Leu
370 375 380

Asn Gly Thr Asp Asp Ser Asn Ser Thr Tyr Ser Met Ser Phe Ser Tyr
385 390 395 400

Thr Trp Thr Asn Gly Ser Tyr Val Gly Ala Thr Phe Gly Ala Asn Ser
405 410 415

Tyr Thr Phe Ser Tyr Ile Ala Gln Glu

420 425

<210> 17
<211> 425
<212> PRT
<213> Adenoviridae - Mastadenovirus

<400> 17

Met Ser Lys Lys Arg Val Arg Val Asp Asp Asp Phe Asp Pro Val Tyr
1 5 10 15

Pro Tyr Asp Ala Asp Asn Ala Pro Thr Val Pro Phe Ile Asn Pro Pro
20 25 30

Phe Val Ser Ser Asp Gly Phe Gln Glu Lys Pro Leu Gly Val Leu Ser
35 40 45

Leu Arg Leu Ala Asp Pro Val Thr Thr Lys Asn Gly Glu Ile Thr Leu
50 55 60

Lys Leu Gly Glu Gly Leu Asp Leu Asp Ser Ser Gly Lys Leu Ile Ser
65 70 75 80

Asn Thr Ala Thr Lys Ala Ala Ala Pro Leu Ser Phe Ser Asn Asn Thr
85 90 95

Ile Ser Leu Asn Met Asp His Pro Phe Tyr Thr Lys Asp Gly Lys Leu
100 105 110

Ser Leu Gln Val Ser Pro Pro Leu Asn Ile Leu Arg Thr Ser Ile Leu
115 120 125

Asn Thr Leu Ala Leu Gly Phe Gly Ser Gly Leu Gly Leu Arg Gly Ser
130 135 140

Ala Leu Ala Val Gln Leu Val Ser Pro Leu Thr Phe Asp Thr Asp Gly
145 150 155 160

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

Ala Ile Glu Ser Asn Ile Ser Trp Ala Lys Gly Leu Lys Phe Glu Asp
180 185 190

Gly Ala Ile Ala Thr Asn Ile Gly Asn Gly Leu Glu Phe Gly Ser Ser
195 200 205

Ser Thr Glu Thr Gly Val Asp Asp Ala Tyr Pro Ile Gln Val Lys Leu
210 215 220

Gly Ser Gly Leu Ser Phe Asp Ser Thr Gly Ala Ile Met Ala Gly Asn
225 230 235 240

Lys Glu Asp Asp Lys Leu Thr Leu Trp Thr Thr Pro Asp Pro Ser Pro
245 250 255

Asn Cys Gln Ile Leu Ala Glu Asn Asp Ala Lys Leu Thr Leu Cys Leu
260 265 270

Thr Lys Cys Gly Ser Gln Ile Leu Ala Thr Val Ser Val Leu Val Val
275 280 285

Gly Ser Gly Asn Leu Asn Pro Ile Thr Gly Thr Val Ser Ser Ala Gln
290 295 300

Val Phe Leu Arg Phe Asp Ala Asn Gly Val Leu Leu Thr Glu His Ser
305 310 315 320

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

Thr Pro Tyr Thr Asn Ala Val Gly Phe Met Pro Asn Leu Lys Ala Tyr
340 345 350

Pro Lys Ser Gln Ser Ser Thr Thr Lys Asn Asn Ile Val Gly Gln Val
355 360 365

Tyr Met Asn Gly Asp Val Ser Lys Pro Met Leu Leu Thr Ile Thr Leu
370 375 380

Asn Gly Thr Asp Asp Ser Asn Ser Thr Tyr Ser Met Ser Phe Ser Tyr
385 390 395 400

Thr Trp Thr Asn Gly Ser Tyr Val Gly Ala Thr Phe Gly Ala Asn Ser
405 410 415

Tyr Thr Phe Ser Tyr Ile Ala Gln Glu
420 425

<210> 18
<211> 442
<212> PRT
<213> Adenoviridae - Mastadenovirus

<400> 18

Met Ser Lys Lys Arg Ala Arg Val Asp Asp Gly Phe Asp Pro Val Tyr
1 5 10 15

Pro Tyr Asp Ala Asp Asn Ala Pro Thr Val Pro Phe Ile Asn Pro Pro
20 25 30

Phe Val Ser Ser Asp Gly Phe Gln Glu Lys Pro Leu Gly Val Leu Ser
35 40 45

Leu Arg Leu Ala Asp Pro Val Thr Thr Lys Asn Gly Ala Val Pro Leu
50 55 60

Lys Leu Gly Glu Gly Val Asp Leu Asp Asp Ser Gly Lys Leu Ile Ser
65 70 75 80

Lys Lys Ser Thr Lys Ala Asn Ser Pro Leu Ser Ile Ser Asn Asn Thr
85 90 95

Ile Ser Leu Asn Met Asp Thr Pro Phe Tyr Thr Lys Asp Gly Lys Leu
100 105 110

Thr Met Gln Val Thr Ala Pro Leu Lys Leu Ala Asn Thr Ala Ile Leu
115 120 125

Asn Thr Leu Ala Met Ala Tyr Gly Asn Gly Leu Gly Leu Asn Asn Asn
130 135 140

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

Val Lys Ile Asn Leu Gly Asn Gly Pro Leu Met Val Ser Ala Asn Lys
165 170 175

Leu Ser Ile Asn Cys Leu Arg Gly Leu Tyr Val Ala Pro Asn Asn Thr
180 185 190

Gly Leu Glu Thr Asn Ile Ser Trp Ala Asn Ala Met Arg Phe Glu Gly
195 200 205

Asn Ala Met Ala Val Tyr Ile Asp Thr Asn Lys Gly Leu Gln Phe Gly
210 215 220

Thr Thr Ser Thr Glu Thr Gly Val Thr Asn Ala Tyr Pro Ile Gln Val
225 230 235 240

Lys Leu Gly Ala Gly Leu Ala Phe Asp Ser Thr Gly Ala Ile Val Ala
245 250 255

Trp Asn Lys Glu Asn Asp Ser Leu Thr Leu Trp Thr Thr Pro Asp Pro
260 265 270

Ser Pro Asn Cys Lys Ile Ala Ser Glu Lys Asp Ala Lys Leu Thr Leu
275 280 285

Cys Leu Thr Lys Cys Gly Ser Gln Ile Leu Gly Thr Val Ser Leu Leu
290 295 300

Ala Val Ser Gly Ser Leu Ala Pro Ile Thr Gly Ala Val Ser Thr Ala
305 310 315 320

Leu Val Ser Leu Lys Phe Asn Ala Asn Gly Ala Leu Leu Asp Lys Ser
325 330 335

Thr Leu Asn Lys Glu Tyr Trp Asn Tyr Arg Gln Gly Asp Leu Ile Pro
340 345 350

Gly Thr Pro Tyr Thr His Ala Val Gly Phe Met Pro Asn Lys Lys Ala
355 360 365

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

Val Tyr Leu Asp Gly Asp Ala Asp Lys Pro Leu Ser Leu Ile Ile Thr
385 390 395 400

Phe Asn Glu Thr Asp Asp Glu Thr Cys Asp Tyr Cys Ile Asn Phe Gln
405 410 415

Trp Lys Trp Gly Ala Asp Gln Tyr Lys Asp Lys Thr Leu Ala Thr Ser
420 425 430

Ser Phe Thr Phe Ser Tyr Ile Ala Gln Glu
435 440

<210> 19
<211> 577
<212> PRT
<213> Adenoviridae - Mastadenovirus

<400> 19

Met Lys Arg Ala Lys Thr Ser Asp Glu Thr Phe Asn Pro Val Tyr Pro
1 5 10 15

Tyr Asp Thr Glu Asn Gly Pro Pro Ser Val Pro Phe Leu Thr Pro Pro
20 25 30

Phe Val Ser Pro Asp Gly Phe Gln Glu Ser Pro Pro Gly Val Leu Ser
35 40 45

Leu Arg Leu Ser Glu Pro Leu Val Thr Ser His Gly Met Leu Ala Leu
50 55 60

Lys Met Gly Asn Gly Leu Ser Leu Asp Asp Ala Gly Asn Leu Thr Ser
65 70 75 80

Gln Asp Val Thr Thr Val Thr Pro Pro Leu Lys Lys Thr Lys Thr Asn
85 90 95

Leu Ser Leu Gln Thr Ser Ala Pro Leu Thr Val Ser Ser Gly Ser Leu
100 105 110

Thr Val Ala Ala Ala Ala Pro Leu Ala Val Ala Gly Thr Ser Leu Thr
115 120 125

Met Gln Ser Gln Ala Pro Leu Thr Val Gln Asp Ala Lys Leu Gly Leu
130 135 140

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

Thr Ser Ala Pro Leu Thr Ala Ala Asp Ser Ser Thr Leu Thr Val Ser
165 170 175

Ala Thr Pro Pro Leu Ser Thr Ser Asn Gly Ser Leu Ser Ile Asp Met
180 185 190

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

Ala Pro Leu His Val Val Asp Thr Leu Asn Ala Leu Thr Val Val Thr
210 215 220

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

Gly Ala Leu Ser Tyr Asp Thr Glu Gly Asn Ile Gln Leu Gln Ala Gly
245 250 255

Gly Gly Met Arg Ile Asp Asn Asn Gly Gln Leu Ile Leu Asn Val Ala
260 265 270

Tyr Pro Phe Asp Ala Gln Asn Asn Leu Ser Leu Arg Leu Gly Gln Gly
275 280 285

Pro Leu Ile Val Asn Ser Ala His Asn Leu Asp Leu Asn Leu Asn Arg
290 295 300

Gly Leu Tyr Leu Phe Thr Ser Gly Asn Thr Lys Lys Leu Glu Val Asn
305 310 315 320

Ile Lys Thr Ala Lys Gly Leu Phe Tyr Asp Gly Thr Ala Ile Ala Ile
325 330 335

Asn Ala Gly Asp Gly Leu Gln Phe Gly Ser Gly Ser Asp Thr Asn Pro
340 345 350

Leu Gln Thr Lys Leu Gly Leu Gly Leu Glu Tyr Asp Ser Asn Lys Ala
355 360 365

Ile Ile Thr Lys Leu Gly Thr Gly Leu Ser Phe Asp Asn Thr Gly Ala
370 375 380

Ile Thr Val Gly Asn Lys Asn Asp Asp Lys Leu Thr Leu Trp Thr Thr
385 390 395 400

Pro Asp Pro Ser Pro Asn Cys Arg Ile Asn Ser Glu Lys Asp Ala Lys
405 410 415

Leu Thr Leu Val Leu Thr Lys Cys Gly Ser Gln Val Leu Ala Ser Val
420 425 430

Ser Val Leu Ser Val Lys Gly Ser Leu Ala Pro Ile Ser Gly Thr Val
435 440 445

Thr Ser Ala Gln Ile Val Leu Arg Phe Asp Glu Asn Gly Val Leu Leu
450 455 460

Ser Asn Ser Ser Leu Asp Pro Gln Tyr Trp Asn Tyr Arg Lys Gly Asp
465 470 475 480

Ser Thr Glu Gly Thr Ala Tyr Thr Asn Ala Val Gly Phe Met Pro Asn
485 490 495

Leu Thr Ala Tyr Pro Lys Thr Gln Ser Gln Thr Ala Lys Ser Asn Ile
500 505 510

Val Ser Gln Val Tyr Leu Asn Gly Asp Lys Thr Lys Pro Met Thr Leu
515 520 525

Thr Ile Thr Leu Asn Gly Thr Asn Glu Thr Gly Asp Ala Thr Val Ser
530 535 540

Thr Tyr Ser Met Ser Phe Ser Trp Asn Trp Asn Gly Ser Asn Tyr Ile
545 550 555 560

Asn Asp Thr Phe Gln Thr Asn Ser Phe Thr Phe Ser Tyr Ile Ala Gln
565 570 575

Glu

<210> 20
<211> 937
<212> PRT
<213> Adenoviridae - Mastadenovirus

<400> 20

Met Ala Thr Pro Ser Met Leu Pro Gln Trp Ala Tyr Met His Ile Ala
1 5 10 15

Gly Gln Asp Ala Ser Glu Tyr Leu Ser Pro Gly Leu Val Gln Phe Ala
20 25 30

Arg Ala Thr Asp Thr Tyr Phe Ser Leu Gly Asn Lys Phe Arg Asn Pro

35 40 45

Thr Val Ala Pro Thr His Asp Val Thr Thr Asp Arg Ser Gln Arg Leu
50 55 60

Thr Leu Arg Phe Val Pro Val Asp Arg Glu Asp Asn Thr Tyr Ser Tyr
65 70 75 80

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

Ala Ser Thr Tyr Phe Asp Ile Arg Gly Val Leu Asp Arg Gly Pro Ser
100 105 110

Phe Lys Pro Tyr Ser Gly Thr Ala Tyr Asn Ser Leu Ala Pro Lys Gly
115 120 125

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

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

Glu Gly Leu Gln Ile Gly Pro Asp Glu Ser Gly Gly Glu Ser Lys Lys
165 170 175

Ile Phe Ala Asp Lys Thr Tyr Gln Pro Glu Pro Gln Leu Gly Asp Glu
180 185 190

Glu Trp His Asp Thr Ile Gly Ala Glu Asp Lys Tyr Gly Gly Arg Ala
195 200 205

Leu Lys Pro Ala Thr Asn Met Lys Pro Cys Tyr Gly Ser Phe Ala Lys
210 215 220

Pro Thr Asn Ala Lys Gly Gly Gln Ala Lys Ser Arg Thr Lys Asp Asp
225 230 235 240

Gly Thr Thr Glu Pro Asp Ile Asp Met Ala Phe Phe Asp Asp Arg Ser
245 250 255

Gln Gln Ala Ser Phe Ser Pro Glu Leu Val Leu Tyr Thr Glu Asn Val
260 265 270

Asp Leu Asp Thr Pro Asp Thr His Ile Ile Tyr Lys Pro Gly Thr Asp
275 280 285

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

Pro Asn Tyr Ile Gly Phe Arg Asp Asn Phe Ile Gly Leu Met Tyr Tyr

305 310 315 320

Asn Ser Thr Gly Asn Met Gly Val Leu Ala Gly Gln Ala Ser Gln Leu
325 330 335

Asn Ala Val Val Asp Leu Gln Asp Arg Asn Thr Glu Leu Ser Tyr Gln
340 345 350

Leu Leu Leu Asp Ser Leu Gly Asp Arg Thr Arg Tyr Phe Ser Met Trp
355 360 365

Asn Gln Ala Val Asp Ser Tyr Asp Pro Asp Val Arg Ile Ile Glu Asn
370 375 380

His Gly Val Glu Asp Glu Leu Pro Asn Tyr Cys Phe Pro Leu Asn Gly
385 390 395 400

Val Gly Phe Thr Asp Thr Phe Gln Gly Ile Lys Val Lys Thr Thr Asn
405 410 415

Asn Gly Thr Ala Asn Ala Thr Glu Trp Glu Ser Asp Thr Ser Val Asn
420 425 430

Asn Ala Asn Glu Ile Ala Lys Gly Asn Pro Phe Ala Met Glu Ile Asn
435 440 445

Ile Gln Ala Asn Leu Trp Arg Asn Phe Leu Tyr Ala Asn Val Ala Leu
450 455 460

Tyr Leu Pro Asp Ser Tyr Lys Tyr Thr Pro Ala Asn Ile Thr Leu Pro
465 470 475 480

Thr Asn Thr Asn Thr Tyr Asp Tyr Met Asn Gly Arg Val Val Ala Pro
485 490 495

Ser Leu Val Asp Ala Tyr Ile Asn Ile Gly Ala Arg Trp Ser Leu Asp
500 505 510

Pro Met Asp Asn Val Asn Pro Phe Asn His His Arg Asn Ala Gly Leu
515 520 525

Arg Tyr Arg Ser Met Leu Leu Gly Asn Gly Arg Tyr Val Pro Phe His
530 535 540

Ile Gln Val Pro Gln Lys Phe Phe Ala Ile Lys Ser Leu Leu Leu Leu
545 550 555 560

Pro Gly Ser Tyr Thr Tyr Glu Trp Asn Phe Arg Lys Asp Val Asn Met
565 570 575

Ile Leu Gln Ser Ser Leu Gly Asn Asp Leu Arg Thr Asp Gly Ala Ser

580 585 590

Ile Ala Phe Thr Ser Ile Asn Leu Tyr Ala Thr Phe Phe Pro Met Ala
595 600 605

His Asn Thr Ala Ser Thr Leu Glu Ala Met Leu Arg Asn Asp Thr Asn
610 615 620

Asp Gln Ser Phe Asn Asp Tyr Leu Ser Ala Ala Asn Met Leu Tyr Pro
625 630 635 640

Ile Pro Ala Asn Ala Thr Asn Val Pro Ile Ser Ile Pro Ser Arg Asn
645 650 655

Trp Ala Ala Phe Arg Gly Trp Ser Phe Thr Arg Leu Lys Thr Arg Glu
660 665 670

Thr Pro Ser Leu Gly Ser Gly Phe Asp Pro Tyr Phe Val Tyr Ser Gly
675 680 685

Ser Ile Pro Tyr Leu Asp Gly Thr Phe Tyr Leu Asn His Thr Phe Lys
690 695 700

Lys Val Ser Ile Thr Phe Asp Ser Ser Val Ser Trp Pro Gly Asn Asp
705 710 715 720

Arg Leu Leu Thr Pro Asn Glu Phe Glu Ile Lys Arg Thr Val Asp Gly
725 730 735

Glu Gly Tyr Asn Val Ala Gln Cys Asn Met Thr Lys Asp Trp Phe Leu
740 745 750

Val Gln Met Leu Ala His Tyr Asn Ile Gly Tyr Gln Gly Phe Tyr Val
755 760 765

Pro Glu Gly Tyr Lys Asp Arg Met Tyr Ser Phe Phe Arg Asn Phe Gln
770 775 780

Pro Met Ser Arg Gln Val Val Asp Glu Val Asn Tyr Lys Asp Tyr Gln
785 790 795 800

Ala Val Thr Leu Ala Tyr Gln His Asn Asn Ser Gly Phe Val Gly Tyr
805 810 815

Leu Ala Pro Thr Met Arg Gln Gly Gln Pro Tyr Pro Ala Asn Tyr Pro
820 825 830

Tyr Pro Leu Ile Gly Lys Ser Ala Val Ala Ser Val Thr Gln Lys Lys
835 840 845

Phe Leu Cys Asp Arg Val Met Trp Arg Ile Pro Phe Ser Ser Asn Phe

850 855 860

Met Ser Met Gly Ala Leu Thr Asp Leu Gly Gln Asn Met Leu Tyr Ala
865 870 875 880

Asn Ser Ala His Ala Leu Asp Met Asn Phe Glu Val Asp Pro Met Asp
885 890 895

Glu Ser Thr Leu Leu Tyr Val Val Phe Glu Val Phe Asp Val Val Arg
900 905 910

Val His Gln Pro His Arg Gly Val Ile Glu Ala Val Tyr Leu Arg Thr
915 920 925

Pro Phe Ser Ala Gly Asn Ala Thr Thr
930 935

<210> 21
<211> 937
<212> PRT
<213> Adenoviridae - Mastadenovirus

<400> 21

Met Ala Thr Pro Ser Met Leu Pro Gln Trp Ala Tyr Met His Ile Ala
1 5 10 15

Gly Gln Asp Ala Ser Glu Tyr Leu Ser Pro Gly Leu Val Gln Phe Ala
20 25 30

Arg Ala Thr Asp Thr Tyr Phe Ser Leu Gly Asn Lys Phe Arg Asn Pro
35 40 45

Thr Val Ala Pro Thr His Asp Val Thr Thr Asp Arg Ser Gln Arg Leu
50 55 60

Thr Leu Arg Phe Val Pro Val Asp Gly Glu Asp Asn Thr Tyr Ser Tyr
65 70 75 80

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

Ala Ser Thr Tyr Phe Asp Ile Arg Gly Val Leu Asp Arg Gly Pro Ser
100 105 110

Phe Lys Pro Tyr Ser Gly Thr Ala Tyr Asn Ala Leu Ala Pro Lys Gly
115 120 125

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

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

Glu Gly Leu Gln Ile Arg Thr Asp Glu Ser Gly Gly Glu Ser Lys Lys
165 170 175

Ile Phe Ala Asp Lys Thr Tyr Gln Pro Glu Pro Gln Leu Gly Asp Glu
180 185 190

Glu Trp His Asp Thr Ile Gly Ala Glu Asp Lys Tyr Gly Gly Arg Ala
195 200 205

Leu Lys Pro Ala Thr Asn Met Lys Pro Cys Tyr Gly Ser Phe Ala Lys
210 215 220

Pro Thr Asn Ala Lys Gly Gly Gln Ala Lys Ser Arg Thr Lys Asp Asp
225 230 235 240

Gly Thr Thr Glu Pro Asp Ile Asp Met Ala Phe Phe Asp Asp Arg Ser
245 250 255

Gln Gln Ala Ser Phe Ser Pro Glu Leu Val Leu Tyr Thr Glu Asn Val
260 265 270

Asp Leu Asp Thr Pro Asp Thr His Ile Ile Tyr Lys Pro Gly Thr Asp
275 280 285

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

Pro Asn Tyr Ile Gly Phe Arg Asp Asn Phe Ile Gly Leu Met Tyr Tyr
305 310 315 320

Asn Ser Thr Gly Asn Met Gly Val Leu Ala Gly Gln Ala Ser Gln Leu
325 330 335

Asn Ala Val Val Asp Leu Gln Asp Arg Asn Thr Glu Leu Ser Tyr Gln
340 345 350

Leu Leu Leu Asp Ser Leu Gly Asp Arg Thr Arg Tyr Phe Ser Met Trp
355 360 365

Asn Gln Ala Val Asp Ser Tyr Asp Pro Asp Val Arg Ile Ile Glu Asn
370 375 380

His Gly Val Glu Asp Glu Leu Pro Asn Tyr Cys Phe Pro Leu Asn Gly
385 390 395 400

Val Gly Phe Thr Asp Thr Phe Gln Gly Ile Lys Val Lys Thr Thr Asn
405 410 415

Asn Gly Thr Ala Asn Ala Thr Glu Trp Glu Ser Asp Thr Ser Val Asn
420 425 430

Asn Ala Asn Glu Ile Ala Lys Gly Asn Pro Phe Ala Met Glu Ile Asn
435 440 445

Ile Gln Ala Asn Leu Trp Arg Asn Phe Leu Tyr Ala Asn Val Ala Leu
450 455 460

Tyr Leu Pro Asp Ser Tyr Lys Tyr Thr Pro Ala Asn Ile Thr Leu Pro
465 470 475 480

Thr Asn Thr Asn Thr Tyr Asp Tyr Met Asn Gly Arg Val Val Ala Pro
485 490 495

Ser Leu Val Asp Ala Tyr Ile Asn Ile Gly Ala Arg Trp Ser Leu Asp
500 505 510

Pro Met Asp Asn Val Asn Pro Phe Asn His His Arg Asn Ala Gly Leu
515 520 525

Arg Tyr Arg Ser Met Leu Leu Gly Asn Gly Arg Tyr Val Pro Phe His
530 535 540

Ile Gln Val Pro Gln Lys Phe Phe Ala Ile Lys Ser Leu Leu Leu Leu
545 550 555 560

Pro Gly Ser Tyr Thr Tyr Glu Trp Asn Phe Arg Lys Asp Val Asn Met
565 570 575

Ile Leu Gln Ser Ser Leu Gly Asn Asp Leu Arg Thr Asp Gly Ala Ser
580 585 590

Ile Ala Phe Thr Ser Ile Asn Leu Tyr Ala Thr Phe Phe Pro Met Ala
595 600 605

His Asn Thr Ala Ser Thr Leu Glu Ala Met Leu Arg Asn Asp Thr Asn
610 615 620

Asp Gln Ser Phe Asn Asp Tyr Leu Ser Ala Ala Asn Met Leu Tyr Pro
625 630 635 640

Ile Pro Ala Asn Ala Thr Asn Val Pro Ile Ser Ile Pro Ser Arg Asn
645 650 655

Trp Ala Ala Phe Arg Gly Trp Ser Phe Thr Arg Leu Lys Thr Arg Glu
660 665 670

Thr Pro Ser Leu Gly Ser Gly Phe Asp Pro Tyr Phe Val Tyr Ser Gly
675 680 685

Ser Ile Pro Tyr Leu Asp Gly Thr Phe Tyr Leu Asn His Thr Phe Lys
690 695 700

Lys Val Ser Ile Thr Phe Asp Ser Ser Val Ser Trp Pro Gly Asn Asp
705 710 715 720

Arg Leu Leu Thr Pro Asn Glu Phe Glu Ile Lys Arg Thr Val Asp Gly
725 730 735

Glu Gly Tyr Asn Val Ala Gln Cys Asn Met Thr Lys Asp Trp Phe Leu
740 745 750

Val Gln Met Leu Ala His Tyr Asn Ile Gly Tyr Gln Gly Phe Tyr Val
755 760 765

Pro Glu Gly Tyr Lys Asp Arg Met Tyr Ser Phe Phe Arg Asn Phe Gln
770 775 780

Pro Met Ser Arg Gln Val Val Asp Glu Val Asn Tyr Lys Asp Tyr Gln
785 790 795 800

Ala Val Thr Leu Ala Tyr Gln His Asn Asn Ser Gly Phe Val Gly Tyr
805 810 815

Leu Ala Pro Thr Met Arg Gln Gly Gln Pro Tyr Pro Ala Asn Tyr Pro
820 825 830

Tyr Pro Leu Ile Gly Lys Ser Ala Val Ala Ser Val Thr Gln Lys Lys
835 840 845

Phe Leu Cys Asp Arg Val Met Trp Arg Ile Pro Phe Ser Ser Asn Phe
850 855 860

Met Ser Met Gly Ala Leu Thr Asp Leu Gly Gln Asn Met Leu Tyr Ala
865 870 875 880

Asn Ser Ala His Ala Leu Asp Met Asn Phe Glu Val Asp Pro Met Asp
885 890 895

Glu Ser Thr Leu Leu Tyr Val Val Phe Glu Val Phe Asp Val Val Arg
900 905 910

Val His Gln Pro His Arg Gly Val Ile Lys Ala Val Tyr Leu Arg Thr
915 920 925

Pro Phe Ser Ala Gly Asn Ala Thr Thr
930 935

<210> 22
<211> 937
<212> PRT
<213> Adenoviridae - Mastadenovirus

<400> 22

Met Ala Thr Pro Ser Met Leu Pro Gln Trp Ala Tyr Met His Ile Ala
1 5 10 15

Gly Gln Asp Ala Ser Glu Tyr Leu Ser Pro Gly Leu Val Gln Phe Ala
20 25 30

Arg Ala Thr Asp Thr Tyr Phe Ser Leu Gly Asn Lys Phe Arg Asn Pro
35 40 45

Thr Val Ala Pro Thr His Asp Val Thr Thr Asp Arg Ser Gln Arg Leu
50 55 60

Thr Leu Arg Phe Val Pro Val Asp Arg Glu Asp Asn Thr Tyr Ser Tyr
65 70 75 80

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

Ala Ser Thr Tyr Phe Asp Ile Arg Gly Val Leu Asp Arg Gly Pro Ser
100 105 110

Phe Lys Pro Tyr Ser Gly Thr Ala Tyr Asn Ser Leu Ala Pro Lys Gly
115 120 125

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

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

Glu Gly Leu Gln Ile Gly Thr Asp Glu Ser Gly Gly Glu Ser Lys Lys
165 170 175

Ile Phe Ala Asp Lys Thr Tyr Gln Pro Glu Pro Gln Leu Gly Asp Glu
180 185 190

Glu Trp His Asp Thr Ile Gly Ala Glu Asp Lys Tyr Gly Gly Arg Ala
195 200 205

Leu Lys Pro Ala Thr Asn Met Lys Pro Cys Tyr Gly Ser Phe Ala Lys
210 215 220

Pro Thr Asn Ala Lys Gly Gly Gln Ala Lys Ser Arg Thr Lys Asp Asp
225 230 235 240

Gly Thr Thr Glu Pro Asp Ile Asp Met Ala Phe Phe Asp Asp Arg Ser
245 250 255

Gln Gln Ala Ser Phe Ser Pro Glu Leu Val Leu Tyr Thr Glu Asn Val
260 265 270

Asp Leu Asp Thr Pro Asp Thr His Ile Ile Tyr Lys Pro Gly Thr Asp
275 280 285

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

Pro Asn Tyr Ile Gly Phe Arg Asp Asn Phe Ile Gly Leu Met Tyr Tyr
305 310 315 320

Asn Ser Thr Gly Asn Met Gly Val Leu Ala Gly Gln Ala Ser Gln Leu
325 330 335

Asn Ala Val Val Asp Leu Gln Asp Arg Asn Thr Glu Leu Ser Tyr Gln
340 345 350

Leu Leu Leu Asp Ser Leu Gly Asp Arg Thr Arg Tyr Phe Ser Met Trp
355 360 365

Asn Gln Ala Val Asp Ser Tyr Asp Pro Asp Val Arg Ile Ile Glu Asn
370 375 380

His Gly Val Glu Asp Glu Leu Pro Asn Tyr Cys Phe Pro Leu Asn Gly
385 390 395 400

Val Gly Phe Thr Asp Thr Phe Gln Gly Ile Lys Val Lys Thr Thr Asn
405 410 415

Asn Gly Thr Ala Asn Ala Thr Glu Trp Glu Ser Asp Thr Ser Val Asn
420 425 430

Asn Ala Asn Glu Ile Ala Lys Gly Asn Pro Phe Ala Met Glu Ile Asn
435 440 445

Ile Gln Ala Asn Leu Trp Arg Asn Phe Leu Tyr Ala Asn Val Ala Leu
450 455 460

Tyr Leu Pro Asp Ser Tyr Lys Tyr Thr Pro Ala Asn Ile Thr Leu Pro
465 470 475 480

Thr Asn Thr Asn Thr Tyr Asp Tyr Met Asn Gly Arg Val Val Ala Pro
485 490 495

Ser Leu Val Asp Ala Tyr Ile Asn Ile Gly Ala Arg Trp Ser Leu Asp
500 505 510

Pro Met Asp Asn Val Asn Pro Phe Asn His His Arg Asn Ala Gly Leu
515 520 525

Arg Tyr Arg Ser Met Leu Leu Gly Asn Gly Arg Tyr Val Pro Phe His
530 535 540

Ile Gln Val Pro Gln Lys Phe Phe Ala Ile Lys Ser Leu Leu Leu Leu
545 550 555 560

Pro Gly Ser Tyr Thr Tyr Glu Trp Asn Phe Arg Lys Asp Val Asn Met
565 570 575

Ile Leu Gln Ser Ser Leu Gly Asn Asp Leu Arg Thr Asp Gly Ala Ser
580 585 590

Ile Ala Phe Thr Ser Ile Asn Leu Tyr Ala Thr Phe Phe Pro Met Ala
595 600 605

His Asn Thr Ala Ser Thr Leu Glu Ala Met Leu Arg Asn Asp Thr Asn
610 615 620

Asp Gln Ser Phe Asn Asp Tyr Leu Ser Ala Ala Asn Met Leu Tyr Pro
625 630 635 640

Ile Pro Ala Asn Ala Thr Asn Val Pro Ile Ser Ile Pro Ser Arg Asn
645 650 655

Trp Ala Ala Phe Arg Gly Trp Ser Phe Thr Arg Leu Lys Thr Arg Glu
660 665 670

Thr Pro Ser Leu Gly Ser Gly Phe Asp Pro Tyr Phe Val Tyr Ser Gly
675 680 685

Ser Ile Pro Tyr Leu Asp Gly Thr Phe Tyr Leu Asn His Thr Phe Lys
690 695 700

Lys Val Ser Ile Thr Phe Asp Ser Ser Val Ser Trp Pro Gly Asn Asp
705 710 715 720

Arg Leu Leu Thr Pro Asn Glu Phe Glu Ile Lys Arg Thr Val Asp Gly
725 730 735

Glu Gly Tyr Asn Val Ala Gln Cys Asn Met Thr Lys Asp Trp Phe Leu
740 745 750

Val Gln Met Leu Ala His Tyr Asn Ile Gly Tyr Gln Gly Phe Tyr Val
755 760 765

Pro Glu Gly Tyr Lys Asp Arg Met Tyr Ser Phe Phe Arg Asn Phe Gln
770 775 780

Pro Met Ser Arg Gln Val Val Asp Glu Val Asn Tyr Lys Asp Tyr Gln
785 790 795 800

Ala Val Thr Leu Ala Tyr Gln His Asn Asn Ser Gly Phe Val Gly Tyr
805 810 815

Leu Ala Pro Thr Met Arg Gln Gly Gln Pro Tyr Pro Ala Asn Tyr Pro
820 825 830

Tyr Pro Leu Ile Gly Lys Ser Ala Val Ala Ser Val Thr Gln Lys Lys
835 840 845

Phe Leu Cys Asp Arg Val Met Trp Arg Ile Pro Phe Ser Ser Asn Phe
850 855 860

Met Ser Met Gly Ala Leu Thr Asp Leu Gly Gln Asn Met Leu Tyr Ala
865 870 875 880

Asn Ser Ala His Ala Leu Asp Met Asn Phe Glu Val Asp Pro Met Asp
885 890 895

Glu Ser Thr Leu Leu Tyr Val Val Phe Glu Val Phe Asp Val Val Arg
900 905 910

Val His Gln Pro His Arg Gly Val Ile Glu Ala Val Tyr Leu Arg Thr
915 920 925

Pro Phe Ser Ala Gly Asn Ala Thr Thr
930 935

<210> 23
<211> 937
<212> PRT
<213> Adenoviridae - Mastadenovirus

<220>
<221> misc_feature
<222> (296)..(296)
<223> Xaa can be any naturally occurring amino acid

<400> 23

Met Ala Thr Pro Ser Met Leu Pro Gln Trp Ala Tyr Met His Ile Ala
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Gly Gln Asp Ala Ser Glu Tyr Leu Ser Pro Gly Leu Val Gln Phe Ala
20 25 30

Arg Ala Thr Asp Thr Tyr Phe Ser Leu Gly Asn Lys Phe Arg Asn Pro
35 40 45

Thr Val Ala Pro Thr His Asp Val Thr Thr Asp Arg Ser Gln Arg Leu
50 55 60

Thr Leu Arg Phe Val Pro Val Asp Arg Glu Asp Asn Thr Tyr Ser Tyr
65 70 75 80

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

Ala Ser Thr Tyr Phe Asp Ile Arg Gly Val Leu Asp Arg Gly Pro Ser
100 105 110

Phe Lys Pro Tyr Ser Gly Thr Ala Tyr Asn Ser Leu Ala Pro Lys Gly
115 120 125

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

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

Glu Gly Leu Gln Ile Gly Thr Asp Glu Ser Gly Gly Lys Ser Lys Lys
165 170 175

Ile Phe Ala Asp Lys Thr Tyr Gln Pro Glu Pro Gln Leu Gly Asp Glu
180 185 190

Glu Trp His Asp Thr Ile Gly Ala Glu Asp Lys Tyr Gly Gly Arg Ala
195 200 205

Leu Lys Pro Ala Thr Asn Met Lys Pro Cys Tyr Gly Ser Phe Ala Lys
210 215 220

Pro Thr Asn Ala Lys Gly Gly Gln Ala Lys Ser Arg Thr Lys Asp Asp
225 230 235 240

Gly Thr Thr Glu Pro Asp Ile Asp Met Ala Phe Phe Asp Asp Arg Ser
245 250 255

Gln Gln Ala Ser Phe Ser Pro Glu Leu Val Leu Tyr Thr Glu Asn Val
260 265 270

Asp Leu Asp Thr Pro Asp Thr His Ile Ile Tyr Lys Pro Gly Thr Asp
275 280 285

Glu Thr Ser Ser Ser Phe Asn Xaa Gly Gln Gln Ser Met Pro Asn Arg
290 295 300

Pro Asn Tyr Ile Gly Phe Arg Asp Asn Phe Ile Gly Leu Met Tyr Tyr
305 310 315 320

Asn Ser Thr Gly Asn Met Gly Val Leu Ala Gly Gln Ala Ser Gln Leu
325 330 335

Asn Ala Val Val Asp Leu Gln Asp Arg Asn Thr Glu Leu Ser Tyr Gln
340 345 350

Leu Leu Leu Asp Ser Leu Gly Asp Arg Thr Arg Tyr Phe Ser Met Trp
355 360 365

Asn Gln Ala Val Asp Ser Tyr Asp Pro Asp Val Arg Ile Ile Glu Asn
370 375 380

His Gly Val Glu Asp Glu Leu Pro Asn Tyr Cys Phe Pro Leu Asn Gly
385 390 395 400

Val Gly Phe Thr Asp Thr Phe Gln Gly Ile Lys Val Lys Thr Thr Asn
405 410 415

Asn Gly Thr Ala Asn Ala Thr Glu Trp Glu Ser Asp Thr Ser Val Asn
420 425 430

Asn Ala Asn Glu Ile Ala Lys Gly Asn Pro Phe Ala Met Glu Ile Asn
435 440 445

Ile Gln Ala Asn Leu Trp Arg Asn Phe Leu Tyr Ala Asn Val Ala Leu
450 455 460

Tyr Leu Pro Asp Ser Tyr Lys Tyr Thr Pro Ala Asn Ile Thr Leu Pro
465 470 475 480

Thr Asn Thr Asn Thr Tyr Asp Tyr Met Asn Gly Arg Val Val Ala Pro
485 490 495

Ser Leu Val Asp Ala Tyr Ile Asn Ile Gly Ala Arg Trp Ser Leu Asp
500 505 510

Pro Met Asp Asn Val Asn Pro Phe Asn His His Arg Asn Ala Gly Leu
515 520 525

Arg Tyr Arg Ser Met Leu Leu Gly Asn Gly Arg Tyr Val Pro Phe His
530 535 540

Ile Gln Val Pro Gln Lys Phe Phe Ala Ile Lys Asn Leu Leu Leu Leu
545 550 555 560

Pro Gly Ser Tyr Thr Tyr Glu Trp Asn Phe Arg Lys Asp Val Asn Met
565 570 575

Ile Leu Gln Ser Ser Leu Gly Asn Asp Leu Arg Thr Asp Gly Ala Ser
580 585 590

Ile Ala Phe Thr Ser Ile Asn Leu Tyr Ala Thr Phe Phe Pro Met Ala
595 600 605

His Asn Thr Ala Ser Thr Leu Glu Ala Met Leu Arg Asn Asp Thr Asn
610 615 620

Asp Gln Ser Phe Asn Asp Tyr Leu Ser Ala Ala Asn Met Leu Tyr Pro
625 630 635 640

Ile Pro Ala Asn Ala Thr Asn Val Pro Ile Ser Ile Pro Ser Arg Asn
645 650 655

Trp Ala Ala Phe Arg Gly Trp Ser Phe Thr Arg Leu Lys Thr Arg Glu
660 665 670

Thr Pro Ser Leu Gly Ser Gly Phe Asp Pro Tyr Phe Val Tyr Ser Gly
675 680 685

Ser Ile Pro Tyr Leu Asp Gly Thr Phe Tyr Leu Asn His Thr Phe Lys
690 695 700

Lys Val Ser Ile Thr Phe Asp Ser Ser Val Ser Trp Pro Gly Asn Asp
705 710 715 720

Arg Leu Leu Thr Pro Asn Glu Phe Glu Ile Lys Arg Thr Val Asp Gly
725 730 735

Glu Gly Tyr Asn Val Ala Gln Cys Asn Met Thr Lys Asp Trp Phe Leu
740 745 750

Val Gln Met Leu Ala His Tyr Asn Ile Gly Tyr Gln Gly Phe Tyr Val
755 760 765

Pro Glu Gly Tyr Lys Asp Arg Met Tyr Ser Phe Phe Arg Asn Phe Gln
770 775 780

Pro Met Ser Arg Gln Val Val Asp Glu Val Asn Tyr Lys Asp Tyr Gln
785 790 795 800

Ala Val Thr Leu Ala Tyr Gln His Asn Asn Ser Gly Phe Val Gly Tyr
805 810 815

Leu Ala Pro Thr Met Arg Gln Gly Gln Pro Tyr Pro Ala Asn Tyr Pro
820 825 830

Tyr Pro Leu Ile Gly Lys Ser Ala Val Ala Ser Val Thr Gln Lys Lys
835 840 845

Phe Leu Cys Asp Arg Val Met Trp Arg Ile Pro Phe Ser Ser Asn Phe
850 855 860

Met Ser Met Gly Ala Leu Thr Asp Leu Gly Gln Asn Met Leu Tyr Ala
865 870 875 880

Asn Ser Ala His Ala Leu Asp Met Asn Phe Glu Val Asp Pro Met Asp
885 890 895

Glu Ser Thr Leu Leu Tyr Val Val Phe Glu Val Phe Asp Val Val Arg
900 905 910

Val His Gln Pro His Arg Gly Val Ile Glu Ala Val Tyr Leu Arg Thr
915 920 925

Pro Phe Ser Ala Gly Asn Ala Thr Thr
930 935

<210> 24
<211> 937
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<213> Adenoviridae - Mastadenovirus

<220>
<221> misc_feature
<222> (538)..(538)
<223> Xaa can be any naturally occurring amino acid

<400> 24

Met Ala Thr Pro Ser Met Leu Pro Gln Trp Ala Tyr Met His Ile Ala
1 5 10 15

Gly Gln Asp Ala Ser Glu Tyr Leu Ser Pro Gly Leu Val Gln Phe Ala
20 25 30

Arg Ala Thr Asp Thr Tyr Phe Ser Leu Gly Asn Lys Phe Arg Asn Pro
35 40 45

Thr Val Ala Pro Thr His Asp Val Thr Thr Asp Arg Ser Gln Arg Leu
50 55 60

Thr Leu Arg Phe Val Pro Val Asp Arg Glu Asp Asn Thr Tyr Ser Tyr
65 70 75 80

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

Ala Ser Thr Tyr Phe Asp Ile Arg Gly Val Leu Asp Arg Gly Pro Ser
100 105 110

Phe Lys Pro Tyr Ser Gly Thr Ala Tyr Asn Ser Leu Ala Pro Lys Gly
115 120 125

Ala Pro Asn Thr Ser Gln Trp Val Thr Lys Asp Asn Gly Thr Asp Lys
130 135 140

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

Glu Gly Leu Gln Ile Gly Thr Asp Asp Ser Ser Thr Glu Ser Lys Lys
165 170 175

Ile Phe Ala Asp Lys Thr Tyr Gln Pro Glu Pro Gln Val Gly Asp Glu

180 185 190

Glu Trp His Asp Thr Ile Gly Ala Glu Asp Lys Tyr Gly Gly Arg Ala
195 200 205

Leu Lys Pro Ala Thr Asn Met Lys Pro Cys Tyr Gly Ser Phe Ala Lys
210 215 220

Pro Thr Asn Ala Lys Gly Gly Gln Ala Lys Thr Arg Thr Lys Asp Asp
225 230 235 240

Gly Thr Thr Glu Pro Asp Ile Asp Met Ala Phe Phe Asp Asp Arg Ser
245 250 255

Gln Gln Ala Ser Phe Ser Pro Glu Leu Val Leu Tyr Thr Glu Asn Val
260 265 270

Asp Leu Glu Thr Pro Asp Thr His Ile Ile Tyr Lys Pro Gly Thr Asp
275 280 285

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

Pro Asn Tyr Ile Gly Phe Arg Asp Asn Phe Ile Gly Leu Met Tyr Tyr
305 310 315 320

Asn Ser Thr Gly Asn Met Gly Val Leu Ala Gly Gln Ala Ser Gln Leu
325 330 335

Asn Ala Val Val Asp Leu Gln Asp Arg Asn Thr Glu Leu Ser Tyr Gln
340 345 350

Leu Leu Leu Asp Ser Leu Gly Asp Arg Thr Arg Tyr Phe Ser Met Trp
355 360 365

Asn Gln Ala Val Asp Ser Tyr Asp Pro Asp Val Arg Ile Ile Glu Asn
370 375 380

His Gly Val Glu Asp Glu Leu Pro Asn Tyr Cys Phe Pro Leu Asn Gly
385 390 395 400

Val Gly Phe Thr Asp Thr Phe Gln Gly Ile Lys Val Lys Thr Thr Asn
405 410 415

Asn Gly Thr Ala Asn Ala Thr Glu Trp Glu Ser Asp Thr Ser Val Asn
420 425 430

Asn Ala Asn Glu Ile Ala Lys Gly Asn Pro Phe Ala Met Glu Ile Asn
435 440 445

Ile Gln Ala Asn Leu Trp Arg Asn Phe Leu Tyr Ala Asn Val Ala Leu

450 455 460

Tyr Leu Pro Asp Ser Tyr Lys Tyr Thr Pro Ala Asn Val Thr Leu Pro
465 470 475 480

Thr Asn Thr Asn Thr Tyr Glu Tyr Met Asn Gly Arg Val Val Ala Pro
485 490 495

Ser Leu Val Asp Ser Tyr Ile Asn Ile Gly Ala Arg Trp Ser Leu Asp
500 505 510

Pro Met Asp Asn Val Asn Pro Phe Asn His His Arg Asn Ala Gly Leu
515 520 525

Arg Tyr Arg Ser Met Leu Leu Gly Asn Xaa Arg Phe Val Pro Phe His
530 535 540

Ile Gln Val Pro Gln Lys Phe Phe Ala Ile Lys Ser Leu Leu Leu Leu
545 550 555 560

Pro Gly Ser Tyr Thr Tyr Glu Trp Asn Phe Arg Lys Asp Val Asn Met
565 570 575

Ile Leu Gln Ser Ser Leu Gly Asn Asp Leu Arg Thr Asp Gly Ala Ser
580 585 590

Ile Ser Phe Thr Ser Ile Asn Leu Tyr Ala Thr Phe Phe Pro Met Ala
595 600 605

His Asn Thr Ala Ser Thr Leu Glu Ala Met Leu Arg Asn Asp Thr Asn
610 615 620

Asp Gln Ser Phe Asn Asp Tyr Leu Ser Ala Ala Asn Met Leu Tyr Pro
625 630 635 640

Ile Pro Ala Asn Ala Thr Asn Val Pro Ile Ser Ile Pro Ser Arg Asn
645 650 655

Trp Ala Ala Phe Arg Gly Trp Ser Phe Thr Arg Leu Lys Thr Lys Glu
660 665 670

Thr Pro Ser Leu Gly Ser Gly Phe Asp Pro Tyr Phe Val Tyr Ser Gly
675 680 685

Ser Ile Pro Tyr Leu Asp Gly Thr Phe Tyr Leu Asn His Thr Phe Lys
690 695 700

Lys Val Ser Ile Thr Phe Asp Ser Ser Val Ser Trp Pro Gly Asn Asp
705 710 715 720

Arg Leu Leu Thr Pro Asn Glu Phe Glu Ile Lys Arg Thr Val Asp Gly

725 730 735

Glu Gly Tyr Asn Val Ala Gln Cys Asn Met Thr Lys Asp Trp Phe Leu
740 745 750

Val Gln Met Leu Ala His Tyr Asn Ile Gly Tyr Gln Gly Phe Tyr Val
755 760 765

Pro Glu Gly Tyr Lys Asp Arg Met Tyr Ser Phe Phe Arg Asn Phe Gln
770 775 780

Pro Met Ser Arg Gln Val Val Asp Glu Val Asn Tyr Lys Asp Tyr Gln
785 790 795 800

Ala Val Thr Leu Ala Tyr Gln His Asn Asn Ser Gly Phe Val Gly Tyr
805 810 815

Leu Ala Pro Thr Met Arg Gln Gly Gln Pro Tyr Pro Ala Asn Tyr Pro
820 825 830

Tyr Pro Leu Ile Gly Lys Ser Ala Val Thr Ser Val Thr Gln Lys Lys
835 840 845

Phe Leu Cys Asp Arg Val Met Trp Arg Ile Pro Phe Ser Ser Asn Phe
850 855 860

Met Ser Met Gly Ala Leu Thr Asp Leu Gly Gln Asn Met Leu Tyr Ala
865 870 875 880

Asn Ser Ala His Ala Leu Asp Met Asn Phe Glu Val Asp Pro Met Asp
885 890 895

Glu Ser Thr Leu Leu Tyr Val Val Phe Glu Val Phe Asp Val Val Arg
900 905 910

Val His Gln Pro His Arg Gly Val Ile Glu Ala Val Tyr Leu Arg Thr
915 920 925

Pro Phe Ser Ala Gly Asn Ala Thr Thr
930 935

<210> 25
<211> 962
<212> PRT
<213> Adenoviridae - Mastadenovirus

<400> 25

Met Ala Thr Pro Ser Met Met Pro Gln Trp Ser Tyr Met His Ile Ser
1 5 10 15

Gly Gln Asp Ala Ser Glu Tyr Leu Ser Pro Gly Leu Val Gln Phe Ala
20 25 30

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Arg Ala Thr Asp Ser Tyr Phe Ser Leu Ser Asn Lys Phe Arg Asn Pro
        35                  40                  45

Thr Val Ala Pro Thr His Asp Val Thr Thr Asp Arg Ser Gln Arg Leu
    50                  55                  60

Thr Leu Arg Phe Ile Pro Val Asp Arg Glu Asp Thr Ala Tyr Ser Tyr
65                  70                  75                  80

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

Ala Ser Thr Tyr Phe Asp Ile Arg Gly Val Leu Asp Arg Gly Pro Thr
            100                 105                 110

Phe Lys Pro Tyr Ser Gly Thr Ala Tyr Asn Ser Leu Ala Pro Lys Gly
        115                 120                 125

Ala Pro Asn Ser Cys Glu Trp Glu Gln Val Glu Pro Ala Glu Glu Ala
    130                 135                 140

Ala Glu Asn Glu Asp Glu Glu Glu Glu Glu Asp Val Val Asp Pro Gln
145                 150                 155                 160

Glu Gln Glu Pro Thr Thr Lys Thr His Val Tyr Ala Gln Ala Pro Leu
                165                 170                 175

Ser Gly Glu Lys Ile Thr Lys Asp Gly Leu Gln Ile Gly Thr Glu Ala
            180                 185                 190

Thr Ala Ala Gly Gly Thr Lys Asp Leu Phe Ala Asp Pro Thr Phe Gln
        195                 200                 205

Pro Glu Pro Gln Val Gly Glu Ser Gln Trp Asn Glu Ala Asp Ala Thr
    210                 215                 220

Ala Ala Gly Gly Arg Val Leu Lys Lys Thr Thr Pro Met Lys Pro Cys
225                 230                 235                 240

Tyr Gly Ser Tyr Ala Arg Pro Thr Asn Ala Asn Gly Gly Gln Gly Val
                245                 250                 255

Leu Lys Ala Asn Ala Gln Gly Val Leu Glu Ser Gln Val Glu Met Gln
            260                 265                 270

Phe Phe Ser Thr Ser Thr Asn Ala Thr Asn Glu Gln Asn Asn Ile Gln
        275                 280                 285

Pro Lys Leu Val Leu Tyr Ser Glu Asp Val His Met Glu Thr Pro Asp
    290                 295                 300
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Thr His Ile Ser Tyr Lys Pro Thr Lys Ser Asp Asp Asn Ser Lys Val
305 310 315 320

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

Arg Asp Asn Phe Ile Gly Leu Met Tyr Tyr Asn Ser Thr Gly Asn Met
340 345 350

Gly Val Leu Ala Gly Gln Ala Ser Gln Leu Asn Ala Val Val Asp Leu
355 360 365

Gln Asp Arg Asn Thr Glu Leu Ser Tyr Gln Leu Leu Leu Asp Ser Met
370 375 380

Gly Asp Arg Thr Arg Tyr Phe Ser Met Trp Asn Gln Ala Val Asp Ser
385 390 395 400

Tyr Asp Pro Asp Val Arg Ile Ile Glu Asn His Gly Thr Glu Asp Glu
405 410 415

Leu Pro Asn Tyr Cys Phe Pro Leu Gly Gly Ile Gly Ile Thr Asp Thr
420 425 430

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

Thr Trp Gln Lys Asp Ser Gln Phe Ala Asp Arg Asn Glu Ile Gly Val
450 455 460

Gly Asn Asn Phe Ala Met Glu Ile Asn Leu Ser Ala Asn Leu Trp Arg
465 470 475 480

Asn Phe Leu Tyr Ser Asn Val Ala Leu Tyr Leu Pro Asp Lys Leu Lys
485 490 495

Tyr Asn Pro Ser Asn Val Glu Ile Ser Asp Asn Pro Asn Thr Tyr Asp
500 505 510

Tyr Met Asn Lys Arg Val Val Ala Pro Gly Leu Val Asp Cys Tyr Ile
515 520 525

Asn Leu Gly Ala Arg Trp Ser Leu Asp Tyr Met Asp Asn Val Asn Pro
530 535 540

Phe Asn His His Arg Asn Ala Gly Leu Arg Tyr Arg Ser Met Leu Leu
545 550 555 560

Gly Asn Gly Arg Tyr Val Pro Phe His Ile Gln Val Pro Gln Lys Phe
565 570 575

Phe Ala Ile Lys Asn Leu Leu Leu Leu Pro Gly Ser Tyr Thr Tyr Glu
580 585 590

Trp Asn Phe Arg Lys Asp Val Asn Met Val Leu Gln Ser Ser Leu Gly
595 600 605

Asn Asp Leu Arg Val Asp Gly Ala Ser Ile Lys Phe Glu Ser Ile Cys
610 615 620

Leu Tyr Ala Thr Phe Phe Pro Met Ala His Asn Thr Ala Ser Thr Leu
625 630 635 640

Glu Ala Met Leu Arg Asn Asp Thr Asn Asp Gln Ser Phe Asn Asp Tyr
645 650 655

Leu Ser Ala Ala Asn Met Leu Tyr Pro Ile Pro Ala Asn Ala Thr Asn
660 665 670

Val Pro Ile Ser Ile Pro Ser Arg Asn Trp Ala Ala Phe Arg Gly Trp
675 680 685

Ala Phe Thr Arg Leu Lys Thr Lys Glu Thr Pro Ser Leu Gly Ser Gly
690 695 700

Phe Asp Pro Tyr Tyr Thr Tyr Ser Gly Ser Ile Pro Tyr Leu Asp Gly
705 710 715 720

Thr Phe Tyr Leu Asn His Thr Phe Lys Lys Val Ser Val Thr Phe Asp
725 730 735

Ser Ser Val Ser Trp Pro Gly Asn Asp Arg Leu Leu Thr Pro Asn Glu
740 745 750

Phe Glu Ile Lys Arg Ser Val Asp Gly Glu Gly Tyr Asn Val Ala Gln
755 760 765

Cys Asn Met Thr Lys Asp Trp Phe Leu Ile Gln Met Leu Ala Asn Tyr
770 775 780

Asn Ile Gly Tyr Gln Gly Phe Tyr Ile Pro Glu Ser Tyr Lys Asp Arg
785 790 795 800

Met Tyr Ser Phe Phe Arg Asn Phe Gln Pro Met Ser Arg Gln Val Val
805 810 815

Asp Glu Thr Lys Tyr Lys Asp Tyr Gln Gln Val Gly Ile Ile His Gln
820 825 830

His Asn Asn Ser Gly Phe Val Gly Tyr Leu Ala Pro Thr Met Arg Glu
835 840 845

Gly Gln Ala Tyr Pro Ala Asn Phe Pro Tyr Pro Leu Ile Gly Lys Thr
850 855 860

Ala Val Asp Ser Ile Thr Gln Lys Lys Phe Leu Cys Asp Arg Thr Leu
865 870 875 880

Trp Arg Ile Pro Phe Ser Ser Asn Phe Met Ser Met Gly Ala Leu Thr
885 890 895

Asp Leu Gly Gln Asn Leu Leu Tyr Ala Asn Ser Ala His Ala Leu Asp
900 905 910

Met Thr Phe Glu Val Asp Pro Met Asp Glu Pro Thr Leu Leu Tyr Val
915 920 925

Leu Phe Glu Val Phe Asp Val Val Arg Val His Gln Pro His Arg Gly
930 935 940

Val Ile Glu Thr Val Tyr Leu Arg Thr Pro Phe Ser Ala Gly Asn Ala
945 950 955 960

Thr Thr

<210> 26
<211> 531
<212> PRT
<213> Adenoviridae - Mastadenovirus

<400> 26

Met Met Arg Arg Val Tyr Pro Glu Gly Pro Pro Pro Ser Tyr Glu Ser
1 5 10 15

Val Met Gln Gln Ala Val Ala Ala Ala Met Gln Pro Pro Leu Glu Ala
20 25 30

Pro Tyr Val Pro Pro Arg Tyr Leu Ala Pro Thr Glu Gly Arg Asn Ser
35 40 45

Ile Arg Tyr Ser Glu Leu Ala Pro Leu Tyr Asp Thr Thr Arg Leu Tyr
50 55 60

Leu Val Asp Asn Lys Ser Ala Asp Ile Ala Ser Leu Asn Tyr Gln Asn
65 70 75 80

Asp His Ser Asn Phe Leu Thr Thr Val Val Gln Asn Asn Asp Phe Thr
85 90 95

Pro Thr Glu Ala Ser Thr Gln Thr Ile Asn Phe Asp Glu Arg Ser Arg
100 105 110

Trp Gly Gly Gln Leu Lys Thr Ile Met His Thr Asn Met Pro Asn Val
115 120 125

Asn Glu Phe Met Tyr Ser Asn Lys Phe Lys Ala Arg Val Met Val Ser
130 135 140

Arg Lys Thr Pro Asn Gly Val Ala Val Gly Asp Asp Tyr Asp Gly Gly
145 150 155 160

Gln Asp Glu Leu Thr Tyr Glu Trp Val Glu Phe Glu Leu Pro Glu Gly
165 170 175

Asn Phe Ser Val Thr Met Thr Ile Asp Leu Met Asn Asn Ala Ile Ile
180 185 190

Asp Asn Tyr Leu Ala Val Gly Arg Gln Asn Gly Val Leu Glu Ser Asp
195 200 205

Ile Gly Val Lys Phe Asp Thr Arg Asn Phe Arg Leu Gly Trp Asp Pro
210 215 220

Val Thr Glu Leu Val Met Pro Gly Val Tyr Thr Asn Glu Ala Phe His
225 230 235 240

Pro Asp Ile Val Leu Leu Pro Gly Cys Gly Val Asp Phe Thr Glu Ser
245 250 255

Arg Leu Ser Asn Leu Leu Gly Ile Arg Lys Arg Gln Pro Phe Gln Glu
260 265 270

Gly Phe Gln Ile Leu Tyr Glu Asp Leu Glu Gly Gly Asn Ile Pro Ala
275 280 285

Leu Leu Asp Val Glu Ala Tyr Glu Lys Ser Lys Glu Glu Ser Ala Ala
290 295 300

Ala Ala Thr Ala Ala Val Ala Thr Ala Ser Thr Glu Val Arg Gly Asp
305 310 315 320

Asn Phe Ala Ser Ala Ala Ala Val Ala Glu Ala Ala Glu Thr Glu Ser
325 330 335

Lys Ile Val Ile Gln Pro Val Glu Lys Asp Ser Lys Asp Arg Ser Tyr
340 345 350

Asn Val Leu Ala Asp Lys Lys Asn Thr Ala Tyr Arg Ser Trp Tyr Leu
355 360 365

Ala Tyr Asn Tyr Gly Asp Pro Glu Lys Gly Val Arg Ser Trp Thr Leu
370 375 380

Leu Thr Thr Ser Asp Val Thr Cys Gly Val Glu Gln Val Tyr Trp Ser
385 390 395 400

Leu Pro Asp Met Met Gln Asp Pro Val Thr Phe Arg Ser Thr Arg Gln
405 410 415

Val Ser Asn Tyr Pro Val Val Gly Ala Glu Leu Leu Pro Val Tyr Ser
420 425 430

Lys Ser Phe Phe Asn Glu Gln Ala Val Tyr Ser Gln Gln Leu Arg Ala
435 440 445

Phe Thr Ser Leu Thr His Val Phe Asn Arg Phe Pro Glu Asn Gln Ile
450 455 460

Leu Val Arg Pro Pro Ala Pro Thr Ile Thr Thr Val Ser Glu Asn Val
465 470 475 480

Pro Ala Leu Thr Asp His Gly Thr Leu Pro Leu Arg Ser Ser Ile Arg
485 490 495

Gly Val Gln Arg Val Thr Val Thr Asp Ala Arg Arg Arg Thr Cys Pro
500 505 510

Tyr Val Tyr Lys Ala Leu Gly Val Val Ala Pro Arg Val Leu Ser Ser
515 520 525

Arg Thr Phe
530

<210> 27
<211> 541
<212> PRT
<213> Adenoviridae - Mastadenovirus

<400> 27

Met Met Arg Arg Val Tyr Pro Glu Gly Pro Pro Pro Ser Tyr Glu Ser
1 5 10 15

Val Met Gln Gln Ala Val Ala Val Ala Met Gln Pro Pro Leu Glu Ala
20 25 30

Pro Tyr Val Pro Pro Arg Tyr Leu Ala Pro Thr Glu Gly Arg Asn Ser
35 40 45

Ile Arg Tyr Ser Glu Leu Ala Pro Leu Tyr Asp Thr Thr Arg Leu Tyr
50 55 60

Leu Val Asp Asn Lys Ser Ala Asp Ile Ala Ser Leu Asn Tyr Gln Asn
65 70 75 80

Asp His Ser Asn Phe Leu Thr Thr Val Val Gln Asn Asn Asp Phe Thr
85 90 95

Pro Thr Glu Ala Ser Thr Gln Thr Ile Asn Phe Asp Glu Arg Ser Arg
100 105 110

Trp Gly Gly Gln Leu Lys Thr Ile Met His Thr Asn Met Pro Asn Val
115 120 125

Asn Glu Phe Met Tyr Ser Asn Lys Phe Lys Ala Arg Val Met Val Ser
130 135 140

Arg Lys Thr Pro Asn Gly Val Thr Val Gly Asp Asp Tyr Asp Gly Ser
145 150 155 160

Gln Asp Glu Leu Thr Tyr Glu Trp Val Glu Phe Glu Leu Pro Glu Gly
165 170 175

Asn Phe Ser Val Thr Met Thr Ile Asp Leu Met Asn Asn Ala Ile Ile
180 185 190

Asp Asn Tyr Leu Ala Val Gly Arg Gln Asn Gly Val Leu Glu Ser Asp
195 200 205

Ile Gly Val Lys Phe Asp Thr Arg Asn Phe Arg Leu Gly Trp Asp Pro
210 215 220

Val Thr Glu Leu Val Met Pro Gly Val Tyr Thr Asn Glu Ala Phe His
225 230 235 240

Pro Asp Ile Val Leu Leu Pro Gly Cys Gly Val Asp Phe Thr Glu Ser
245 250 255

Arg Leu Ser Asn Leu Leu Gly Ile Arg Lys Arg Gln Pro Phe Gln Glu
260 265 270

Gly Phe Gln Ile Leu Tyr Glu Asp Leu Glu Gly Gly Asn Ile Pro Ala
275 280 285

Leu Leu Asp Val Glu Ala Tyr Glu Lys Ser Lys Glu Asp Ser Ala Ala
290 295 300

Ala Thr Thr Ala Ala Val Ala Thr Ala Ala Thr Thr Asp Ala Asp Ala
305 310 315 320

Thr Thr Thr Arg Gly Asp Thr Phe Ala Thr Gln Ala Glu Glu Ala Ala
325 330 335

Ala Leu Ala Ala Thr Asp Asp Ser Glu Ser Lys Ile Val Ile Lys Pro
340 345 350

Val Glu Lys Asp Ser Lys Asp Arg Ser Tyr Asn Val Leu Ala Asp Lys
355 360 365

Lys Asn Thr Ala Tyr Arg Ser Trp Tyr Leu Ala Tyr Asn Tyr Gly Asp
370 375 380

Pro Glu Lys Gly Val Arg Ser Trp Thr Leu Leu Thr Thr Ser Asp Val
385 390 395 400

Thr Cys Gly Val Glu Gln Val Tyr Trp Ser Leu Pro Asp Met Met Gln
405 410 415

Asp Pro Val Thr Phe Arg Ser Thr Arg Gln Val Ser Asn Tyr Pro Val
420 425 430

Val Gly Ala Glu Leu Leu Pro Val Tyr Ser Lys Ser Phe Phe Asn Glu
435 440 445

Gln Ala Val Tyr Ser Gln Gln Leu Arg Ala Phe Thr Ser Leu Thr His
450 455 460

Val Phe Asn Arg Phe Pro Glu Asn Gln Ile Leu Val Arg Pro Pro Ala
465 470 475 480

Pro Thr Ile Thr Thr Val Ser Glu Asn Val Pro Ala Leu Thr Asp His
485 490 495

Gly Thr Leu Pro Leu Arg Ser Ser Ile Arg Gly Val Gln Arg Val Thr
500 505 510

Val Thr Asp Ala Arg Arg Arg Thr Cys Pro Tyr Val Tyr Lys Ala Leu
515 520 525

Gly Val Val Ala Pro Arg Val Leu Ser Ser Arg Thr Phe
530 535 540

<210> 28
<211> 532
<212> PRT
<213> Adenoviridae - Mastadenovirus

<400> 28

Met Met Arg Arg Val Tyr Pro Glu Gly Pro Pro Pro Ser Tyr Glu Ser
1 5 10 15

Val Met Gln Gln Ala Val Ala Ala Ala Met Gln Pro Pro Leu Glu Ala
20 25 30

Pro Tyr Val Pro Pro Arg Tyr Leu Ala Pro Thr Glu Gly Arg Asn Ser
35 40 45

Ile Arg Tyr Ser Glu Leu Ala Pro Leu Tyr Asp Thr Thr Arg Leu Tyr

50 55 60

Leu Val Asp Asn Lys Ser Ala Asp Ile Ala Ser Leu Asn Tyr Gln Asn
65 70 75 80

Asp His Ser Asn Phe Leu Thr Thr Val Val Gln Asn Asn Asp Phe Thr
85 90 95

Pro Thr Glu Ala Ser Thr Gln Thr Ile Asn Phe Asp Glu Arg Ser Arg
100 105 110

Trp Gly Gly Gln Leu Lys Thr Ile Met His Thr Asn Met Pro Asn Val
115 120 125

Asn Glu Phe Met Tyr Ser Asn Lys Phe Lys Ala Arg Val Met Val Ser
130 135 140

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

Leu Thr Tyr Glu Trp Val Glu Phe Glu Leu Pro Glu Gly Asn Phe Ser
165 170 175

Val Thr Met Thr Ile Asp Leu Met Asn Asn Ala Ile Ile Asp Asn Tyr
180 185 190

Leu Ala Val Gly Arg Gln Asn Gly Val Leu Glu Ser Asp Ile Gly Val
195 200 205

Lys Phe Asp Thr Arg Asn Phe Arg Leu Gly Trp Asp Pro Val Thr Glu
210 215 220

Leu Val Met Pro Gly Val Tyr Thr Asn Glu Ala Phe His Pro Asp Ile
225 230 235 240

Val Leu Leu Pro Gly Cys Gly Val Asp Phe Thr Glu Ser Arg Leu Ser
245 250 255

Asn Leu Leu Gly Ile Arg Lys Arg Gln Pro Phe Gln Glu Gly Phe Gln
260 265 270

Ile Leu Tyr Glu Asp Leu Glu Gly Gly Asn Ile Pro Ala Leu Leu Asp
275 280 285

Val Glu Ala Tyr Glu Lys Ser Lys Glu Asp Ser Thr Ala Val Ala Thr
290 295 300

Ala Ala Thr Val Ala Asp Ala Thr Val Thr Arg Gly Asp Thr Phe Ala
305 310 315 320

Thr Gln Ala Glu Glu Ala Ala Ala Leu Ala Ala Thr Asp Asp Ser Glu

325 330 335

Ser Lys Ile Val Ile Lys Pro Val Glu Lys Asp Ser Lys Asp Arg Ser
340 345 350

Tyr Asn Val Leu Ser Asp Gly Lys Asn Thr Ala Tyr Arg Ser Trp Tyr
355 360 365

Leu Ala Tyr Asn Tyr Gly Asp Pro Glu Lys Gly Val Arg Ser Trp Thr
370 375 380

Leu Leu Thr Thr Ser Asp Val Thr Cys Gly Val Glu Gln Val Tyr Trp
385 390 395 400

Ser Leu Pro Asp Met Met Gln Asp Pro Val Thr Phe Arg Ser Thr Arg
405 410 415

Gln Val Ser Asn Tyr Pro Val Val Gly Ala Glu Leu Leu Pro Val Tyr
420 425 430

Ser Lys Ser Phe Phe Asn Glu Gln Ala Val Tyr Ser Gln Gln Leu Arg
435 440 445

Ala Phe Thr Ser Leu Thr His Val Phe Asn Arg Phe Pro Glu Asn Gln
450 455 460

Ile Leu Val Arg Pro Pro Ala Pro Thr Ile Thr Thr Val Ser Glu Asn
465 470 475 480

Val Pro Ala Leu Thr Asp His Gly Thr Leu Pro Leu Arg Ser Ser Ile
485 490 495

Arg Gly Val Gln Arg Val Thr Val Thr Asp Ala Arg Arg Arg Thr Cys
500 505 510

Pro Tyr Val Tyr Lys Ala Leu Gly Val Val Ala Pro Arg Val Leu Ser
515 520 525

Ser Arg Thr Phe
530

<210> 29
<211> 528
<212> PRT
<213> Adenoviridae - Mastadenovirus

<400> 29

Met Met Arg Arg Val Tyr Pro Glu Gly Pro Pro Pro Ser Tyr Glu Ser
1 5 10 15

Val Met Gln Gln Ala Val Ala Ala Ala Met Gln Pro Pro Leu Glu Ala
20 25 30

Pro Tyr Val Pro Pro Arg Tyr Leu Ala Pro Thr Glu Gly Arg Asn Ser
35 40 45

Ile Arg Tyr Ser Glu Leu Ala Pro Leu Tyr Asp Thr Thr Arg Leu Tyr
50 55 60

Leu Val Asp Asn Lys Ser Ala Asp Ile Ala Ser Leu Asn Tyr Gln Asn
65 70 75 80

Asp His Ser Asn Phe Leu Thr Thr Val Val Gln Asn Asn Asp Phe Thr
85 90 95

Pro Thr Glu Ala Ser Thr Gln Thr Ile Asn Phe Asp Glu Arg Ser Arg
100 105 110

Trp Gly Gly Gln Leu Lys Thr Ile Met His Thr Asn Met Pro Asn Val
115 120 125

Asn Glu Phe Leu Tyr Ser Asn Lys Phe Lys Ala Arg Val Met Val Ser
130 135 140

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

Leu Thr Tyr Glu Trp Val Glu Phe Glu Leu Pro Glu Gly Asn Phe Ser
165 170 175

Val Thr Met Thr Ile Asp Leu Met Asn Asn Ala Ile Ile Asp Asn Tyr
180 185 190

Leu Ala Val Gly Arg Gln Asn Gly Val Leu Glu Ser Asp Ile Gly Val
195 200 205

Lys Phe Asp Thr Arg Asn Phe Arg Leu Gly Trp Asp Pro Val Thr Glu
210 215 220

Leu Val Met Pro Gly Val Tyr Thr Asn Glu Ala Phe His Pro Asp Ile
225 230 235 240

Val Leu Leu Pro Gly Cys Gly Val Asp Phe Thr Glu Ser Arg Leu Ser
245 250 255

Asn Leu Leu Gly Ile Arg Lys Arg Gln Pro Phe Gln Glu Gly Phe Gln
260 265 270

Ile Met Tyr Glu Asp Leu Glu Gly Gly Asn Ile Pro Ala Leu Leu Asp
275 280 285

Val Glu Ala Tyr Glu Lys Ser Lys Glu Asp Ser Ala Ala Ala Ala Thr
290 295 300

Ala Ala Val Ala Thr Ala Ser Thr Glu Val Arg Gly Asp Asn Phe Ala
305 310 315 320

Ser Ala Ala Ala Val Ala Glu Ala Ala Glu Thr Glu Ser Lys Ile Val
325 330 335

Ile Gln Pro Val Glu Lys Asp Ser Lys Asp Arg Ser Tyr Asn Val Leu
340 345 350

Ala Asp Lys Lys Asn Thr Ala Tyr Arg Ser Trp Tyr Leu Ala Tyr Asn
355 360 365

Tyr Gly Asp Pro Glu Lys Gly Val Arg Ser Trp Thr Leu Leu Thr Thr
370 375 380

Ser Asp Val Thr Cys Gly Val Glu Gln Val Tyr Trp Ser Leu Pro Asp
385 390 395 400

Met Met Gln Asp Pro Val Thr Phe Arg Ser Thr Arg Gln Val Ser Asn
405 410 415

Tyr Pro Val Val Gly Ala Glu Leu Leu Pro Val Tyr Ser Lys Ser Phe
420 425 430

Phe Asn Glu Gln Ala Val Tyr Ser Gln Gln Leu Arg Ala Phe Thr Ser
435 440 445

Leu Thr His Val Phe Asn Arg Phe Pro Glu Asn Gln Ile Leu Val Arg
450 455 460

Pro Pro Ala Pro Thr Ile Thr Thr Val Ser Glu Asn Val Pro Ala Leu
465 470 475 480

Thr Asp His Gly Thr Leu Pro Leu Arg Ser Ser Ile Arg Gly Val Gln
485 490 495

Arg Val Thr Val Thr Asp Ala Arg Arg Arg Thr Cys Pro Tyr Val Tyr
500 505 510

Lys Ala Leu Gly Val Val Ala Pro Arg Val Leu Ser Ser Arg Thr Phe
515 520 525

<210> 30
<211> 535
<212> PRT
<213> Adenoviridae - Mastadenovirus

<400> 30

Met Met Arg Arg Ala Tyr Pro Glu Gly Pro Pro Pro Ser Tyr Glu Ser
1 5 10 15

Val Met Gln Gln Ala Met Ala Ala Ala Ala Ala Met Gln Pro Pro Leu
20 25 30

Glu Ala Pro Tyr Val Pro Pro Arg Tyr Leu Ala Pro Thr Glu Gly Arg
35 40 45

Asn Ser Ile Arg Tyr Ser Glu Leu Ala Pro Leu Tyr Asp Thr Thr Arg
50 55 60

Leu Tyr Leu Val Asp Asn Lys Ser Ala Asp Ile Ala Ser Leu Asn Tyr
65 70 75 80

Gln Asn Asp His Ser Asn Phe Leu Thr Thr Val Val Gln Asn Asn Asp
85 90 95

Phe Thr Pro Thr Glu Ala Ser Thr Gln Thr Ile Asn Phe Asp Glu Arg
100 105 110

Ser Arg Trp Gly Gly Gln Leu Lys Thr Ile Met His Thr Asn Met Pro
115 120 125

Asn Val Asn Glu Phe Met Tyr Ser Asn Lys Phe Lys Ala Arg Val Met
130 135 140

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

Gly Ser Gln Asp Glu Leu Lys Tyr Glu Trp Val Glu Phe Glu Leu Pro
165 170 175

Glu Gly Asn Phe Ser Val Thr Met Thr Ile Asp Leu Met Asn Asn Ala
180 185 190

Ile Ile Asp Asn Tyr Leu Ala Val Gly Arg Gln Asn Gly Val Leu Glu
195 200 205

Ser Asp Ile Gly Val Lys Phe Asp Thr Arg Asn Phe Arg Leu Gly Trp
210 215 220

Asp Pro Val Thr Glu Leu Val Met Pro Gly Val Tyr Thr Asn Glu Ala
225 230 235 240

Phe His Pro Asp Ile Val Leu Leu Pro Gly Cys Gly Val Asp Phe Thr
245 250 255

Glu Ser Arg Leu Ser Asn Leu Leu Gly Ile Arg Lys Arg Gln Pro Phe
260 265 270

Gln Glu Gly Phe Gln Ile Met Tyr Glu Asp Leu Glu Gly Gly Asn Ile
275 280 285

Pro Ala Leu Leu Asp Val Asp Ala Tyr Glu Lys Ser Lys Glu Glu Ser
290 295 300

Ala Ala Ala Ala Thr Ala Ala Val Ala Thr Ala Ser Thr Glu Val Arg
305 310 315 320

Gly Asp Asn Phe Ala Ser Ala Ala Ala Val Ala Ala Ala Glu Ala Ala
325 330 335

Glu Thr Glu Ser Lys Ile Val Ile Gln Pro Val Glu Lys Asp Ser Lys
340 345 350

Asp Arg Ser Tyr Asn Val Leu Pro Asp Lys Ile Asn Thr Ala Tyr Arg
355 360 365

Ser Trp Tyr Leu Ala Tyr Asn Tyr Gly Asp Pro Glu Lys Gly Val Arg
370 375 380

Ser Trp Thr Leu Leu Thr Thr Ser Asp Val Thr Cys Gly Val Glu Gln
385 390 395 400

Val Tyr Trp Ser Leu Pro Asp Met Met Gln Asp Pro Val Thr Phe Arg
405 410 415

Ser Thr Arg Gln Val Ser Asn Tyr Pro Val Val Gly Ala Glu Leu Leu
420 425 430

Pro Val Tyr Ser Lys Ser Phe Phe Asn Glu Gln Ala Val Tyr Ser Gln
435 440 445

Gln Leu Arg Ala Phe Thr Ser Leu Thr His Val Phe Asn Arg Phe Pro
450 455 460

Glu Asn Gln Ile Leu Val Arg Pro Pro Ala Pro Thr Ile Thr Thr Val
465 470 475 480

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

Ser Ser Ile Arg Gly Val Gln Arg Val Thr Val Thr Asp Ala Arg Arg
500 505 510

Arg Thr Cys Pro Tyr Val Tyr Lys Ala Leu Gly Ile Val Ala Pro Arg
515 520 525

Val Leu Ser Ser Arg Thr Phe
530 535

<210> 31
<211> 581
<212> PRT

<213> Adenoviridae - Mastadenovirus

<400> 31

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Met Arg Arg Ala Ala Met Tyr His Glu Gly Pro Pro Pro Ser Tyr Glu
1               5                  10                  15

Ser Val Val Gly Ala Ala Ala Ala Ser Pro Phe Ala Ser Gln Leu Glu
            20                  25                  30

Pro Pro Tyr Val Pro Pro Arg Tyr Leu Arg Pro Thr Gly Gly Arg Asn
        35                  40                  45

Ser Ile Arg Tyr Ser Glu Leu Ala Pro Leu Tyr Asp Thr Thr Arg Val
    50                  55                  60

Tyr Leu Val Asp Asn Lys Ser Ala Asp Val Ala Ser Leu Asn Tyr Gln
65                  70                  75                  80

Asn Asp His Ser Asn Phe Leu Thr Thr Val Ile Gln Asn Asn Asp Tyr
                85                  90                  95

Thr Pro Ser Glu Ala Ser Thr Gln Thr Ile Asn Leu Asp Asp Arg Ser
            100                 105                 110

His Trp Gly Gly Asp Leu Lys Thr Ile Leu His Thr Asn Met Pro Asn
        115                 120                 125

Val Asn Glu Phe Met Phe Thr Asn Lys Phe Lys Ala Arg Val Met Val
    130                 135                 140

Ser Arg Ser His Thr Lys Asp Asp Arg Val Glu Leu Lys Tyr Glu Trp
145                 150                 155                 160

Val Glu Phe Glu Leu Pro Glu Gly Asn Tyr Ser Glu Thr Met Thr Ile
                165                 170                 175

Asp Leu Met Asn Asn Ala Ile Val Glu His Tyr Leu Lys Val Gly Arg
            180                 185                 190

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

Asn Phe Arg Leu Gly Leu Asp Pro Val Thr Gly Leu Val Met Pro Gly
    210                 215                 220

Val Tyr Thr Asn Glu Ala Phe His Pro Asp Ile Ile Leu Leu Pro Gly
225                 230                 235                 240

Cys Gly Val Asp Phe Thr Tyr Ser Arg Leu Ser Asn Leu Leu Gly Ile
                245                 250                 255
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Arg Lys Arg Gln Pro Phe Gln Glu Gly Phe Arg Ile Thr Tyr Glu Asp
260 265 270

Leu Glu Gly Gly Asn Ile Pro Ala Leu Leu Asp Val Glu Ala Tyr Gln
275 280 285

Asp Ser Leu Lys Glu Glu Glu Ala Gly Glu Gly Ser Gly Gly Gly Ala
290 295 300

Gly Gln Glu Glu Gly Gly Ala Ser Ser Glu Ala Ser Ala Asp Pro Ala
305 310 315 320

Ala Ala Ala Glu Ala Glu Ala Ala Asp Pro Ala Met Val Val Glu Glu
325 330 335

Glu Lys Asp Met Asn Asp Glu Ala Val Arg Gly Asp Thr Phe Ala Thr
340 345 350

Arg Gly Glu Glu Lys Lys Ala Glu Ala Glu Ala Ala Ala Glu Glu Ala
355 360 365

Ala Ala Ala Ala Ala Ala Val Glu Ala Ala Ala Glu Ala Glu Lys Pro
370 375 380

Pro Lys Glu Pro Val Ile Lys Pro Leu Thr Glu Asp Ser Lys Lys Arg
385 390 395 400

Ser Tyr Asn Val Leu Lys Asp Ser Thr Asn Thr Glu Tyr Arg Ser Trp
405 410 415

Tyr Leu Ala Tyr Asn Tyr Gly Asp Pro Ala Thr Gly Val Arg Ser Trp
420 425 430

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

Trp Ser Leu Pro Asp Met Met Gln Asp Pro Val Thr Phe Arg Ser Thr
450 455 460

Arg Gln Val Ser Asn Phe Pro Val Val Gly Ala Glu Leu Leu Pro Val
465 470 475 480

His Ser Lys Ser Phe Tyr Asn Asp Gln Ala Val Tyr Ser Gln Leu Ile
485 490 495

Arg Gln Phe Thr Ser Leu Thr His Val Phe Asn Arg Phe Pro Glu Asn
500 505 510

Gln Ile Leu Ala Arg Pro Pro Ala Pro Thr Ile Thr Thr Val Ser Glu
515 520 525

Asn Val Pro Ala Leu Thr Asp His Gly Thr Leu Pro Leu Arg Asn Ser
530 535 540

Ile Gly Gly Val Gln Arg Val Thr Val Thr Asp Ala Arg Arg Arg Thr
545 550 555 560

Cys Pro Tyr Val Tyr Lys Ala Leu Gly Ile Val Ser Pro Arg Val Leu
565 570 575

Ser Ser Arg Thr Phe
580

<210> 32
<211> 1323
<212> DNA
<213> Adenoviridae - Mastadenovirus

<400> 32
atgtccaaaa agcgcgtccg ggtggatgat gacttcgacc ccgtctaccc ctacgatgca 60

gacaacgcac cgaccgtgcc cttcatcaac cctcccttcg tctcttcaga tggattccaa 120

gaaaagcccc tgggggtgtt gtccctgcga ctggctgacc ccgtcaccac caagaacggg 180

gaaatcaccc tcaagctggg agagggggtg gacctcgacg actcgggaaa actcatctcc 240

aaaaatgcca ccaaggccac tgcccctctc agtatttcca acagcaccat ttcccttaac 300

atggatgccc ctctttacaa caacaatgga aagttaggca taagaatagg agcacctcta 360

aaggtagtag acttactaaa cactttagct gtagcctatg gatcgggtct aggtctcaag 420

aataatgccc ttacagttca gttagtttct ccactcactt ttgataacaa aggcaatgta 480

aaaattaact tagggaatgg cccattaaca gttgcggcaa accgactgag tgttacctgc 540

aaaagaggtt tatatgtcac tactacagga gatgcactcg aaagcaacat aagctgggct 600

aaaggtataa gatttgaagg aaatgcaata gcagcaaata ttggcaaagg gcttgaattt 660

ggtactacta gttcagagtc agatgtcagc aatgcttatc ctatccaagt aaaactaggt 720

actggtctca cctttgacag cacaggtgca attgtcgctt ggaacaaaga agatgacaaa 780

cttacactgt ggaccacagc cgatccatct ccaaactgtc acatatattc tgacaaggat 840

gctaagctta cactctgctt gacaaagtgt ggcagtcaga tactgggcac tgtttctctc 900

atagctgttg atactggtag cttaaatcca ataacaggac aagtaaccac tgctcttgtt 960

tcacttaaat tcgatgccaa tggagttttg caaaccagtt caacattgga caaagaatat 1020

tggaatttta gaaaaggaga tgtgacacct gctgagccat atactaatgc tataggtttt 1080

atgcccaata taaaggcata tccgaaaaac acaaattcag ctgcaaaaag tcacattgtg 1140

ggaaaagtat acctacatgg ggaagtaagc aagccactag acttgataat tacatttaat 1200

gaaaccagta atgaaacctg tacctattgc attaactttc agtggcagtg gggaactgac 1260

aaatataaaa atgaaacgct tgctgtcagt tcattcacct tttcctacat tgcccaagaa 1320

taa 1323

<210> 33
<211> 1332
<212> DNA
<213> Adenoviridae - Mastadenovirus

<400> 33
atgtccaaaa agcgcgtccg ggtggatgat gacttcgacc ccgtctaccc ctacgatgca 60

gacaacgcac cgaccgtgcc cttcatcaac ccccccttcg tctcttcaga tggattccaa 120

gagaagcccc tgggggtgtt gtccctgcga ctggccgacc ccgtcaccac caagaacggg 180

gaaatcaccc tcaagctggg agagggggtg gacctcgacg actcgggaaa actcatctcc 240

aaaaatgcca ccaaggccac tgcccctctc agtatttcca acagcaccat ttcccttaac 300

atggctgccc ctttttacaa caacaatgga acgttaagtc tcaatgtttc tacaccatta 360

gcagtatttc ccacttttaa cactttaggt atcagtcttg gcaacggtct tcaaacttct 420

aataagttgc tggctgtaca gttaactcat cctcttacat tcagctcaaa tagcatcaca 480

gtaaaaacag acaaaggact ctatattaat tctagtggaa acagagggct tgaggctaac 540

ataagcctaa aaagaggact gatttttgat ggtaatgcta ttgcaacata ccttggaagt 600

ggtttagact atggatccta tgatagcgat ggaaaaacaa gacccatcat caccaaaatt 660

ggagcaggct tgaattttga ttctaataat gccatggctg tgaagctagg cacaggttta 720

agttttgact ctgccggtgc cttaacagct ggaaacaaag aggatgacaa gctaacactt 780

tggactacac ctgaccccag ccctaattgt caattacttt cagacagaga tgccaaattt 840

accctatgtc ttacaaaatg cggtagtcaa atactaggca ctgttgcagt agctgctgtt 900

actgtaagtt cagcactaaa tccaattaat gacacagtaa aaagcgccat agtattcctt 960

agatttgact ctgacggtgt gctcatgtca aactcatcaa tggtaggtga ttactggaac 1020

tttagggaag gacagaccac ccaaagtgtg gcctatacaa atgctgtggg attcatgccc 1080

aatctaggtg catatcctaa aacccaaagc aaaacaccaa aaaatagtat agtaagccag 1140

gtatatttaa atggagaaac tactatgcca atgacactga caataacttt caatggcact 1200

gatgaaaaag acacaacacc tgtcagcact tactctatga cttttacatg gcagtggact 1260

ggagactata aggacaagaa tattaccttt gctaccaact cctttacttt ctcctacatg 1320

gcccaagaat aa 1332

<210> 34
<211> 1278
<212> DNA
<213> Adenoviridae - Mastadenovirus

<400> 34
atgtccaaaa agcgcgtccg ggtggatgat gacttcgacc ccgtctaccc ctacgatgca 60

gacaacgcac cgaccgtgcc cttcatcaac ccccccttcg tctcttcaga tggattccaa 120

gagaagcccc tgggggtgtt gtccctgcga ctggccgacc ccgtcaccac caagaacggg 180

gaaatcaccc tcaagctggg agagggggtg gacctcgact cctcgggaaa actcatctcc 240

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atggatcacc ccttttacac taaagatgga aaattagcct tacaagtttc tccaccatta 360

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<400> 43

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gtgctggaga gcgacatcgg cgtgaagttc gacacgcgca acttccggct gggctgggac 660

cccgtgaccg agctggtgat gccgggcgtg tacaccaacg aggccttcca ccccgacatc 720

gtcctgctgc ccggctgcgg cgtggacttc accgagagcc gcctcagcaa cctgctgggc 780

atccgcaagc ggcagccctt ccaggagggc ttccagatcc tgtacgagga cctggagggg 840

ggcaacatcc ccgcgctctt ggatgtcgaa gcctacgaga aaagcaagga ggatagcacc 900

gccgtggcta ccgccgcgac tgtggcagat gccactgtca ccaggggcga tacattcgcc 960

acccaggcgg aggaagcagc cgccctagcg gcgaccgatg atagtgaaag taagatagtt 1020

atcaagccgg tggagaagga cagcaaggac aggagctaca acgttctatc ggatggaaag 1080

aacaccgcct accgcagctg gtacctggcc tacaactacg gcgaccccga gaagggcgtg 1140

cgctcctgga cgctgctcac cacctcggac gtcacctgcg gcgtggagca agtctactgg 1200

tcgctgcccg acatgatgca agacccggtc accttccgct ccacgcgtca agttagcaac 1260

tacccggtgg tgggcgccga gctcctgccc gtctactcca agagcttctt caacgagcag 1320

gccgtctact cgcagcagct gcgcgccttc acctcgctca cgcacgtctt caaccgcttc 1380

cccgagaacc agatcctcgt ccgcccgccc gcgcccacca ttaccaccgt cagtgaaaac 1440

gttcctgctc tcacagatca cgggaccctg ccgctgcgca gcagtatccg gggagtccag 1500

cgcgtgaccg tcactgacgc cagacgccgc acctgcccct acgtctacaa ggccctgggc 1560

gtagtcgcgc cgcgcgtcct ctcgagccgc accttctaa 1599

<210> 47
<211> 1587
<212> DNA
<213> Adenoviridae - Mastadenovirus

<400> 47
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gcggtggcgg cggcgatgca gcccccgctg gaggcgcctt acgtgccccc gcggtacctg 120

gcgcctacgg aggggcggaa cagcattcgt tactcggagc tggcaccctt gtacgatacc 180

acccggttgt acctggtgga caacaagtcg gcggacatcg cctcgctgaa ctaccagaac 240

gaccacagca acttcctgac caccgtggtg cagaacaacg atttcacccc cacggaggcc 300

agcacccaga ccatcaactt tgacgagcgc tcgcggtggg gcggccagct gaaaaccatc 360

atgcacacca acatgcccaa cgtgaacgag ttcctgtaca gcaacaagtt caaggcgcgg 420

gtgatggtct cgcgcaagac ccccaacggg gtcacagtaa cagatggtag tcaggacgag 480

ctgacctacg agtgggtgga gtttgagctg cccgagggca acttctcggt gaccatgacc 540

atcgatctga tgaacaacgc cattatcgac aattacttgg cggtggggcg gcagaacggg 600

gtgctggaga gcgacatcgg cgtgaagttc gacacgcgca acttcaggct cggttgggac 660

cccgtgaccg agctggtcat gccgggcgtg tacaccaacg aggccttcca ccccgacatc 720

gtcctgctgc ccggctgcgg cgtggacttc accgagagcc gcctcagcaa cctgctgggc 780

attcgcaaga ggcagccctt ccaggagggt ttccagatca tgtacgagga tctggagggg 840

ggcaacatcc ccgcgctcct ggatgtcgag gcctacgaga aaagcaagga ggatagcgcc 900

gccgcggcga ccgcagccgt ggccaccgcc tctaccgagg tgcggggcga taattttgct 960

agcgccgcgg cagtggccga ggcggctgaa accgaaagta agatagtgat ccagccggtg 1020

gagaaggaca gcaaggacag gagctacaac gtgctcgcgg acaagaaaaa caccgcctac 1080

cgcagctggt acctggccta caactacggc gaccccgaga agggcgtgcg ctcctggacg 1140

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ggcgccgagc tcctgcccgt ctactccaag agcttcttca acgagcaggc cgtctactcg 1320

cagcagctgc gcgccttcac ctcgctcacg cacgtcttca accgcttccc cgagaaccag 1380

atcctcgtcc gcccgcccgc gcccaccatt accaccgtca gtgaaaacgt tcctgctctc 1440

acagatcacg ggaccctgcc gctgcgcagc agtatccggg gagtccagcg cgtgaccgtc 1500

actgacgcca gacgccgcac ctgcccctac gtctacaagg ccctgggcgt agtcgcgccg 1560

cgcgtcctct cgagccgcac cttctaa 1587

<210> 48
<211> 1608
<212> DNA
<213> Adenoviridae - Mastadenovirus

<400> 48
atgatgaggc gtgcgtaccc ggagggtcct cctccctcgt acgagagcgt gatgcagcag 60

gcgatggcgg cggcggcggc gatgcagccc ccgctggagg ctccttacgt gcccccgcgg 120

tacctggcgc ctacggaggg gcggaacagc attcgttact cggagctggc acccttgtac 180

gataccaccc ggttgtacct ggtggacaac aagtcggcgg acatcgcctc gctgaactac 240

cagaacgacc acagcaactt cctgaccacc gtggtgcaga acaatgactt caccccacg 300

gaggccagca cccagaccat caactttgac gagcgctcgc ggtggggcgg ccagctgaaa 360

accatcatgc acaccaacat gcccaacgtg aacgagttca tgtacagcaa caagttcaag 420

gcgcgggtca tggtctcccg caagaccccc aacggggtga cagtgacaga ggattatgat 480

ggtagtcagg atgagctgaa atacgagtgg gtggagtttg agctgcccga aggcaacttc 540

tcggtgacca tgactatcga cctgatgaac aacgccatca tcgacaatta cttggcggtg 600

gggcggcaga acggggtgct ggagagcgac atcggcgtga agttcgacac taggaacttc 660

aggctgggct gggaccccgt gaccgagctg gtcatgcccg gggtgtacac caacgaggcc 720

ttccatcccg atattgtctt gctgcccggc tgcggggtgg acttcaccga gagccgcctc 780

agcaacctgc tgggcattcg caagaggcag cccttccagg agggcttcca gatcatgtac 840

gaggatctgg agggggggtaa catccccgcg ctcctggatg tcgacgccta tgagaaaagc 900

aaggaggaga gcgccgccgc ggcgaccgca gccgtagcca ccgcctctac cgaggtcagg 960

ggcgataatt ttgctagcgc cgcagcagtg gcagcggccg aggcggctga aaccgaaagt 1020

aagatagtca ttcagccggt ggagaaggat agcaaagaca ggagctacaa cgtgctgccg 1080

gacaagataa acaccgccta ccgcagctgg tacctggcct acaactatgg cgaccccgag 1140

aagggcgtgc gctcctggac gctgctcacc acctcggacg tcacctgcgg cgtggagcaa 1200

gtctactggt cgctgcccga catgatgcaa gacccggtca ccttccgctc cacgcgtcaa 1260

gttagcaact acccggtggt gggcgccgag ctcctgcccg tctactccaa gagcttcttc 1320

aacgagcagg ccgtctactc gcagcagctg cgcgccttca cctcgctcac gcacgtcttc 1380

aaccgcttcc ccgagaacca gatcctcgtc cgcccgcccg cgcccaccat taccaccgtc 1440

agtgaaaacg ttcctgctct cacagatcac gggaccctgc cgctgcgcag cagtatccgg 1500

ggagtccagc gcgtgaccgt tactgacgcc agacgccgca cctgccccta cgtctacaag 1560

gccctgggca tagtcgcgcc gcgcgtcctc tcgagccgca ccttctaa 1608

<210> 49
<211> 1743
<212> DNA
<213> Adenoviridae - Mastadenovirus

<400> 49
atgcggcgcg cggcgatgta ccacgaggga cctcctccct cttatgagag cgtggtgggc 60
gcggcggcgg cctctccctt tgcgtcgcag ctggagccgc cgtacgtgcc tccgcggtac 120
ctgcggccta cgggggggaag aaacagcatc cgttactcgg agctggcgcc cctgtacgac 180
accacccggg tgtacctggt ggacaacaag tcggcggacg tggcctccct gaactaccag 240
aacgaccaca gcaatttttt gaccacggtc atccagaaca atgactacac cccgagcgag 300
gccagcaccc agaccatcaa tctggatgac cggtcgcact ggggcggcga cctgaaaacc 360
atcctgcaca ccaacatgcc caacgtgaac gagttcatgt tcaccaataa gttcaaggcg 420
cgggtgatgg tgtcgcgctc gcacaccaag gacgaccggg tggagctgaa gtacgagtgg 480
gtagagttcg agctgcccga gggcaactac tcggagacca tgaccataga cctgatgaac 540
aacgcgatcg tggagcacta tctgaaagtg ggcaggcaga acggggtcct ggagagcgac 600
atcggggtca agttcgacac caggaacttc cgcctggggc tggacccggt caccgggctg 660
gttatgcccg gggtctacac caacgaggcc ttccaccccg acatcatcct gctgcccggc 720
tgcggggtgg acttcaccta cagccgcctg agcaacctgc tgggcatccg caagcggcag 780
cccttccagg agggcttcag gatcacctac gaggacctgg agggggggcaa catccccgcg 840
ctcctggatg tggaggccta ccaggatagc ttgaaggaag aagaggcggg agagggcagc 900
ggcggtggcg ccggtcagga ggagggcggg gcctcctctg aggcctctgc ggacccagcc 960
gctgccgccg aggcggaggc ggccgacccc gcgatggtgg tagaggaaga gaaggatatg 1020
aacgacgagg cggtgcgcgg cgacaccttt gccactcggg gggaggagaa gaaagcggag 1080
gccgaggccg cggcagagga ggcggcagca gcggcggcgg cagtagaggc ggcggccgag 1140
gcggagaagc cccccaagga gcccgtgatt aagcccctga ccgaagatag caagaagcgc 1200
agttacaacg tgctcaagga cagcaccaac accgagtacc gcagctggta cctggcctac 1260
aactacggcg acccggcgac gggggtgcgc tcctggaccc tgctgtgtac gccggacgtg 1320
acctgcggct cggagcaggt gtactggtcg ctgcccgaca tgatgcaaga ccccgtgacc 1380
ttccgctcca cgcggcaggt cagcaacttc ccggtggtgg gcgccgagct gctgcccgtg 1440
cactccaaga gcttctacaa cgaccaggcc gtctactccc agctcatccg ccagttcacc 1500
tctctgaccc acgtgttcaa tcgctttcct gagaaccaga ttctggcgcg cccgcccgcc 1560
cccaccatca ccaccgtcag tgaaaacgtt cctgctctca cagatcacgg gacgctaccg 1620
ctgcgcaaca gcatcggagg agtccagcga gtgaccgtaa ctgacgccag acgccgcacc 1680
tgcccctacg tttacaaggc cctgggcata gtctcgccgc gcgtcctttc cagccgcact 1740
ttt 1743

<210> 50

<211> 577
<212> PRT
<213> Adenoviridae - Mastadenovirus

<400> 50

Met Lys Arg Ala Lys Thr Ser Asp Glu Thr Phe Asn Pro Val Tyr Pro
1 5 10 15

Tyr Asp Thr Glu Asn Gly Pro Pro Ser Val Pro Phe Leu Thr Pro Pro
20 25 30

Phe Val Ser Pro Asp Gly Phe Gln Glu Ser Pro Pro Gly Val Leu Ser
35 40 45

Leu Arg Leu Ser Glu Pro Leu Val Thr Ser His Gly Met Leu Ala Leu
50 55 60

Lys Met Gly Asn Gly Leu Ser Leu Asp Asp Ala Gly Asn Leu Thr Ser
65 70 75 80

Gln Asp Val Thr Thr Val Thr Pro Pro Leu Lys Lys Thr Lys Thr Asn
85 90 95

Leu Ser Leu Gln Thr Ser Ala Pro Leu Thr Val Ser Ser Gly Ser Leu
100 105 110

Thr Val Ala Ala Ala Ala Pro Leu Ala Val Ala Gly Thr Ser Leu Thr
115 120 125

Met Gln Ser Gln Ala Pro Leu Thr Val Gln Asp Ala Lys Leu Gly Leu
130 135 140

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

Thr Ser Ala Pro Leu Thr Ala Ala Asp Ser Ser Thr Leu Thr Val Ser
165 170 175

Ala Thr Pro Pro Leu Ser Thr Ser Asn Gly Ser Leu Ser Ile Asp Met
180 185 190

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

Ala Pro Leu His Val Val Asp Thr Leu Asn Ala Leu Thr Val Val Thr
210 215 220

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

Gly Ala Leu Ser Tyr Asp Thr Glu Gly Asn Ile Gln Leu Gln Ala Gly
245 250 255

Gly Gly Met Arg Ile Asp Asn Asn Gly Gln Leu Ile Leu Asn Val Ala
260 265 270

Tyr Pro Phe Asp Ala Gln Asn Asn Leu Ser Leu Arg Leu Gly Gln Gly
275 280 285

Pro Leu Ile Val Asn Ser Ala His Asn Leu Asp Leu Asn Leu Asn Arg
290 295 300

Gly Leu Tyr Leu Phe Thr Ser Gly Asn Thr Lys Lys Leu Glu Val Asn
305 310 315 320

Ile Lys Thr Ala Lys Gly Leu Phe Tyr Asp Gly Thr Ala Ile Ala Ile
325 330 335

Asn Ala Gly Asp Gly Leu Gln Phe Gly Ser Gly Ser Asp Thr Asn Pro
340 345 350

Leu Gln Thr Lys Leu Gly Leu Gly Leu Glu Tyr Asp Ser Asn Lys Ala
355 360 365

Ile Ile Thr Lys Leu Gly Thr Gly Leu Ser Phe Asp Asn Thr Gly Ala
370 375 380

Ile Thr Val Gly Asn Lys Asn Asp Asp Lys Leu Thr Leu Trp Thr Thr
385 390 395 400

Pro Asp Pro Ser Pro Asn Cys Arg Ile Asn Ser Glu Lys Asp Ala Lys
405 410 415

Leu Thr Leu Val Leu Thr Lys Cys Gly Ser Gln Val Leu Ala Ser Val
420 425 430

Ser Val Leu Ser Val Lys Gly Ser Leu Ala Pro Ile Ser Gly Thr Val
435 440 445

Thr Ser Ala Gln Ile Val Leu Arg Phe Asp Glu Asn Gly Val Leu Leu
450 455 460

Ser Asn Ser Ser Leu Asp Pro Gln Tyr Trp Asn Tyr Arg Lys Gly Asp
465 470 475 480

Ser Thr Glu Gly Thr Ala Tyr Thr Asn Ala Val Gly Phe Met Pro Asn
485 490 495

Leu Thr Ala Tyr Pro Lys Thr Gln Ser Gln Thr Ala Lys Ser Asn Ile
500 505 510

Val Ser Gln Val Tyr Leu Asn Gly Asp Lys Thr Lys Pro Met Thr Leu
515 520 525

Thr Ile Thr Leu Asn Gly Thr Asn Glu Thr Gly Asp Ala Thr Val Ser
530 535 540

Thr Tyr Ser Met Ser Phe Ser Trp Asn Trp Asn Gly Ser Asn Tyr Ile
545 550 555 560

Asn Asp Thr Phe Gln Thr Asn Ser Phe Thr Phe Ser Tyr Ile Ala Gln
565 570 575

Glu

<210> 51
<211> 955
<212> PRT
<213> Adenoviridae - Mastadenovirus

<400> 51

Met Ala Thr Pro Ser Met Met Pro Gln Trp Ser Tyr Met His Ile Ser
1 5 10 15

Gly Gln Asp Ala Ser Glu Tyr Leu Ser Pro Gly Leu Val Gln Phe Ala
20 25 30

Arg Ala Thr Asp Ser Tyr Phe Ser Leu Ser Asn Lys Phe Arg Asn Pro
35 40 45

Thr Val Ala Pro Thr His Asp Val Thr Thr Asp Arg Ser Gln Arg Leu
50 55 60

Thr Leu Arg Phe Ile Pro Val Asp Arg Glu Asp Thr Ala Tyr Ser Tyr
65 70 75 80

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

Ala Ser Thr Tyr Phe Asp Ile Arg Gly Val Leu Asp Arg Gly Pro Thr
100 105 110

Phe Lys Pro Tyr Ser Gly Thr Ala Tyr Asn Ser Leu Ala Pro Lys Gly
115 120 125

Ala Pro Asn Pro Cys Glu Trp Asp Glu Ala Val Thr Ala Val Asp Ile
130 135 140

Asn Leu Asp Glu Leu Gly Glu Asp Glu Asp Asp Ala Glu Gly Glu Ala
145 150 155 160

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

Asn Ile Thr Lys Glu Gly Ile Gln Ile Gly Val Asp Thr Thr Ser Gln
180 185 190

Ala Gln Thr Pro Leu Tyr Ala Asp Lys Thr Phe Gln Pro Glu Pro Gln
195 200 205

Val Gly Glu Ser Gln Trp Asn Glu Thr Glu Ile Asn Tyr Gly Ala Gly
210 215 220

Arg Val Leu Lys Lys Thr Thr Leu Met Lys Pro Cys Tyr Gly Ser Tyr
225 230 235 240

Ala Arg Pro Thr Asn Glu Asn Gly Gly Gln Gly Ile Leu Leu Glu Lys
245 250 255

Glu Gly Gly Lys Pro Glu Ser Gln Val Glu Met Gln Phe Phe Ser Thr
260 265 270

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

Val Leu Tyr Ser Glu Asp Val His Leu Glu Thr Pro Asp Thr His Ile
290 295 300

Ser Tyr Met Pro Thr Ser Asn Glu Ala Asn Ser Arg Glu Leu Leu Gly
305 310 315 320

Gln Gln Ala Met Pro Asn Arg Pro Asn Tyr Ile Ala Phe Arg Asp Asn
325 330 335

Phe Ile Gly Leu Met Tyr Tyr Asn Ser Thr Gly Asn Met Gly Val Leu
340 345 350

Ala Gly Gln Ala Ser Gln Leu Asn Ala Val Val Asp Leu Gln Asp Arg
355 360 365

Asn Thr Glu Leu Ser Tyr Gln Leu Leu Leu Asp Ser Met Gly Asp Arg
370 375 380

Thr Arg Tyr Phe Ser Met Trp Asn Gln Ala Val Asp Ser Tyr Asp Pro
385 390 395 400

Asp Val Arg Ile Ile Glu Asn His Gly Thr Glu Asp Glu Leu Pro Asn
405 410 415

Tyr Cys Phe Pro Leu Gly Gly Ile Ile Asn Thr Glu Thr Leu Thr Lys
420 425 430

Val Lys Pro Lys Thr Gly Gln Asp Ala Gln Trp Glu Lys Asp Thr Glu
435 440 445

Phe Ser Glu Lys Asn Glu Ile Arg Val Gly Asn Asn Phe Ala Met Glu
450 455 460

Ile Asn Leu Asn Ala Asn Leu Trp Arg Asn Phe Leu Tyr Ser Asn Val
465 470 475 480

Ala Leu Tyr Leu Pro Asp Lys Leu Lys Tyr Thr Pro Ala Asn Val Gln
485 490 495

Ile Ser Ser Asn Ser Asn Ser Tyr Asp Tyr Met Asn Lys Arg Val Val
500 505 510

Ala Pro Gly Leu Val Asp Cys Tyr Ile Asn Leu Gly Ala Arg Trp Ser
515 520 525

Leu Asp Tyr Met Asp Asn Val Asn Pro Phe Asn His His Arg Asn Ala
530 535 540

Gly Leu Arg Tyr Arg Ser Met Leu Leu Gly Asn Gly Arg Tyr Val Pro
545 550 555 560

Phe His Ile Gln Val Pro Gln Lys Phe Phe Ala Ile Lys Asn Leu Leu
565 570 575

Leu Leu Pro Gly Ser Tyr Thr Tyr Glu Trp Asn Phe Arg Lys Asp Val
580 585 590

Asn Met Val Leu Gln Ser Ser Leu Gly Asn Asp Leu Arg Val Asp Gly
595 600 605

Ala Ser Ile Lys Phe Glu Ser Ile Cys Leu Tyr Ala Thr Phe Phe Pro
610 615 620

Met Ala His Asn Thr Ala Ser Thr Leu Glu Ala Met Leu Arg Asn Asp
625 630 635 640

Thr Asn Asp Gln Ser Phe Asn Asp Tyr Leu Ser Ala Ala Asn Met Leu
645 650 655

Tyr Pro Ile Pro Ala Asn Ala Thr Asn Val Pro Ile Ser Ile Pro Ser
660 665 670

Arg Asn Trp Ala Ala Phe Arg Gly Trp Ala Phe Thr Arg Leu Lys Thr
675 680 685

Lys Glu Thr Pro Ser Leu Gly Ser Gly Phe Asp Pro Tyr Tyr Thr Tyr
690 695 700

Ser Gly Ser Ile Pro Tyr Leu Asp Gly Thr Phe Tyr Leu Asn His Thr
705 710 715 720

Phe Lys Lys Val Ser Val Thr Phe Asp Ser Ser Val Ser Trp Pro Gly
725 730 735

Asn Asp Arg Leu Leu Thr Pro Asn Glu Phe Glu Ile Lys Arg Ser Val
740 745 750

Asp Gly Glu Gly Tyr Asn Val Ala Gln Cys Asn Met Thr Lys Asp Trp
755 760 765

Phe Leu Ile Gln Met Leu Ala Asn Tyr Asn Ile Gly Tyr Gln Gly Phe
770 775 780

Tyr Ile Pro Glu Ser Tyr Lys Asp Arg Met Tyr Ser Phe Phe Arg Asn
785 790 795 800

Phe Gln Pro Met Ser Arg Gln Val Val Asp Glu Thr Lys Tyr Lys Asp
805 810 815

Tyr Gln Gln Val Gly Ile Ile His Gln His Asn Asn Ser Gly Phe Val
820 825 830

Gly Tyr Leu Ala Pro Thr Met Arg Glu Gly Gln Ala Tyr Pro Ala Asn
835 840 845

Phe Pro Tyr Pro Leu Ile Gly Lys Thr Ala Val Asp Ser Val Thr Gln
850 855 860

Lys Lys Phe Leu Cys Asp Arg Thr Leu Trp Arg Ile Pro Phe Ser Ser
865 870 875 880

Asn Phe Met Ser Met Gly Ala Leu Thr Asp Leu Gly Gln Asn Leu Leu
885 890 895

Tyr Ala Asn Ser Ala His Ala Leu Asp Met Thr Phe Glu Val Asp Pro
900 905 910

Met Asp Glu Pro Thr Leu Leu Tyr Val Leu Phe Glu Val Phe Asp Val
915 920 925

Val Arg Val His Gln Pro His Arg Gly Val Ile Glu Thr Val Tyr Leu
930 935 940

Arg Thr Pro Phe Ser Ala Gly Asn Ala Thr Thr
945 950 955

<210> 52
<211> 582
<212> PRT
<213> Adenoviridae - Mastadenovirus

<400> 52

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Met Arg Arg Ala Ala Met Tyr His Glu Gly Pro Pro Pro Ser Tyr Glu
1               5                  10                  15

Ser Val Val Gly Ala Ala Ala Ala Ser Pro Phe Ala Ser Gln Leu Glu
            20                  25                  30

Pro Pro Tyr Val Pro Pro Arg Tyr Leu Arg Pro Thr Gly Gly Arg Asn
        35                  40                  45

Ser Ile Arg Tyr Ser Glu Leu Ala Pro Leu Tyr Asp Thr Thr Arg Val
    50                  55                  60

Tyr Leu Val Asp Asn Lys Ser Ala Asp Val Ala Ser Leu Asn Tyr Gln
65                  70                  75                  80

Asn Asp His Ser Asn Phe Leu Thr Thr Val Ile Gln Asn Asn Asp Tyr
                85                  90                  95

Thr Pro Ser Glu Ala Ser Thr Gln Thr Ile Asn Leu Asp Asp Arg Ser
            100                 105                 110

His Trp Gly Gly Asp Leu Lys Thr Ile Leu His Thr Asn Met Pro Asn
        115                 120                 125

Val Asn Glu Phe Met Phe Thr Asn Lys Phe Lys Ala Arg Val Met Val
    130                 135                 140

Ser Arg Ser His Thr Lys Asp Asp Arg Val Glu Leu Lys Tyr Glu Trp
145                 150                 155                 160

Val Glu Phe Glu Leu Pro Glu Gly Asn Tyr Ser Glu Thr Met Thr Ile
                165                 170                 175

Asp Leu Met Asn Asn Ala Ile Val Glu His Tyr Leu Lys Val Gly Arg
            180                 185                 190

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

Asn Phe Arg Leu Gly Leu Asp Pro Val Thr Gly Leu Val Met Pro Gly
    210                 215                 220

Val Tyr Thr Asn Glu Ala Phe His Pro Asp Ile Ile Leu Leu Pro Gly
225                 230                 235                 240

Cys Gly Val Asp Phe Thr Tyr Ser Arg Leu Ser Asn Leu Leu Gly Ile
                245                 250                 255

Arg Lys Arg Gln Pro Phe Gln Glu Gly Phe Arg Ile Thr Tyr Glu Asp
            260                 265                 270
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Leu Glu Gly Gly Asn Ile Pro Ala Leu Leu Asp Val Glu Ala Tyr Gln
275 280 285

Asn Ser Leu Lys Glu Glu Glu Ala Gly Glu Gly Ser Gly Gly Gly Gly
290 295 300

Ala Gly Gln Glu Glu Gly Gly Ala Ser Ser Glu Ala Ser Ala Asp Ala
305 310 315 320

Ala Ala Ala Glu Ala Glu Glu Ala Ala Asp Pro Ala Met Val Val Glu
325 330 335

Glu Glu Lys Asp Met Asn Asp Glu Ala Val Arg Gly Asp Thr Phe Ala
340 345 350

Thr Arg Gly Glu Glu Lys Lys Ala Glu Ala Glu Ala Ala Ala Glu Glu
355 360 365

Ala Ala Ala Ala Ala Ala Ala Val Glu Ala Ala Ala Glu Ala Glu Lys
370 375 380

Pro Pro Lys Glu Pro Val Ile Lys Pro Leu Thr Glu Asp Ser Lys Lys
385 390 395 400

Arg Ser Tyr Asn Val Leu Lys Asp Ser Thr Asn Thr Glu Tyr Arg Ser
405 410 415

Trp Tyr Leu Ala Tyr Asn Tyr Gly Asp Pro Ala Thr Gly Val Arg Ser
420 425 430

Trp Thr Leu Leu Cys Thr Pro Asp Val Thr Cys Gly Ser Glu Gln Val
435 440 445

Tyr Trp Ser Leu Pro Asp Met Met Gln Asp Pro Val Thr Phe Arg Ser
450 455 460

Thr Arg Gln Val Ser Asn Phe Pro Val Val Gly Ala Glu Leu Leu Pro
465 470 475 480

Val His Ser Lys Ser Phe Tyr Asn Asp Gln Ala Val Tyr Ser Gln Leu
485 490 495

Ile Arg Gln Phe Thr Ser Leu Thr His Val Phe Asn Arg Phe Pro Glu
500 505 510

Asn Gln Ile Leu Ala Arg Pro Pro Ala Pro Thr Ile Thr Thr Val Ser
515 520 525

Glu Asn Val Pro Ala Leu Thr Asp His Gly Thr Leu Pro Leu Arg Asn
530 535 540

Ser Ile Gly Gly Val Gln Arg Val Thr Val Thr Asp Ala Arg Arg Arg
545 550 555 560

Thr Cys Pro Tyr Val Tyr Lys Ala Leu Gly Ile Val Ser Pro Arg Val
565 570 575

Leu Ser Ser Arg Thr Phe
580

<210> 53
<211> 542
<212> PRT
<213> Adenoviridae - Mastadenovirus

<400> 53

Met Lys Arg Ala Lys Thr Ser Asp Glu Thr Phe Asn Pro Val Tyr Pro
1 5 10 15

Tyr Asp Thr Glu Asn Gly Pro Pro Ser Val Pro Phe Leu Thr Pro Pro
20 25 30

Phe Val Ser Pro Asp Gly Phe Gln Glu Ser Pro Pro Gly Val Leu Ser
35 40 45

Leu Arg Leu Ser Glu Pro Leu Val Thr Ser His Gly Met Leu Ala Leu
50 55 60

Lys Met Gly Asn Gly Leu Ser Leu Asp Asp Ala Gly Asn Leu Thr Ser
65 70 75 80

Gln Asp Val Thr Thr Val Thr Pro Pro Leu Lys Lys Thr Lys Thr Asn
85 90 95

Leu Ser Leu Gln Thr Ser Ala Pro Leu Thr Val Ser Ser Gly Ser Leu
100 105 110

Thr Val Ala Ala Ala Ala Pro Leu Ala Val Ala Gly Thr Ser Leu Thr
115 120 125

Met Gln Ser Gln Ala Pro Leu Thr Val Gln Asp Ala Lys Leu Gly Leu
130 135 140

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

Thr Ser Ala Pro Leu Thr Ala Ala Asp Ser Ser Thr Leu Thr Val Gly
165 170 175

Thr Thr Pro Pro Ile Ser Val Ser Ser Gly Ser Leu Gly Leu Asp Met
180 185 190

Glu Asp Pro Met Tyr Thr His Asp Gly Lys Leu Gly Ile Arg Ile Gly

195 200 205

Gly Pro Leu Gln Val Val Asp Ser Leu His Thr Leu Thr Val Val Thr
210 215 220

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

Gly Ala Leu Gly Tyr Asp Ser Ser Gly Asn Leu Glu Leu Arg Ala Ala
245 250 255

Gly Gly Met Arg Ile Asn Thr Gly Gly Gln Leu Ile Leu Asp Val Ala
260 265 270

Tyr Pro Phe Asp Ala Gln Asn Asn Leu Ser Leu Arg Leu Gly Gln Gly
275 280 285

Pro Leu Tyr Val Asn Thr Asn His Asn Leu Asp Leu Asn Cys Asn Arg
290 295 300

Gly Leu Thr Thr Thr Thr Ser Ser Asn Thr Thr Lys Leu Glu Thr Lys
305 310 315 320

Ile Asp Ser Gly Leu Asp Tyr Asn Ala Asn Gly Ala Ile Ile Ala Lys
325 330 335

Leu Gly Thr Gly Leu Thr Phe Asp Asn Thr Gly Ala Ile Thr Val Gly
340 345 350

Asn Thr Gly Asp Asp Lys Leu Thr Leu Trp Thr Thr Pro Asp Pro Ser
355 360 365

Pro Asn Cys Arg Ile His Ala Asp Lys Asp Cys Lys Phe Thr Leu Val
370 375 380

Leu Thr Lys Cys Gly Ser Gln Ile Leu Ala Ser Val Ala Ala Leu Ala
385 390 395 400

Val Ser Gly Asn Leu Ser Ser Met Thr Gly Thr Val Ser Ser Val Thr
405 410 415

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

Leu Asp Lys Glu Tyr Trp Asn Phe Arg Asn Gly Asn Ser Thr Asn Ala
435 440 445

Thr Pro Tyr Thr Asn Ala Val Gly Phe Met Pro Asn Leu Ser Ala Tyr
450 455 460

Pro Lys Thr Gln Ser Gln Thr Ala Lys Asn Asn Ile Val Ser Glu Val

465 470 475 480

Tyr Leu His Gly Asp Lys Ser Lys Pro Met Ile Leu Thr Ile Thr Leu
485 490 495

Asn Gly Thr Asn Glu Ser Ser Glu Thr Ser Gln Val Ser His Tyr Ser
500 505 510

Met Ser Phe Thr Trp Ser Trp Asp Ser Gly Lys Tyr Ala Thr Glu Thr
515 520 525

Phe Ala Thr Asn Ser Phe Thr Phe Ser Tyr Ile Ala Glu Gln
530 535 540

<210> 54
<211> 964
<212> PRT
<213> Adenoviridae - Mastadenovirus

<400> 54

Met Ala Thr Pro Ser Met Met Pro Gln Trp Ser Tyr Met His Ile Ser
1 5 10 15

Gly Gln Asp Ala Ser Glu Tyr Leu Ser Pro Gly Leu Val Gln Phe Ala
20 25 30

Arg Ala Thr Asp Ser Tyr Phe Ser Leu Ser Asn Lys Phe Arg Asn Pro
35 40 45

Thr Val Ala Pro Thr His Asp Val Thr Thr Asp Arg Ser Gln Arg Leu
50 55 60

Thr Leu Arg Phe Ile Pro Val Asp Arg Glu Asp Thr Ala Tyr Ser Tyr
65 70 75 80

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

Ala Ser Thr Tyr Phe Asp Ile Arg Gly Val Leu Asp Arg Gly Pro Thr
100 105 110

Phe Lys Pro Tyr Ser Gly Thr Ala Tyr Asn Ser Leu Ala Pro Lys Gly
115 120 125

Ala Pro Asn Ser Cys Glu Trp Glu Gln Glu Glu Thr Gln Thr Ala Glu
130 135 140

Glu Ala Gln Asp Glu Glu Glu Asp Glu Ala Glu Ala Glu Glu Glu Met
145 150 155 160

Pro Gln Glu Glu Gln Ala Pro Val Lys Lys Thr His Val Tyr Ala Gln
165 170 175

Ala Pro Leu Ser Gly Glu Lys Ile Thr Lys Asp Gly Leu Gln Ile Gly
180 185 190

Thr Asp Ala Thr Ala Thr Glu Gln Lys Pro Ile Tyr Ala Asp Pro Thr
195 200 205

Phe Gln Pro Glu Pro Gln Ile Gly Glu Ser Gln Trp Asn Glu Ala Asp
210 215 220

Ala Ser Val Ala Gly Gly Arg Val Leu Lys Lys Thr Thr Pro Met Lys
225 230 235 240

Pro Cys Tyr Gly Ser Tyr Ala Arg Pro Thr Asn Ala Asn Gly Gly Gln
245 250 255

Gly Val Leu Val Glu Lys Asp Gly Gly Lys Met Glu Ser Gln Val Asp
260 265 270

Met Gln Phe Phe Ser Thr Ser Glu Asn Ala Arg Asn Glu Ala Asn Asn
275 280 285

Ile Gln Pro Lys Leu Val Leu Tyr Ser Glu Asp Val His Met Glu Thr
290 295 300

Pro Asp Thr His Ile Ser Tyr Lys Pro Ala Lys Ser Asp Asp Asn Ser
305 310 315 320

Lys Val Met Leu Gly Gln Gln Ser Met Pro Asn Arg Pro Asn Tyr Ile
325 330 335

Gly Phe Arg Asp Asn Phe Ile Gly Leu Met Tyr Tyr Asn Ser Thr Gly
340 345 350

Asn Met Gly Val Leu Ala Gly Gln Ala Ser Gln Leu Asn Ala Val Val
355 360 365

Asp Leu Gln Asp Arg Asn Thr Glu Leu Ser Tyr Gln Leu Leu Leu Asp
370 375 380

Ser Met Gly Asp Arg Thr Arg Tyr Phe Ser Met Trp Asn Gln Ala Val
385 390 395 400

Asp Ser Tyr Asp Pro Asp Val Arg Ile Ile Glu Asn His Gly Thr Glu
405 410 415

Asp Glu Leu Pro Asn Tyr Cys Phe Pro Leu Gly Gly Ile Gly Val Thr
420 425 430

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

Asn Thr Thr Trp Thr Lys Asp Glu Thr Phe Ala Asp Arg Asn Glu Ile
450 455 460

Gly Val Gly Asn Asn Phe Ala Met Glu Ile Asn Leu Ser Ala Asn Leu
465 470 475 480

Trp Arg Asn Phe Leu Tyr Ser Asn Val Ala Leu Tyr Leu Pro Asp Lys
485 490 495

Leu Lys Tyr Asn Pro Ser Asn Val Glu Ile Ser Asp Asn Pro Asn Thr
500 505 510

Tyr Asp Tyr Met Asn Lys Arg Val Val Ala Pro Gly Leu Val Asp Cys
515 520 525

Tyr Ile Asn Leu Gly Ala Arg Trp Ser Leu Asp Tyr Met Asp Asn Val
530 535 540

Asn Pro Phe Asn His His Arg Asn Ala Gly Leu Arg Tyr Arg Ser Met
545 550 555 560

Leu Leu Gly Asn Gly Arg Tyr Val Pro Phe His Ile Gln Val Pro Gln
565 570 575

Lys Phe Phe Ala Ile Lys Asn Leu Leu Leu Leu Pro Gly Ser Tyr Thr
580 585 590

Tyr Glu Trp Asn Phe Arg Lys Asp Val Asn Met Val Leu Gln Ser Ser
595 600 605

Leu Gly Asn Asp Leu Arg Val Asp Gly Ala Ser Ile Lys Phe Glu Ser
610 615 620

Ile Cys Leu Tyr Ala Thr Phe Phe Pro Met Ala His Asn Thr Ala Ser
625 630 635 640

Thr Leu Glu Ala Met Leu Arg Asn Asp Thr Asn Asp Gln Ser Phe Asn
645 650 655

Asp Tyr Leu Ser Ala Ala Asn Met Leu Tyr Pro Ile Pro Ala Asn Ala
660 665 670

Thr Asn Val Pro Ile Ser Ile Pro Ser Arg Asn Trp Ala Ala Phe Arg
675 680 685

Gly Trp Ala Phe Thr Arg Leu Lys Thr Lys Glu Thr Pro Ser Leu Gly
690 695 700

Ser Gly Phe Asp Pro Tyr Tyr Thr Tyr Ser Gly Ser Ile Pro Tyr Leu
705 710 715 720

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Asp Gly Thr Phe Tyr Leu Asn His Thr Phe Lys Lys Val Ser Val Thr
                725                 730                 735

Phe Asp Ser Ser Val Ser Trp Pro Gly Asn Asp Arg Leu Leu Thr Pro
            740                 745                 750

Asn Glu Phe Glu Ile Lys Arg Ser Val Asp Gly Glu Gly Tyr Asn Val
        755                 760                 765

Ala Gln Cys Asn Met Thr Lys Asp Trp Phe Leu Ile Gln Met Leu Ala
    770                 775                 780

Asn Tyr Asn Ile Gly Tyr Gln Gly Phe Tyr Ile Pro Glu Ser Tyr Lys
785                 790                 795                 800

Asp Arg Met Tyr Ser Phe Phe Arg Asn Phe Gln Pro Met Ser Arg Gln
                805                 810                 815

Val Val Asp Glu Thr Lys Tyr Lys Asp Tyr Gln Gln Val Gly Ile Ile
            820                 825                 830

His Gln His Asn Asn Ser Gly Phe Val Gly Tyr Leu Ala Pro Thr Met
        835                 840                 845

Arg Glu Gly Gln Ala Tyr Pro Ala Asn Phe Pro Tyr Pro Leu Ile Gly
    850                 855                 860

Lys Thr Ala Val Asp Ser Val Thr Gln Lys Lys Phe Leu Cys Asp Arg
865                 870                 875                 880

Thr Leu Trp Arg Ile Pro Phe Ser Ser Asn Phe Met Ser Met Gly Ala
                885                 890                 895

Leu Thr Asp Leu Gly Gln Asn Leu Leu Tyr Ala Asn Ser Ala His Ala
            900                 905                 910

Leu Asp Met Thr Phe Glu Val Asp Pro Met Asp Glu Pro Thr Leu Leu
        915                 920                 925

Tyr Val Leu Phe Glu Val Phe Asp Val Val Arg Val His Gln Pro His
    930                 935                 940

Arg Gly Val Ile Glu Thr Val Tyr Leu Arg Thr Pro Phe Ser Ala Gly
945                 950                 955                 960

Asn Ala Thr Thr
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<210> 55
<211> 584

<212> PRT
<213> Adenoviridae - Mastadenovirus

<400> 55

Met Arg Arg Ala Ala Met Tyr His Glu Gly Pro Pro Pro Ser Tyr Glu
1 5 10 15

Ser Val Val Gly Ala Ala Ala Ala Ser Pro Phe Ala Ser Gln Leu Glu
20 25 30

Pro Pro Tyr Val Pro Pro Arg Tyr Leu Arg Pro Thr Gly Gly Arg Asn
35 40 45

Ser Ile Arg Tyr Ser Glu Leu Ala Pro Leu Tyr Asp Thr Thr Arg Val
50 55 60

Tyr Leu Val Asp Asn Lys Ser Ala Asp Val Ala Ser Leu Asn Tyr Gln
65 70 75 80

Asn Asp His Ser Asn Phe Leu Thr Thr Val Ile Gln Asn Asn Asp Tyr
85 90 95

Thr Pro Ser Glu Ala Ser Thr Gln Thr Ile Asn Leu Asp Asp Arg Ser
100 105 110

His Trp Gly Gly Asp Leu Lys Thr Ile Leu His Thr Asn Met Pro Asn
115 120 125

Val Asn Glu Phe Met Phe Thr Asn Lys Phe Lys Ala Arg Val Met Val
130 135 140

Ser Arg Ser His Thr Lys Asp Asp Arg Val Glu Leu Lys Tyr Glu Trp
145 150 155 160

Val Glu Phe Glu Leu Pro Glu Gly Asn Tyr Ser Glu Thr Met Thr Ile
165 170 175

Asp Leu Met Asn Asn Ala Ile Val Glu His Tyr Leu Lys Val Gly Arg
180 185 190

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

Asn Phe Arg Leu Gly Leu Asp Pro Val Thr Gly Leu Val Met Pro Gly
210 215 220

Val Tyr Thr Asn Glu Ala Phe His Pro Asp Ile Ile Leu Leu Pro Gly
225 230 235 240

Cys Gly Val Asp Phe Thr Tyr Ser Arg Leu Ser Asn Leu Leu Gly Ile
245 250 255

Arg Lys Arg Gln Pro Phe Gln Glu Gly Phe Arg Ile Thr Tyr Glu Asp
260 265 270

Leu Glu Gly Gly Asn Ile Pro Ala Leu Leu Asp Val Glu Ala Tyr Gln
275 280 285

Asp Ser Leu Lys Glu Glu Glu Ala Gly Glu Gly Ser Gly Gly Gly Gly
290 295 300

Gly Ala Gly Gln Glu Glu Gly Gly Ala Ser Ser Glu Ala Ser Ala Asp
305 310 315 320

Ala Ala Ala Ala Ala Glu Ala Glu Ala Ala Asp Pro Ala Met Val Val
325 330 335

Glu Glu Glu Lys Asp Met Asn Asp Glu Ala Val Arg Gly Asp Thr Phe
340 345 350

Ala Thr Arg Gly Glu Glu Lys Lys Ala Glu Ala Glu Ala Ala Ala Glu
355 360 365

Glu Ala Ala Ala Ala Ala Ala Ala Ala Val Glu Ala Ala Ala Glu Ala
370 375 380

Glu Lys Pro Pro Lys Glu Pro Val Ile Lys Ala Leu Thr Glu Asp Ser
385 390 395 400

Lys Lys Arg Ser Tyr Asn Val Leu Lys Asp Ser Thr Asn Thr Ala Tyr
405 410 415

Arg Ser Trp Tyr Leu Ala Tyr Asn Tyr Gly Asp Pro Ala Thr Gly Val
420 425 430

Arg Ser Trp Thr Leu Leu Cys Thr Pro Asp Val Thr Cys Gly Ser Glu
435 440 445

Gln Val Tyr Trp Ser Leu Pro Asp Met Met Gln Asp Pro Val Thr Phe
450 455 460

Arg Ser Thr Arg Gln Val Ser Asn Phe Pro Val Val Gly Ala Glu Leu
465 470 475 480

Leu Pro Val His Ser Lys Ser Phe Tyr Asn Asp Gln Ala Val Tyr Ser
485 490 495

Gln Leu Ile Arg Gln Phe Thr Ser Leu Thr His Val Phe Asn Arg Phe
500 505 510

Pro Glu Asn Gln Ile Leu Ala Arg Pro Pro Ala Pro Thr Ile Thr Thr
515 520 525

Val Ser Glu Asn Val Pro Ala Leu Thr Asp His Gly Thr Leu Pro Leu
530 535 540

Arg Asn Ser Ile Gly Gly Val Gln Arg Val Thr Val Thr Asp Ala Arg
545 550 555 560

Arg Arg Thr Cys Pro Tyr Val Tyr Lys Ala Leu Gly Ile Val Ser Pro
565 570 575

Arg Val Leu Ser Ser Arg Thr Phe
580

<210> 56
<211> 1734
<212> DNA
<213> Adenoviridae - Mastadenovirus

<400> 56
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gaaagccccc caggggtcct gtctctgcgc ctgtcagagc ccctggtcac ttcccacggc 180

atgcttgccc tgaaaatggg aaatggcctc tccctggatg acgccggcaa cctcacctct 240

caagatgtca ccaccgtcac ccctcccctc aaaaaaacca agaccaacct cagcctccag 300

acctcagccc ccctgaccgt tagctctggg tccctcaccg tcgcggccgc cgctccactg 360

gcggtggccg gcacctctct caccatgcaa tctcaggccc ccttgacagt gcaagatgca 420

aaactcggcc tggccaccca gggacccctg accgtgtctg aaggcaaact caccttgcag 480

acatcggctc cactgacggc cgctgacagc agcactctca ctgttagtgc cacacctccc 540

ctcagcacaa gcaatggtag tttgagcatt gacatgcagg ccccgattta taccaccaat 600

ggaaaactgg cacttaacat tggtgctccc ctgcatgtgg tagacaccct aaatgcacta 660

actgtagtaa ctggccaggg tcttaccata aatggaagag ccctgcaaac tagagtcacg 720

ggtgccctca gttatgacac agaaggcaac atccaactgc aagccggagg gggtatgcgc 780

attgacaata atggccaact tatccttaat gtagcttatc catttgatgc tcaaaacaac 840

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ataaaaacag ccaaaggtct attttacgat ggcaccgcta tagcaatcaa tgcaggtgac 1020

gggctacagt ttgggtctgg ttcagataca aatccattgc aaactaaact tggattgggg 1080

ctggaatatg actccaacaa agctataatc actaaacttg gaactggcct aagctttgac 1140

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ccagacccct ccccaaactg cagaattaat tcagaaaaag atgctaaact cacactagtt 1260

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cttgccccca tcagcggcac agtaactagc gcccagattg ttttaagatt tgatgaaaac 1380

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tctacagaag gcactgcata tactaatgct gtgggattta tgcccaacct cacagcatac 1500

cctaaaacac agagccagac tgctaaaagc aacattgtaa gtcaagttta cttgaatggg 1560

gacaaaacaa aacccatgac cctaaccatc accctcaatg gaactaatga aacaggggat 1620

gctacagtaa gcacatactc catgtcattt tcatggaact ggaatggaag taattacatt 1680

aatgacacct tccaaaccaa ctcctttacc ttctcctaca tcgcccaaga ataa 1734

<210> 57
<211> 2868
<212> DNA
<213> Adenoviridae - Mastadenovirus

<400> 57
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tcggagtacc tgagccccgg gctggtgcag ttcgcccgcg ccaccgacag ctacttcagc 120

ctgagtaaca agtttaggaa ccccacggtg gcgcccacgc acgatgtgac caccgaccgg 180

tcccagcgcc tgacgctgcg gttcatcccc gtggaccgcg aggacaccgc gtactcttac 240

aaggcgcggt tcaccctggc cgtgggcgac aaccgcgtgc tggacatggc ctccacctac 300

tttgacatcc gcggcgtgct ggacaggggc cccaccttta agccctactc cggcactgcc 360

tacaactccc tggcccccaa gggcgccccc aacccctgtg agtgggatga agccgttact 420

gctgttgaca ttaacctgga tgagctcggc gaagatgaag acgacgccga aggggaagca 480

gaacagcaaa aaagtcatgt atttggtcaa gcgccctact caggacaaaa cattacgaag 540

gagggcatac aaattggggt agataccacc agccaagccc aaacaccttt atacgctgac 600

aaaacattcc aacccgaacc tcaggttgga gaatcccaat ggaatgagac agaaatcaat 660

tatggagcgg gacgagtgct aaaaaagacc accctcatga aaccatgcta tgggtcatat 720

gcaagaccta ctaatgaaaa cggcggtcag ggcatactgc tggagaaaga gggtggtaaa 780

ccagaaagtc aagttgaaat gcaatttttt tctactactc aggccgccgc ggctggtaat 840

tcagataatc ttactccaaa agttgttttg tatagcgagg atgttcacct ggaaacgcca 900

gatacacaca tttcatatat gcccactagc aacgaagcca attcaagaga actgttggga 960

caacaagcta tgcccaacag acccaactac attgccttca gagacaactt tattggcctt 1020

atgtattaca acagcactgg caacatggga gtgctggcag gtcaggcctc acagttgaat 1080

gcagtggtgg acttgcaaga cagaaacaca gaactgtcct accagctctt gcttgattcc 1140

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gatgttagaa ttattgaaaa tcatggaact gaagatgagc tgcccaacta ttgtttcccc 1260

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cagtgcaaca tgaccaagga ctggttcctc atccagatgc tggccaacta caacatcggc 2340

tatcagggct tctacatccc agagagctac aaggacagga tgtactcctt ctttaggaac 2400

ttccagccca tgagccggca ggtggtggac gaaaccaagt acaaggacta ccagcaggtg 2460

ggcatcatcc accagcacaa caactcgggc ttcgtgggct acctcgcccc caccatgcgc 2520

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gcccacgcgc tcgacatgac cttcgaggtc gaccccatgg acgagcccac ccttctctat 2760

gttctgttcg aagtctttga cgtggtccgg gtccaccagc cgcaccgcgg cgtcatcgag 2820

accgtgtacc tgcgcacgcc cttctcggcc ggcaacgcca ccacctaa 2868

<210> 58
<211> 1749
<212> DNA
<213> Adenoviridae - Mastadenovirus

<400> 58
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cgggtgatgg tgtcgcgttc gcacaccaag gacgaccggg tggagctgaa gtacgagtgg 480
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acttttaa 1749

<210> 59
<211> 1629
<212> DNA
<213> Adenoviridae - Mastadenovirus

<400> 59
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gaaagccccc caggggtcct gtctctgcgc ctgtcagagc ccctggtcac ttcccacggc 180
atgcttgccc tgaaaatggg aaatggcctc tccctggatg acgccggcaa cctcacctct 240
caagatgtca ccaccgtcac ccctcccctc aaaaaaacca agaccaacct cagcctccag 300
acctcagccc ccctgaccgt tagctctggg tccctcaccg tcgcggccgc cgctccactg 360
gcggtggccg gcacctctct caccatgcaa tctcaggccc ccttgacggt gcaagatgca 420

aaactgggtc tggccaccca gggacccctg accgtgtctg aaggcaaact caccttgcag 480

acatcggctc cactgacggc cgccgacagc agcactctca ctgttggcac cacaccgcca 540

atcagtgtga gcagtggaag tctaggctta gatatggaag accccatgta tactcacgat 600

ggaaaactgg gaatcagaat tggtggccca ctgcaagtag tagacagctt gcacacactc 660

actgtagtta ctggaaacgg aataactgta gctaacaatg cccttcaaac taaagttgcg 720

ggtgccctgg gttatgactc atctggcaat ctagaattgc gagccgcagg gggtatgcga 780

attaacacag ggggtcaact cattcttgat gtggcttatc catttgatgc tcagaacaat 840

ctcagcctta gactcggcca gggaccttta tatgtgaaca ccaatcacaa cctagattta 900

aattgcaaca gaggtctgac cacaaccacc agcagtaaca caaccaaact tgaaactaaa 960

atcgattcgg gcttagacta taacgccaat ggggctatca ttgctaaact tggcactggg 1020

ttaacctttg acaacacagg tgccataact gtgggaaaca ctggggatga caaactcact 1080

ctgtggacta ccccagatcc ctctcctaac tgcagaattc acgcagacaa agactgcaag 1140

tttactctag tcctgactaa gtgtggaagt caaattctgg cctccgtcgc cgccctggcg 1200

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ttcgatcaga atggagttct tatggaaaat tcctcgctag acaaggagta ctggaacttc 1320

agaaatggta attccaccaa tgccaccccc tacaccaatg cggttgggtt catgcccaac 1380

ctcagcgcct accccaaaac ccagagtcaa actgcaaaaa acaacattgt aagtgaggtt 1440

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