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DESCRIPTION

FIELD

[0001] This disclosure relates to the field of immunology, more specifically to methods and compositions for producing an immune response to polyomavirus, particularly BK polyomavirus.

BACKGROUND

[0002] The process of organ transplantation has been revolutionized since the first successful kidney transplant in identical twins more than five decades ago (Harrison et al., Surg. Forum 6:432-436, 1956; Merrill et al., J. Am Med. Assoc. 160:277-282, 1956). Since then, the use of immunosuppressants, such as cyclosporine, have improved the outcome of transplants (Calne, Mt. Sinai J. Med. 54:465-466, 1987), but the process is still fraught with many challenges, such as the management of chronic and acute rejection, nephrotoxicity from immunosuppressant and antiviral drugs, and avoiding reactivated (or novel) infectious agents that could threaten the graft. To balance these needs, clinical guidelines on the management of kidney transplant (Kasiske et al., Am. J. Transpl. 9:S1-S155, 2009) generally suggest the use of an immunosuppressant and an anti-proliferative agent in the initial stages of the process, followed by a lowering of dose of immunosuppressants if there is no acute rejection. However, careful monitoring of allograft function is crucial; and tests to detect increase in proteinuria, elevated serum creatinine levels, and detection of viral nucleic acids in plasma are also recommended.

[0003] One of the problems that threatens kidney allograft survival is the development of polyomavirus-associated nephropathy (PVAN) (Purighalla et al., Am. J. Kidney Dis. 26:671-673, 1995; also known as BKV associated nephropathy (BKVN)). Left untreated, PVAN can lead to a loss of the allograft, but early diagnosis, monitoring and intervention can prevent it. In kidney transplant recipients, current estimates of PVAN are about 1-10% (Ramos et al., Clin. Transpl. 2002:143-153; Hirsch et al., Transplantation 79:1277-1286, 2005), and graft losses range from 10-100% (Hirsch and Steiger, Lancet Inf. Dis. 3:611-623, 2003) depending on the drug regimen, monitoring, and interventions performed. Polyomavirus-associated pathologies such as PVAN or progressive multifocal leukoencephalopathy (PML) also cause significant morbidity or even mortality in other patients receiving immunosuppressive therapy (for example, for auto-immune disorders).

[0004] Trond Flaegstad et al, J Med Virology, V19, no3 pp287-296, 1986, discloses a neutralization test to detect BKV. The prior art also discloses treatments of BKV with human IVIG preparations, see e.g. Randhawa PS et al: "Polyomavirus BK neutralizing activity in human immunoglobulin preparations.", Transplantation. 2010 June 27; 89(12): 1462-1465; Sharma AP et al: "Intravenous immunoglobulin as rescue therapy for BK virus nephropathy.",

PEDIATRIC TRANSPLANTATION, 02-2009, vol. 13, no. 1, pages 123-129; Sener A et al: "Intravenous immunoglobulin as a treatment for BK virus associated nephropathy: one-year follow-up of renal allograft recipients.", TRANSPLANTATION, 15 JAN 2006, vol. 81, no. 1, pages 117-120; Marfo K et al: "Desensitization protocols and their outcome.", CLINICAL JOURNAL OF THE AMERICAN SOCIETY OF NEPHROLOGY, APR 2011, vol. 6, no. 4, pages 922-936; Dheir H et al: "Intensive Polyoma Virus Nephropathy Treatment as a Preferable Approach for Graft Surveillance.", TRANSPLANTATION PROCEEDINGS, vol. 43, no. 3, 10 March 2011 (2011-03-10), pages 867-870.

SUMMARY

[0005] The invention is defined in the claims.

[0006] Disclosed herein are methods of eliciting an immune response against a polyomavirus (for example, BKV serotype I (BKV-I), BKV serotype II (BKV-II), BKV serotype III (BKV-III), and/or BKV serotype IV (BKV-IV)) and methods of treating or inhibiting polyomavirus-associated pathology (such as PVAN, BKV-associated hemorrhagic cystitis, or JC virus-associated PML). Further disclosed are immunogenic compositions of use in the disclosed methods. In some embodiments, the immunogenic composition includes at least one capsid polypeptide (or a nucleic acid encoding such polypeptides) from two or more BKV serotypes (e.g., a multivalent immunogenic composition).

[0007] Also disclosed are methods of selecting a transplant donor and/or transplant recipient (for example a renal transplant donor or recipient) including detecting whether the prospective donor and/or recipient has BKV serotype-specific (such as BKV-IV-specific) neutralizing antibodies.

[0008] The foregoing and other features of the disclosure will become more apparent from the following detailed description, which proceeds with reference to the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

FIG. 1 is a series of graphs showing ELISA and neutralizing antibody titers in mice immunized with virus-like particles (VLPs) formed by expression of recombinant VP1 capsid proteins derived from BKV-I isolate KOM-5 (subtype BKV-Ib1) or BKV-IV isolate A-66H (subtype BKV-IVc2). Six mice were immunized with BKV-I (circles) or BKV-IV (squares) VLPs. In the top panel, sera were titrated using separate BKV-I (x axis) or BKV-IV (y axis) VLP ELISAs. A data point from one relatively non-responsive animal is shown as an open circle. The middle panel depicts BKV genotype-specific neutralizing titers for the same set of mice. The bottom panel shows the ratio of the neutralizing titer for the BKV genotype administered as a vaccine versus

the neutralizing titer for the heterologous BKV genotype for individual animals. The non-responsive animal was excluded from the analysis in the bottom panel. In the top and middle panels, the diagonal line shows a theoretical 1:1 correlation between BKV-I and BKV-IV titers.

FIG. 2 is a series of graphs showing BKV-I and BKV-IV ELISA versus neutralizing titers in VLP immunized mice. ELISA (x axis) or neutralizing titers (y axis) for six BKV-I (circles) or BKV-IV (squares) VLP immunized mice are shown. Neutralizing titers against the BKV-I pseudovirus are shown in the left panel and anti-BKV-IV titers are shown in the right panel. A data point from the relatively non-responsive animal (FIG. 1) is shown as an open circle.

FIG. 3 is a pair of graphs showing BKV-I and BKV-IV serological titers in healthy adults. Sera from 48 healthy adults were evaluated for BKV type-specific serological titers. The upper panel shows BKV-I and BKV-IV titers evaluated by ELISA. The lower panel shows neutralizing titers. The diagonal line shows a theoretical 1:1 correlation between BKV-I and BKV-IV titers.

FIG. 4 is a series of graphs showing BKV-I and BKV-IV ELISA versus neutralizing titers in healthy adults. ELISA (x axis) or neutralizing titers (y axis) for BKV-I (circles) or BKV-IV (squares) are shown. Neutralizing titers against the BKV-I pseudovirus are shown in the left panel and anti-BKV-IV titers are shown in the right panel.

FIG. 5 is a series of graphs showing BKV-I and BKV-IV serological patterns in sera from individual kidney transplant recipients. Sera from kidney transplant recipients were titrated for the presence of BKV-I (circles) or BKV-IV (squares) type-specific neutralizing titers (y axis). The neutralizing titer categories shown on the y axis are defined as: 1) <95% neutralization at a serum dilution of 1:100; 2) ≥95% neutralization at 1:100; 3) ≥95% neutralization at 1:500; 4) ≥95% neutralization at 1:5000; and 5) ≥95% neutralization at 1:50,000. Sera were collected at five different time points (x axis) spanning roughly 1, 4, 12, 26, and 52 weeks post-transplantation, designated A-E. In each panel, the notations in the bottom right corner represent the BKV genotype (I or IV) observed in the patient's urine (superscript u) or blood (superscript b). The subject denoted I/IV^u showed urinary shedding of BKV-I at week 5 and urinary shedding of BKV-IV at week 16. The patterns of 12 representative patients are shown.

FIG. 6 is a series of graphs showing BKV-I and BKV-IV serological profiles in all 108 kidney transplant patients analyzed. Neutralizing titer categories (y-axis) and time points (x-axis) are as described for FIG. 5. The numbers at the top of each graph denote quantitation of BKV viruria (log₁₀ BKV DNA copies per ml) at each time point. Dashes indicate that BKV DNA was not detected in the urine. The symbol "nr" indicates no results for the time point. The symbol "utq" indicates that the BKV viruria signal was too low for accurate quantitation. Asterisks mark time points at which BKV viremia was quantitated. The symbol JC+ indicates that JC virus DNA was detected.

FIG. 7 is a pair of graphs showing BKV-I and BKV-IV neutralizing titers in kidney transplant recipients at study entry and exit. Sera from 108 kidney transplant recipients were titrated for the presence of BKV-I (top panel) or BKV-IV (bottom panel) type-specific neutralizing antibodies. The percentages of patients at a particular titer cut-off at study entry (one week after transplantation) are depicted as open bars, while the percentages of patients at a

particular titer cut-off at study exit (one year post-transplantation) are depicted as filled bars.

FIG. 8 is a sequence alignment of BKV VP1 polypeptides. Because it is not possible to distinguish between Ia and Ib1 subtypes based on VP1 amino acid sequences, BKV-Ia indicates genotypes Ia/Ib1 and BKV-Ib indicates genotype Ib2. It is also not possible to distinguish between BKV-IV subtypes based on VP1 amino acid sequences. Therefore, BKV-IV indicates genotypes IV-b1/IV-c2. Amino acids that are completely conserved among all BKV types are shaded. Sequence identifiers for the amino acid sequences are provided in Table 5 (below).

FIG. 9 is a phylogenetic tree showing the relationship of additional partial BKV VP1 sequences with selected BKV-I to BKV-IV VP1 sequences

FIG. 10 is a sequence alignment of BKV partial VP1 polypeptides (SEQ ID NOs: 126-158) with amino acids 31-174 of BKV-Ia (SEQ ID NO: 52), BKV-Ia (SEQ ID NO: 75), BKV-Ib2 (SEQ ID NO: 75), BKV-Ic (SEQ ID NO: 103), BKV-II (SEQ ID NO: 105), BKV-III (SEQ ID NO: 107), BKV-IVb1 (SEQ ID NO: 125), and BKV-IVc2 (SEQ ID NO: 124) polypeptides.

SEQUENCE LISTING

[0010] Any nucleic acid and amino acid sequences listed herein or in the accompanying sequence listing are shown using standard letter abbreviations for nucleotide bases and amino acids. In at least some cases, only one strand of each nucleic acid sequence is shown, but the complementary strand is understood as included by any reference to the displayed strand.

SEQ ID NOs: 1-3 are amino acid sequences of exemplary BKV-Ib 1 VP1, VP2, and VP3 proteins, respectively.

SEQ ID NOs: 4-6 are amino acid sequences of exemplary BKV-IVc2 VP1, VP2, and VP3 proteins, respectively.

SEQ ID NOs: 7-9 are amino acid sequences of exemplary BKV-II VP1, VP2, and VP3 proteins, respectively.

SEQ ID NOs: 10-12 are amino acid sequences of exemplary BKV-III VP1, VP2, and VP3 proteins, respectively.

SEQ ID NO: 13 is an exemplary BKV-Ia VP1 amino acid sequence.

SEQ ID NO: 14 is an exemplary BKV-Ib2 VP1 amino acid sequence.

SEQ ID NO: 15 is an exemplary BKV-Ic VP1 amino acid sequence.

SEQ ID NO: 16 is an exemplary BKV-IV-b1 VP1 amino acid sequence.

SEQ ID NOs: 17-19 are amino acid sequences of exemplary JCV-1A VP1, VP2, and VP3 proteins, respectively.

SEQ ID NO: 20 is an exemplary JCV-2A VP1 amino acid sequence.

SEQ ID NO: 21 is an exemplary JCV-3B VP1 amino acid sequence.

SEQ ID NOs: 22-23 are exemplary JCV consensus VP2 and VP3 amino acid sequences, respectively.

SEQ ID NOs: 24-26 are exemplary BKV-Ib1 VP1, VP2, and VP3 encoding nucleic acid sequences, respectively.

SEQ ID NOs: 27-29 are exemplary BKV-IVc2 VP1, VP2, and VP3 encoding nucleic acid sequences, respectively.

SEQ ID NOs: 30-32 are exemplary BKV-II VP1, VP2, and VP3 encoding nucleic acid sequences, respectively.

SEQ ID NOs: 33-35 are exemplary BKV-III VP1, VP2, and VP3 encoding nucleic acid sequences, respectively.

SEQ ID NOs: 36-38 are exemplary JCV-1A VP1, VP2, and VP3 encoding nucleic acid sequences, respectively.

SEQ ID NOs: 39-41 are exemplary codon-optimized BKV-IVc2 VP1, VP2, and VP3 polypeptide encoding nucleic acid sequences, respectively.

SEQ ID NO: 42 is an exemplary codon-optimized BKV-Ia VP1 polypeptide encoding nucleic acid sequence.

SEQ ID NO: 43 is an exemplary codon-optimized BKV-Ib2 VP1 polypeptide encoding nucleic acid sequence.

SEQ ID NO: 44 is an exemplary codon-optimized BKV-Ic VP1 polypeptide encoding nucleic acid sequence.

SEQ ID NOs: 45 and 46 are exemplary codon-optimized BKV-II and BKV-III VP1 polypeptide encoding nucleic acid sequences, respectively.

SEQ ID NO: 47 is an exemplary codon-optimized BKV-IVb1 VP1 polypeptide encoding nucleic acid sequence.

SEQ ID NO: 48 is an exemplary codon-optimized JCV-2A VP1 polypeptide encoding nucleic acid sequence.

SEQ ID NO: 49 is an exemplary codon-optimized JCV-3B VP1 polypeptide encoding nucleic acid sequence.

SEQ ID NOs: 50 and 51 are exemplary codon-optimized JCV consensus VP2 and VP3

polypeptide encoding nucleic acid sequences, respectively.

SEQ ID NOs: 52-125 are exemplary BKV VP1 polypeptide amino acid sequences.

SEQ ID NOs: 126-160 are exemplary partial BVK VP1 polypeptide amino acid sequences.

DETAILED DESCRIPTION

[0011] BKV is a ubiquitous DNA virus and up to 90% of healthy individuals are seropositive. This virus is believed to initiate infection in the urinary tract and then remain latent without disturbing its host, with occasional reactivation in the form of low-level shedding of virions in the urine (viruria). However, in immunocompromised individuals BKV (and the related JC polyomavirus) can cause significant morbidity or even mortality.

[0012] In pediatric kidney transplants, being seronegative for BKV by a serological test before the procedure has been associated with developing PVAN. In adult kidney transplant recipients, it has been suggested that the role of donor BKV status plays a role in developing PVAN. However, pre-transplant BKV serology is not usually monitored; both because nearly all adults are believed to be seropositive for BKV, and because it has been generally believed that seropositivity for BKV is associated with protection against development of PVAN. Furthermore, the role of intravenous immunoglobulin (IVIG) in treating PVAN has been unclear.

[0013] BKV consists of four subgroups (or types; BKV-I, BKV-II, BKV-III, and BKV-IV) that have been equated with separate serotypes and have limited cross-reactivity as measured by hemagglutination inhibition (HI) and neutralization assays. However, the high BKV prevalence rates in humans, as measured by polymerase chain reaction or BKV seropositivity generally refer to serotype I only. The incidence of the other BKV types in patients prior to kidney or bone marrow transplant in Caucasians has been estimated to be about 3% for BKV-II, 6-7% for BKV-IV and undetectable for BKV-III. However, the present inventors have found a panel of sera from 48 healthy adults to be substantially higher than expected for genotypes II, III, and IV. In a few cases, the inventors have demonstrated that kidney transplant patients who initially had only BKV-I viruria later developed viruria and viremia (presence of virus in the bloodstream) with BKV-IV.

[0014] The cross-reactivity of anti-BKV antibodies between types has not been revisited since 1989; and it may have important implications in the development of PVAN in transplant patients, especially if the organ donor is positive for a less common BKV type. The present inventors have demonstrated that 23-43% of renal transplant patients with undetectable levels of BKV-IV neutralizing antibodies at the time of transplant seroconverted (changed from a negative result to a positive result in a serologic test) within one year, irrespective of their BKV-I serostatus. The small number of initially BKV-I seronegative renal transplant recipients all seroconverted for BKV-I, irrespective of their BKV-IV serostatus.

[0015] Thus, the inventors have demonstrated that presence of neutralizing antibodies against one BKV serotype does not protect from infection with other BKV serotypes, as was previously believed. Furthermore, the presence of neutralizing antibodies to BKV-Ib2 does not provide neutralization of BKV-Ia, demonstrating that not all BKV-I neutralizing antibodies can provide protection from all BKV-I subtypes. This indicates that vaccination of individuals (such as organ transplant recipients or other immunocompromised individuals) with a vaccine to a single BKV serotype or subtype may not effectively elicit an immune response to all serotypes or subtypes and may not provide adequate protection from polyomavirus-associated pathologies such as PVAN or PML. Furthermore, it indicates that the prevalence of BKV-I in the general population does not protect at risk individuals from infection with other BKV serotypes (such as BKV-IV).

I. Abbreviations

[0016]

BKV

BK polyomavirus

BKV-I

BKV serotype I

BKV-II

BKV serotype II

BKV-III

BKV serotype III

BKV-IV

BKV serotype IV

ELISA

enzyme-linked immunosorbant assay

IVIG

intravenous immunoglobulin

JCV

JC polyomavirus

PML

progressive multifocal leukoencephalopathy

PVAN

polyomavirus-associated nephropathy

SV40

simian virus 40

VLP

virus-like particle

II. Terms

[0017] Unless otherwise noted, technical terms are used according to conventional usage. Definitions of common terms in molecular biology may be found in Benjamin Lewin, *Genes VII*, published by Oxford University Press, 2000 (ISBN 019879276X); Kendrew et al. (eds.), *The Encyclopedia of Molecular Biology*, published by Blackwell Publishers, 1994 (ISBN 0632021829); Robert A. Meyers (ed.), *Molecular Biology and Biotechnology: a Comprehensive Desk Reference*, published by Wiley, John & Sons, Inc., 1995 (ISBN 0471186341); and George P. Rédei, *Encyclopedic Dictionary of Genetics, Genomics, and Proteomics*, 2nd Edition, 2003 (ISBN: 0-471-26821-6).

[0018] The following explanations of terms and methods are provided to better describe the present disclosure and to guide those of ordinary skill in the art to practice the present disclosure. The singular forms "a," "an," and "the" refer to one or more than one, unless the context clearly dictates otherwise. For example, the term "comprising a polypeptide" includes single or plural polypeptides and is considered equivalent to the phrase "comprising at least one polypeptide." As used herein, "comprises" means "includes." Thus, "comprising A or B," means "including A, B, or A and B," without excluding additional elements.

[0019] . In case of conflict, the present specification, including explanations of terms, will control.

[0020] Although methods and materials similar or equivalent to those described herein can be used to practice or test the disclosed technology, suitable methods and materials are described below. The materials, methods, and examples are illustrative only and not intended to be limiting.

[0021] To facilitate review of the various embodiments of this disclosure, the following explanations of specific terms are provided:

Antibody: A protein (or protein complex) that includes one or more polypeptides substantially encoded by immunoglobulin genes or fragments of immunoglobulin genes. The recognized immunoglobulin genes include the kappa, lambda, alpha, gamma, delta, epsilon, and mu constant region genes, as well as the myriad of immunoglobulin variable region genes. Light chains are classified as either kappa or lambda. Heavy chains are classified as gamma, mu, alpha, delta, or epsilon, which in turn define the immunoglobulin classes, IgG, IgM, IgA, IgD and IgE, respectively. A **neutralizing antibody** is an antibody which, on mixture with the homologous infectious agent (such as a polyomavirus), reduces the infectious titer. In some examples, a neutralizing antibody is an antibody that blocks the ability of its antigen to perform a physiological function.

[0022] The basic immunoglobulin (antibody) structural unit is generally a tetramer. Each tetramer is composed of two identical pairs of polypeptide chains, each pair having one "light" (about 25 kDa) and one "heavy" (about 50-70 kDa) chain. The N-terminus of each chain

defines a variable region of about 100 to 110 or more amino acids primarily responsible for antigen recognition. The terms "variable light chain" (V_L) and "variable heavy chain" (V_H) refer, respectively, to these light and heavy chains.

[0023] As used herein, the term "antibodies" includes intact immunoglobulins as well as a number of well-characterized fragments. For instance, Fabs, Fvs, and single-chain Fvs (SCFvs) that bind to target protein (or epitope within a protein or fusion protein) would also be specific binding agents for that protein (or epitope). These antibody fragments are defined as follows: (1) Fab, the fragment which contains a monovalent antigen-binding fragment of an antibody molecule produced by digestion of whole antibody with the enzyme papain to yield an intact light chain and a portion of one heavy chain; (2) Fab', the fragment of an antibody molecule obtained by treating whole antibody with pepsin, followed by reduction, to yield an intact light chain and a portion of the heavy chain; two Fab' fragments are obtained per antibody molecule; (3) (Fab')₂, the fragment of the antibody obtained by treating whole antibody with the enzyme pepsin without subsequent reduction; (4) F(ab')₂, a dimer of two Fab' fragments held together by two disulfide bonds; (5) Fv, a genetically engineered fragment containing the variable region of the light chain and the variable region of the heavy chain expressed as two chains; and (6) single chain antibody, a genetically engineered molecule containing the variable region of the light chain, the variable region of the heavy chain, linked by a suitable polypeptide linker as a genetically fused single chain molecule. Methods of making these fragments are routine (see, for example, Harlow and Lane, *Using Antibodies: A Laboratory Manual*, CSHL, New York, 1999).

[0024] BK polyomavirus (BKV): A polyomavirus originally isolated from patient B.K. after renal transplantation (Gardner et al., *Lancet* 1:1253-1257, 1971). Four BKV serotypes are known (serotypes I-IV; e.g., Knowles et al., *J. Med. Virol.* 28:118-123, 1989). BKV is nearly ubiquitous, and up to 90% of healthy individuals are seropositive for BKV. Acute infection is generally asymptomatic and proceeds to latent infection, primarily in the urogenital tract. BKV can be reactivated in immunocompromised individuals, and can cause significant morbidity, particularly in renal transplant patients.

[0025] BKV nucleic acid and amino acid sequences are publicly available. For example, GenBank Accession Nos. AB211374, AB263920, AB211386, and AB369093 disclose exemplary BKV-I, BKV-II, BKV-III, and BKV-IV nucleic acid sequences, respectively.

[0026] Capsid polypeptide: One of three structural proteins that forms the polyomavirus capsid. The polyomavirus capsid is formed from viral protein 1 (VP1), viral protein 2 (VP2), and viral protein 3 (VP3).

[0027] Codon-optimized: A "codon-optimized" nucleic acid refers to a nucleic acid sequence that has been altered such that the codons are optimal for expression in a particular system (such as a particular species or group of species). For example, a nucleic acid sequence can be optimized for expression in mammalian cells, bacteria or yeast. Codon optimization does not alter the amino acid sequence of the encoded protein.

[0028] Conservative variants: A substitution of an amino acid residue for another amino acid residue having similar biochemical properties. "Conservative" amino acid substitutions include those substitutions that do not substantially affect or decrease an activity or antigenicity of a polypeptide. A peptide can include one or more amino acid substitutions, for example 1-10 conservative substitutions, 2-5 conservative substitutions, 4-9 conservative substitutions, such as 1, 2, 5 or 10 conservative substitutions. Specific, non-limiting examples of a conservative substitution include the following examples (Table 1).

Table 1. Exemplary conservative amino acid substitutions

Original Amino Acid	Conservative Substitutions
Ala	Ser
Arg	Lys
Asn	Gln, His
Asp	Glu
Cys	Ser
Gln	Asn
Glu	Asp
His	Asn; Gln
Ile	Leu, Val
Leu	He; Val
Lys	Arg; Gln; Glu
Met	Leu; Ile
Phe	Met; Leu; Tyr
Ser	Thr
Thr	Ser
Trp	Tyr
Tyr	Trp; Phe
Val	He; Leu

[0029] The term conservative variation also includes the use of a substituted amino acid in place of an unsubstituted parent amino acid, provided that antibodies raised to the substituted polypeptide also immunoreact with the unsubstituted polypeptide, or that an immune response can be generated against the substituted polypeptide that is similar to the immune response against the unsubstituted polypeptide. Thus, in one embodiment, non-conservative substitutions are those that reduce an activity or antigenicity.

[0030] Immune response: A response of a cell of the immune system, such as a B-cell, T-cell, macrophage or polymorphonucleocyte, to a stimulus such as an antigen. An immune response

can include any cell of the body involved in a host defense response, for example, an epithelial cell that secretes an interferon or a cytokine. An immune response includes, but is not limited to, an innate immune response or inflammation.

[0031] Immunocompromised: An immunocompromised subject is a subject who is incapable of developing or unlikely to develop a robust immune response, usually as a result of disease, malnutrition, or immunosuppressive therapy. An immunocompromised immune system is an immune system that is functioning below normal. Immunocompromised subjects are more susceptible to opportunistic infections, for example viral, fungal, protozoan, or bacterial infections, prion diseases, and certain neoplasms.

[0032] Those who can be considered to be immunocompromised include, but are not limited to, subjects with AIDS (or HIV positive), subjects with severe combined immunodeficiency (SCID), diabetics, subjects who have had transplants and who are taking immunosuppressants, and those who are receiving chemotherapy for cancer. Immunocompromised individuals also includes subjects with most forms of cancer (other than skin cancer), sickle cell anemia, cystic fibrosis, those who do not have a spleen, subjects with end stage kidney disease (dialysis), and those who have been taking corticosteroids or other immune suppressing therapy on a frequent basis within the last year.

[0033] Immunosuppressant: Any compound that decreases the function or activity of one or more aspects of the immune system, such as a component of the humoral or cellular immune system or the complement system. Immunosuppressants are also referred to as "immunosuppressive agents" or "immunosuppressive therapies."

[0034] In some examples, an immunosuppressant includes, but is not limited to: (1) antimetabolites, such as purine synthesis inhibitors (such as inosine monophosphate dehydrogenase (IMPDH) inhibitors, *e.g.*, azathioprine, mycophenolate, and mycophenolate mofetil), pyrimidine synthesis inhibitors (*e.g.*, leflunomide and teriflunomide), and antifolates (*e.g.*, methotrexate); (2) calcineurin inhibitors, such as tacrolimus, cyclosporine A, pimecrolimus, and voclosporin; (3) TNF- α inhibitors, such as thalidomide and lenalidomide; (4) IL-1 receptor antagonists, such as anakinra; (5) mammalian target of rapamycin (mTOR) inhibitors, such as rapamycin (sirolimus), deforolimus, everolimus, temsirolimus, zotarolimus, and biolimus A9; (6) corticosteroids, such as prednisone; and (7) antibodies to any one of a number of cellular or serum targets (including anti-lymphocyte globulin and anti-thymocyte globulin).

[0035] Exemplary cellular targets and their respective inhibitor compounds include, but are not limited to complement component 5 (*e.g.*, eculizumab); tumor necrosis factors (TNFs) (*e.g.*, infliximab, adalimumab, certolizumab pegol, afelimomab and golimumab); IL-5 (*e.g.*, mepolizumab); IgE (*e.g.*, omalizumab); BAYX (*e.g.*, nerelimomab); interferon (*e.g.*, faralimomab); IL-6 (*e.g.*, elsilimomab); IL-12 and IL-13 (*e.g.*, lebrikizumab and ustekinumab); CD3 (*e.g.*, muromonab-CD3, otelexizumab, teplizumab, visilizumab); CD4 (*e.g.*, clenoliximab, keliximab and zanolimumab); CD11a (*e.g.*, efalizumab); CD18 (*e.g.*, erlizumab); CD20 (*e.g.*,

rituximab, afutuzumab, ocrelizumab, pascolizumab); CD23 (e.g., lumiliximab); CD40 (e.g., teneliximab, toralizumab); CD52 (e.g., alemtuzumab); CD62L/L-selectin (e.g., aselizumab); CD80 (e.g., galiximab); CD147/basigin (e.g., gavilimomab); CD154 (e.g., ruplizumab); BLyS (e.g., belimumab); CTLA-4 (e.g., ipilimumab, tremelimumab); CAT (e.g., bertilimumab, lerdelimumab, metelimumab); integrin (e.g., natalizumab); IL-6 receptor (e.g., tocilizumab); LFA-1 (e.g., odulimomab); and IL-2 receptor/CD25 (e.g., basiliximab, daclizumab, inolimomab).

[0036] Inhibiting or treating a disease: "Inhibiting" a disease refers to inhibiting the full development of a disease, for example, PVAN, PML, or BKV-associated hemorrhagic cystitis. Inhibition of a disease can span the spectrum from partial inhibition to substantially complete inhibition (e.g., including, but not limited to prevention) of the disease. In some examples, the term "inhibiting" refers to reducing or delaying the onset or progression of a disease. A subject to be administered with a therapeutically effective amount of the disclosed immunogenic compositions can be identified by standard diagnosing techniques for such a disorder, for example, basis of family history, or risk factor to develop the disease or disorder. "Treatment" refers to a therapeutic intervention that ameliorates a sign or symptom of a disease or pathological condition after it has begun to develop.

[0037] Isolated: An "isolated" or "purified" biological component (such as a nucleic acid, peptide, protein, protein complex, or virus-like particle) has been substantially separated, produced apart from, or purified away from other biological components in the cell of the organism in which the component naturally occurs, that is, other chromosomal and extrachromosomal DNA and RNA, and proteins. Nucleic acids, peptides and proteins that have been "isolated" or "purified" thus include nucleic acids and proteins purified by standard purification methods. The term also embraces nucleic acids, peptides and proteins prepared by recombinant expression in a host cell, as well as chemically synthesized nucleic acids or proteins.

[0038] The term "isolated" or "purified" does not require absolute purity; rather, it is intended as a relative term. Thus, for example, an isolated biological component is one in which the biological component is more enriched than the biological component is in its natural environment within a cell, or other production vessel. Preferably, a preparation is purified such that the biological component represents at least 50%, such as at least 70%, at least 90%, at least 95%, or greater, of the total biological component content of the preparation.

[0039] JC polyomavirus (JCV): A polyomavirus originally isolated from a patient (J.C.) with progressive multifocal leukoencephalopathy (Padgett et al., Lancet 1:1257-1260, 1971). JCV is genetically similar to BKV and simian virus 40 (SV40). JCV is very common in the general population, with 70-90% of individuals seropositive for JCV. The initial site of infection may be the tonsils or gastrointestinal tract. The primary sites of JC infection are thought to be tubular epithelial cells in the kidney, the lining of the ureters and bladder, and oligodendrocytes and astrocytes in the central nervous system.

[0040] JCV can reactivate in immunocompromised individuals and can cause **JCV-associated progressive multifocal leukoencephalopathy (PML)**, which is usually fatal. PML occurs in about 10% of patients suffering from HIV-induced AIDS and can also occur in other immunosuppressed patients, including but not limited to patients treated with rituximab, natalizumab, alemtuzumab, or efalizumab. JCV can also cause urinary tract pathology in some organ transplant recipients.

[0041] JCV nucleic acid and amino acid sequences are publicly available. For example, GenBank Accession Nos. NC_001699, AB038251, and AF281600 disclose exemplary JCV nucleic acid sequences. JCV isolates have been classified into eight distinct genotypes, based in part on the amino acid sequences of VP1 proteins of individual isolates (Cubitt et al., J. Neurovirol. 7:339-344, 2001).

[0042] Pharmaceutically acceptable carrier: The pharmaceutically acceptable carriers (vehicles) useful in this disclosure are conventional. Remington: The Science and Practice of Pharmacy, The University of the Sciences in Philadelphia, Editor, Lippincott, Williams, & Wilkins, Philadelphia, PA, 21st Edition (2005), describes compositions and formulations suitable for pharmaceutical delivery of one or more therapeutic compositions, such as one or more polyomavirus capsid polypeptides or fragments thereof, and additional pharmaceutical agents.

[0043] In general, the nature of the carrier will depend on the particular mode of administration being employed. For instance, parenteral formulations usually comprise injectable fluids that include pharmaceutically and physiologically acceptable fluids such as water, physiological saline, balanced salt solutions, aqueous dextrose, glycerol or the like as a vehicle. For solid compositions (for example, powder, pill, tablet, or capsule forms), conventional non-toxic solid carriers can include, for example, pharmaceutical grades of mannitol, lactose, starch, or magnesium stearate. In addition to biologically-neutral carriers, pharmaceutical compositions to be administered can contain minor amounts of non-toxic auxiliary substances, such as wetting or emulsifying agents, preservatives, and pH buffering agents and the like, for example sodium acetate or sorbitan monolaurate. **Polyomavirus:** A genus of nonenveloped viruses having an icosahedral capsid. The genome of polyomaviruses includes non-structural proteins (large T-antigen and small t-antigen), a non-coding region including an origin of replication and promoters, and structural proteins (VP1, VP2, and VP3). Polyomaviruses include but are not limited to BK polyomavirus, JC polyomavirus, Merkel cell polyomavirus, and simian virus 40 (SV40). Related human polyomaviruses WU virus (Gaynor et al., PLoS Pathog. 3:e64, 2007) and KI virus (Allander et al., J. Virol. 81:4130-4136, 2007) have recently been reported in clinical samples

[0044] Polyomavirus infection is generally asymptomatic in healthy subjects. However, polyomavirus infection can occur or be reactivated in immunocompromised individuals and can cause significant morbidity. **Polyomavirus-associated nephropathy (PVAN;** also called BK polyomavirus-associated nephropathy or BK virus nephritis) occurs in up to 10% of renal transplant recipients and is believed to be caused by BKV infection or reactivation of latent BKV infection. It causes kidney allograft dysfunction and may lead to loss of the allograft.

Polyomavirus-associated hemorrhagic cystitis is characterized by inflammation of the bladder leading to dysuria, hematuria, and hemorrhage. It can occur in bone marrow transplant recipients and other individuals who are receiving immunosuppressants or other therapies which decrease immune system function.

[0045] Sequence identity: The similarity between two nucleic acid sequences, or two amino acid sequences, is expressed in terms of the similarity between the sequences, otherwise referred to as sequence identity. Sequence identity is frequently measured in terms of percentage identity (or similarity or homology); the higher the percentage, the more similar the two sequences are.

[0046] Methods of alignment of sequences for comparison are well known in the art. Various programs and alignment algorithms are described in: Smith & Waterman, Adv. Appl. Math. 2: 482, 1981; Needleman & Wunsch, J. Mol. Biol. 48: 443, 1970; Pearson & Lipman, Proc. Natl. Acad. Sci. USA 85: 2444, 1988; Higgins & Sharp, Gene, 73: 237-244, 1988; Higgins & Sharp, Comput. Appl. Biosci. 5: 151-153, 1989; Corpet et al., Nucl. Acids Res. 16, 10881-90, 1988; Huang et al., Comput. Appl. Biosci. 8, 155-65, 1992; and Pearson, Methods Mol. Biol. 24:307-331, 1994. Altschul et al. (J. Mol. Biol. 215:403-410, 1990) presents a detailed consideration of sequence alignment methods and homology calculations.

[0047] The NCBI Basic Local Alignment Search Tool (BLAST) (Altschul et al., J. Mol. Biol. 215:403-410, 1990) is available from several sources, including the National Center for Biotechnology Information (NCBI, Bethesda, MD) and on the Internet, for use in connection with the sequence analysis programs blastp, blastn, blastx, tblastn and tblastx. By way of example, for comparisons of amino acid sequences of greater than about 30 amino acids, the Blast 2 sequences function is employed using the default BLOSUM62 matrix set to default parameters (gap existence cost of 11, and a per residue gap cost of 1). When aligning short peptides (fewer than around 30 amino acids), the alignment is performed using the Blast 2 sequences function, employing the PAM30 matrix set to default parameters (open gap 9, extension gap 1 penalties).

[0048] Nucleic acid sequences that do not show a high degree of sequence identity may nevertheless encode similar amino acid sequences, due to the degeneracy of the genetic code. It is understood that changes in nucleic acid sequence can be made using this degeneracy to produce multiple nucleic acid molecules that all encode substantially the same protein.

[0049] Subject: Living multi-cellular vertebrate organisms, a category that includes both human and non-human mammals (such as mice, rats, rabbits, sheep, horses, cows, and non-human primates).

[0050] Therapeutically effective amount: A quantity of a specified agent sufficient to achieve a desired effect in a subject being treated with that agent. For example, this may be the amount of a polyomavirus capsid polypeptide or nucleic acid (or fragment thereof) useful for

eliciting an immune response in a subject and/or for inhibiting or preventing infection or pathology by a polyomavirus (such as BKV or JCV). Ideally, in the context of the present disclosure, a therapeutically effective amount of a polyomavirus polypeptide or nucleic acid (or fragment thereof) is an amount sufficient to increase resistance to, prevent, ameliorate, and/or treat infection caused by a polyomavirus in a subject without causing a substantial cytotoxic effect in the subject. The effective amount of a polyomavirus polypeptide or nucleic acid (or fragment thereof) useful for increasing resistance to, preventing, ameliorating, and/or treating infection in a subject will be dependent on, for example, the subject being treated, the manner of administration of the therapeutic composition, and other factors.

[0051] Virus-like particle (VLP): A non-replicating viral shell, derived from any of several viruses. VLPs are generally composed of one or more viral proteins, such as, but not limited to, those proteins referred to as capsid, coat, shell, surface and/or envelope proteins, or particle-forming polypeptides derived from these proteins. VLPs can form spontaneously upon recombinant expression of the protein in an appropriate expression system. Methods for producing particular VLPs are known in the art. The presence of VLPs following recombinant expression of viral proteins can be detected using conventional techniques known in the art, such as by electron microscopy, biophysical characterization, and the like. See, for example, Baker et al. (1991) *Biophys. J.* 60:1445-1456; Hagensee et al. (1994) *J. Virol.* 68:4503-4505. For example, VLPs can be isolated by density gradient centrifugation and/or identified by characteristic density banding. Alternatively, cryoelectron microscopy can be performed on vitrified aqueous samples of the VLP preparation in question, and images recorded under appropriate exposure conditions.

III. Immune Response to Polyomavirus

[0052] Disclosed herein are methods of eliciting an immune response against a polyomavirus (for example, BKV or JCV). The disclosed methods utilize one or more capsid polypeptides (or a fragment thereof) of a polyomavirus to elicit an immune response in a subject. In some examples, the methods are of use to treat, inhibit, or even prevent infection of a subject with a polyomavirus or to treat, inhibit, or even prevent polyomavirus-associated disorders (for example, PVAN, BKV-associated hemorrhagic cystitis, and/or JCV-associated PML). In some embodiments, the methods include administering at least one capsid polypeptide (or a fragment thereof) from each of two or more BKV serotypes (such as a multivalent BKV serotype immunogenic composition) to a subject. In some examples, the multivalent immunogenic composition includes at least one capsid polypeptide (or a fragment thereof) from two or more BKV-I subtypes (such as BKV-Ia, BKV-Ib1, BKV-Ib2, and/or BKV-Ic subtypes). The methods may further include administering at least one JCV capsid polypeptide (or a fragment thereof) to the subject. Also disclosed are methods of identifying a transplant donor and/or transplant recipient (such as a renal transplant donor or recipient) who does not have antibodies for one or more BKV serotypes (for example, BKV-IV or BKV-I), such as a donor and/or recipient who does not have detectable levels of antibodies capable of neutralizing one or more BKV serotypes (for example, BKV-I or BKV-IV).

A. Methods of Eliciting an Immune Response to BKV

[0053] In some aspects, the methods include eliciting an immune response against a BKV in a subject (such as one or more BKV serotypes). The methods include administering to a subject in need of enhanced immunity to BKV a therapeutically effective amount of at least one isolated BKV-I capsid polypeptide (or a fragment thereof) or a nucleic acid encoding the at least one BKV-I capsid polypeptide (such as at least one BKV-Ia VP1 polypeptide, BKV-Ib1 VP1 polypeptide, BKV-Ib2 VP1 polypeptide, and/or BKV-Ic VP1 polypeptide) and a therapeutically effective amount of at least one isolated BKV-IV capsid polypeptide (or a fragment thereof) or a nucleic acid encoding the at least one BKV-IV capsid polypeptide (such as at least one BKV-IVb1 VP1 polypeptide and/or BKV-IVc2 VP1 polypeptide). In some examples, the at least one BKV-I capsid polypeptide (or fragment thereof) and the at least one BKV-IV capsid polypeptide (or fragment thereof) are different from one another. The BKV-I and BKV-IV capsid polypeptides include one or more of VP1, VP2, and VP3 (such as SEQ ID NOs: 1-6 and 13-16), and are discussed in detail in Section IV, below. In particular examples, administering the at least one isolated BKV-I capsid polypeptide includes administering a VLP including the BKV-I capsid polypeptide(s) and/or administering the at least one BKV-IV capsid polypeptide includes administering a VLP including the BKV-IV capsid polypeptide(s). In particular examples, the subject does not have BKV-IV neutralizing antibodies. In other examples, the subject does not have BKV-I neutralizing antibodies.

[0054] In one non-limiting example, the methods include administering to a subject in need of enhanced immunity to BKV a therapeutically effective amount of at least one BKV-Ia VP1 polypeptide, at least one BKV-Ib2 VP1 polypeptide, and at least one BKV-IV VP1 polypeptide (such as at least one BKV-IVb1 VP1 polypeptide and/or BKV-IVc2 VP1 polypeptide). In other examples, the methods may also include administering to a subject in need of enhanced immunity to BKV a therapeutically effective amount of at least one BKV-Ic VP1 polypeptide. In some examples, the BKV-Ia/Ib1 VP1 polypeptide includes a glutamic acid at amino acid position 73 and/or a glutamic acid at amino acid position 82 (such as SEQ ID NO: 1 or SEQ ID NO: 13). In additional examples, the BKV-Ib2 VP1 polypeptide includes a lysine residue at amino acid position 73 and/or an aspartic acid at amino acid position 82 (such as SEQ ID NO: 14).

[0055] In some examples, the methods further include administering to the subject a therapeutically effective amount of at least one isolated BKV-II capsid polypeptide (or a fragment thereof) or a nucleic acid encoding the at least one BKV-II capsid polypeptide and/or a therapeutically effective amount of at least one BKV-III capsid polypeptide (or a fragment thereof) or a nucleic acid encoding the at least one BKV-III capsid polypeptide. In some examples, the BKV-II capsid polypeptide (or fragment thereof) and the BKV-III capsid polypeptide (or fragment thereof) are different from one another and are also different from the BKV-I and BKV-IV capsid polypeptides (or fragments thereof). The BKV-II and BKV-III capsid polypeptides include one or more of VP1, VP2, and VP3 (such as SEQ ID NOs: 7-12), and are

discussed in detail in Section IV, below. In particular examples, administering the at least one isolated BKV-II capsid polypeptide includes administering a VLP including the BKV-II capsid polypeptide(s) and/or administering the at least one BKV-III capsid polypeptide includes administering a VLP including the BKV-III capsid polypeptide(s).

[0056] The methods may further include selecting a subject in need of enhanced immunity to BKV. In some examples, a subject in need of enhanced immunity to BKV is a subject at risk of BKV infection or at risk of BKV-associated disorders, such as PVAN or BKV-associated hemorrhagic cystitis. Subjects in need of enhanced immunity to BKV include subjects who are immunocompromised, for example subjects who are infected with human immunodeficiency virus (HIV), subjects with SCID, diabetics, subjects who are receiving chemotherapy for cancer, and subjects who are receiving immunosuppressive therapy (such as corticosteroids, a calcineurin inhibitor, such as tacrolimus, cyclosporine, or pimecrolimus, or other therapies that decrease immune system function, such as rituximab, natalizumab, efalizumab, or alemtuzumab). In some examples, subjects who are receiving immunosuppressive therapy include individuals who have received an organ transplant (such as a renal transplant or other solid organ transplant or a bone marrow transplant). In a particular example, a subject in need of enhanced immunity to BKV is a renal transplant recipient. In another example, a subject in need of enhanced immunity to BKV is a bone marrow transplant recipient. In other examples, subjects in need of enhanced immunity to BKV include those who are candidates for organ or bone marrow transplantation or those who are candidates for immunosuppressive therapy. In a particular example, the subject has renal failure or is otherwise a candidate for a renal transplant. In further examples, a subject in need of enhanced immunity to BKV may include a subject who has or is at risk for cancer (for example, prostate cancer or bladder carcinoma).

[0057] The methods may further include administering to the subject a therapeutically effective amount of at least one JCV capsid polypeptide (or a fragment thereof) or a nucleic acid encoding the at least one JCV capsid polypeptide. The JCV capsid polypeptides include one or more of VP1, VP2, and VP3 (for example, SEQ ID NOs: 17-23), and are discussed in detail in Section IV, below. In particular examples, administering the at least one isolated JCV capsid polypeptide includes administering a VLP including the JCV capsid polypeptide(s).

[0058] In some examples, the subject who is administered the at least one JCV capsid polypeptide or nucleic acid encoding the JCV capsid polypeptide is a subject in need of enhanced immunity to JCV or a subject at risk of a JCV-associated disorder (for example, JCV-associated PML). In particular examples, the subject is an immunocompromised subject, for example a subject who is infected with HIV, a subject with SCID, a diabetic subject, a subject who is receiving chemotherapy for cancer, or a subject who is receiving immunosuppressive therapy (such as corticosteroids, a calcineurin inhibitor, such as tacrolimus, cyclosporine, or pimecrolimus, or other therapies that decrease immune system function, such as rituximab, natalizumab, efalizumab, or alemtuzumab). In some examples, a subject who is receiving immunosuppressive therapy includes a subject who has received an organ transplant (such as a renal transplant or other solid organ transplant or a bone marrow transplant). In a particular example, a subject in need of enhanced immunity to JCV is a renal transplant recipient or a

bone marrow transplant recipient. In another example, a subject in need of enhanced immunity to JCV is a subject who is receiving rituximab therapy (or a subject who will or has received rituximab therapy). In other examples, subjects in need of enhanced immunity to JCV include those who are candidates for organ or bone marrow transplantation or those who are candidates for immunosuppressive therapy.

B. Methods of Treating or Inhibiting Polyomavirus-Associated Disorders

[0059] The methods may include treating or inhibiting (or in some examples, even preventing) a polyomavirus-associated disorder, such as PVAN, BKV-associated hemorrhagic cystitis, or JCV-associated PML. In some examples, the methods include administering to a subject in need of treatment for or inhibition of a polyomavirus-associated disorder a therapeutically effective amount of at least one isolated BKV-IV capsid polypeptide (or a fragment thereof) or a nucleic acid encoding the at least one BKV-IV capsid polypeptide to the selected subject (such as at least one BKV-IVb1 VP1 polypeptide and/or at least one BKV-IVc2 VP1 polypeptide). In some examples, administering the one or more BKV-IV capsid polypeptides (such as VP1, VP2, or VP3, for example, SEQ ID NOs: 4-6 and/or SEQ ID NO: 16) includes administering a VLP including the capsid polypeptide(s).

[0060] The methods may further include selecting a subject in need of treatment for inhibition of a polyomavirus-associated disorder. In some examples, a subject is in need of treating or inhibiting PVAN or BK-associated hemorrhagic cystitis. (such as a subject who has had an organ or bone marrow transplant or a candidate for an organ or bone marrow transplant). In one example, the subject is a candidate for a kidney transplant. In other examples, the subject is a candidate for a bone marrow transplant. In further examples, the subject is immunocompromised (such as a transplant recipient, a subject who is infected with HIV, or a subject treated with an immunosuppressant), or is a candidate for treatment with an immunosuppressant (such as an organ or bone marrow transplant candidate). In particular examples, the subject does not have BKV-IV neutralizing antibodies and/or BKV-I neutralizing antibodies.

[0061] In some examples, the methods further include administering to the subject a therapeutically effective amount of at least one isolated BKV-I capsid polypeptide (or a fragment thereof) or a nucleic acid encoding the at least one BKV-I capsid polypeptide, at least one isolated BKV-II capsid polypeptide (or a fragment thereof) or a nucleic acid encoding the at least one BKV-II capsid polypeptide, at least one isolated BKV-III capsid polypeptide (or a fragment thereof) or a nucleic acid encoding the at least one BKV-III capsid polypeptide, at least one isolated JCV capsid polypeptide (or a fragment thereof) or a nucleic acid encoding the at least one JCV capsid polypeptide, or a combination of two or more thereof (for example, one or more of SEQ ID NOs: 1-23). In particular non-limiting examples, the methods include administering to the subject a therapeutically effective amount of at least one BKV-Ia VP1 polypeptide and at least one BKV-Ib2 VP1 polypeptide (such as SEQ ID NOs: 1, 14, or 15). In some examples, administering the one or more BKV and/or JCV capsid polypeptides (such as

VP1, VP2, or VP3) includes administering a VLP including the capsid polypeptide(s).

[0062] In particular examples, the subject is a candidate for organ transplant (for example, renal transplant or bone marrow transplant) and the therapeutically effective amount of the BKV-IV capsid polypeptide or nucleic acid encoding the capsid polypeptide is administered to the subject a sufficient time prior to the organ transplant to produce an immune response to the BKV-IV capsid polypeptide in the subject. One of skill in the art can identify the time required to produce an immune response in the subject based on factors such as the general state of the subject's health, and the robustness of the subject's immune system. In some examples, the at least one isolated BKV-IV capsid polypeptide or nucleic acid encoding the BKV-IV capsid polypeptide is administered to the subject at least about six months (for example, at least about 6 months, 5 months, 4 months, 3 months, 2 months, 6 weeks, 5 weeks, 4 weeks, 3 weeks, 2 weeks, or even 1 week) prior to the organ transplant. In some examples, the BKV-IV capsid polypeptide is administered to the subject at least about 2 weeks prior to the organ transplant. In other examples, the BKV-IV capsid polypeptide is administered to the subject at least about 6 weeks prior to the organ transplant, with a booster dose about 2 weeks prior to transplant. In some examples, a BKV-I, BKV-II, BKV-III, and/or JCV capsid polypeptide (or fragment thereof) is further administered to the subject prior to the organ transplant.

[0063] The methods may include administering to the subject a therapeutically effective amount of a purified human gamma globulin preparation that has been found to contain antibodies capable of neutralizing BKV-I, BKV-II, BKV-III and/or BKV-IV. Subjects include those described above. Methods of identifying serum containing BKV-I, BKV-II, BKV-III, and/or BKV-IV neutralizing antibodies are known to one of skill in the art and include the methods discussed in Section VI, below. In some examples, the gamma globulin preparations that may be used include commercially available preparations of intact gamma globulin and preparations of the Fc, F(ab')₂ fragments of gamma globulin or combinations thereof. Methods of preparing gamma globulin, for example, for administration to a subject are known to one of ordinary skill in the art. See, e.g., U.S. Pat. Nos. 5,177,194; 6,504,012; and 7,879,331.

[0064] The dosage of gamma globulin and the method of administration will vary with the severity and nature of the particular condition being treated, the duration of treatment, the adjunct therapy used, the age and physical condition of the subject of treatment and similar factors. In some examples, dosages for intravenous administration are from 100 mg/kg to 2.5 g/kg (such as about 400 mg/kg to 2 g/kg or 1 g/kg to 2 g/kg). The dosage can be varied based on the frequency of administration, for example, 400 mg/kg/day for 5 consecutive days per month or 2 g/kg/day once a month. In another example, the gamma globulin preparation is administered subcutaneously or intramuscularly. In some examples, the dosage for subcutaneous or intramuscular administration is from about 1 mg/kg to 30 mg/kg body weight (such as about 4 mg/kg to 20 mg/kg or about 10 mg/kg to 20 mg/kg).

[0065] The gamma globulin is administered as a pharmaceutical composition containing a pharmaceutically acceptable carrier. Pharmaceutically acceptable carriers of use for gamma

globulin compositions include those described in section V, below.

C. Methods of Selecting a Renal Transplant Donor and/or Recipient

[0066] In further embodiments, the methods include selecting a candidate organ transplant donor and/or organ transplant recipient. In some examples, the candidate donor is a candidate renal transplant donor and the candidate transplant recipient is a candidate renal transplant recipient. The methods include screening a candidate donor and/or recipient for presence of BKV serotype-specific antibodies (including, but not limited to BKV-IV-specific neutralizing antibodies).

[0067] In some embodiments, the methods include selecting a subject as a renal transplant donor if BKV serotype-specific (such as BKV-IV or BKV-I) neutralizing antibodies are not present in the subject. In some examples, the methods further include selecting a subject as a renal transplant recipient if BKV serotype-specific (such as BKV-IV or BKV-I) neutralizing antibodies are not present in the subject who is a candidate transplant recipient. In some examples, the methods include detecting presence of BKV-IV neutralizing antibodies in a subject (in a sample from a subject) and selecting the subject as a transplant donor or recipient if BKV-IV neutralizing antibodies are not present in the sample. The sample can include any suitable biological sample from the subject, including a blood sample or serum sample.

[0068] Methods of detecting neutralizing antibodies in a subject (such as in a blood or serum sample from a subject) are known to one of ordinary skill in the art. Such methods are discussed in Section VI, below.

IV. Polyomavirus Capsid Polypeptides

[0069] Polyomavirus nucleic acid and polypeptide sequences are publicly available and can be identified by one of skill in the art. Exemplary BKV genomic nucleic acid sequences include, but are not limited to, GenBank Accession Nos. JF894228, AB211374, DQ989796, AB211377, AB263920, AB211386, AB211390, and

[0070] AB369093.

[0071] It is disclosed herein that several BKV capsid polypeptides (or fragments thereof) can be used to elicit an immune response to BKV. In several embodiments, the BKV capsid polypeptide comprises or consists of the amino acid sequence set forth as SEQ ID NOs: 1-12. Additional BKV VP1 polypeptides are disclosed herein, for example from additional BKV subtypes. In some embodiments, the BKV VP1 polypeptide comprises or consists of the amino acid sequence set forth as SEQ ID NOs: 13-16.

[0072] Exemplary JCV genomic nucleic acid sequences include, but are not limited to, GenBank Accession Nos. NC_001699, AF300945, and AY536541.

[0073] It is also disclosed herein that several JCV capsid polypeptides (or fragments thereof) can be used to elicit an immune response to JCV, for example, in combination with one or more BKV capsid polypeptides. In several embodiments, the JCV capsid polypeptide comprises or consists of the amino acid sequence set forth as SEQ ID NOs: 17-23. In some embodiments, the polyomavirus capsid polypeptides (such as BKV or JCV capsid polypeptides) of use in the methods disclosed herein have a sequence at least 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, or 99%, such as 100% identical to the amino acid sequence set forth in one of SEQ ID NOs: 1-23 or 52-125. In other examples, the polyomavirus capsid polypeptides (such as BKV VP1 polypeptides) comprise a sequence at least 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, or 99%, such as 100% identical to the amino acid sequence set forth in one of SEQ ID NOs: 126-158. In some examples, the BKV subtype or serotype of the polypeptide is known. In other examples, the BKV subtype or serotype of the polypeptide is not known. One of ordinary skill in the art can determine the BKV subtype or serotype of an unknown BKV capsid polypeptide, for example by sequence analysis and ELISA or neutralizing assays (such as those described in Examples 1-3, below). Exemplary sequences can be obtained using computer programs that are readily available on the internet and the amino acid sequences set forth herein. In one example, the polypeptide retains a function of the polyomavirus capsid polypeptide, such as binding to an antibody that specifically binds the polyomavirus epitope.

[0074] Minor modifications of a polyomavirus capsid polypeptide primary amino acid sequences may result in peptides which have substantially equivalent activity as compared to the unmodified counterpart polypeptide described herein. Such modifications may be deliberate, as by site-directed mutagenesis, or may be spontaneous. All of the polypeptides produced by these modifications are included herein. Thus, a specific, non-limiting example of a polyomavirus capsid polypeptide is a conservative variant of the polyomavirus capsid polypeptide (such as a single conservative amino acid substitution, for example, one or more conservative amino acid substitutions, for example 1-10 conservative substitutions, 2-5 conservative substitutions, 4-9 conservative substitutions, such as 1, 2, 5 or 10 conservative substitutions). A table of conservative substitutions is provided herein. Substitutions of the amino acids sequence shown in SEQ ID NOs: 1-23 or 52-158 can be made based on this table.

[0075] An "epitope" or "antigenic determinant" refers to a site on an antigen to which B and/or T cells respond. T cells can respond to the epitope when the epitope is presented in conjunction with an MHC molecule. Epitopes can be formed both from contiguous amino acids (linear) or noncontiguous amino acids juxtaposed by tertiary folding of an antigenic polypeptide (conformational). Epitopes formed from contiguous amino acids are typically retained on exposure to denaturing solvents whereas epitopes formed by tertiary folding are typically lost on treatment with denaturing solvents. Normally, a B-cell epitope will include at least about 5 amino acids but can be as small as 3-4 amino acids. A T-cell epitope, such as a CTL epitope,

will include at least about 7-9 amino acids, and a helper T-cell epitope at least about 12-20 amino acids. Normally, an epitope will include between about 5 and 15 amino acids, such as 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, or 15 amino acids. In some examples, the immunogenic compositions disclosed herein include a fragment (such as an immunogenic fragment) or antigenic determinant of a polyomavirus capsid protein. One of skill in the art can identify predicted antigenic determinants, for example using an HLA peptide binding prediction program, such as BIMAS (www.bimas.cit.nih.gov/molbio/hla_bind/) or IEDB analysis resource (immuneptiope.org). In some examples, the polyomavirus capsid polypeptide includes, consists essentially of, or consists of five or more amino acids (for example, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, or 23 amino acids) of the VP1 BC loop (e.g., amino acids 61-83 of a BKV VP1 polypeptide; see, e.g., Tremolada et al., *Virus Res.* 149:190-196, 2010).

[0076] The polyomavirus capsid polypeptides disclosed herein can be chemically synthesized by standard methods, or can be produced recombinantly. An exemplary process for polypeptide production is described in Lu et al., *FEBS Lett.* 429:31-35, 1998. They can also be isolated by methods including preparative chromatography and immunological separations. Polypeptides can also be produced using molecular genetic techniques, such as by inserting a nucleic acid encoding at least one polyomavirus capsid polypeptide or an epitope thereof into an expression vector, introducing the expression vector into a host cell, and isolating the polypeptide. Any suitable cell can be utilized to express the disclosed polypeptides, including bacteria (e.g., *E. coli*), yeast, insect cells (e.g., Sf9 cells), or mammalian cells (e.g., 293 cells). In some examples, the polypeptide spontaneously assembles into a virus-like particle (VLP).

[0077] In some examples, the disclosed polyomavirus capsid polypeptides (or fragments thereof), for example a capsid polypeptide comprising the amino acid sequence of one or more of SEQ ID NOs: 1-23 or 52-125, are a part of a VLP, such as a BKV-I VLP, BKV-II VLP, BKV-III VLP, BKV-IV VLP, or JCV VLP. Immunogens are typically presented multimerically (e.g., about 72 pentamers or about 360 capsid polypeptides per VLP particle) to immune cells such as B cells and antigen presenting cells. This results in effectively inducing immune responses against the immunogen, in particular, antibody responses. In some examples, the VLP includes one or more of VP1, VP2, and VP3 (such as 1, 2, or all 3) from BKV-I (such as BKV-Ia, BKV-Ib1, BKV-Ib2, and/or BKV-Ic), BKV-II, BKV-III, BKV-IV (such as BKV-IVb1 and/or BKV-IVc2), or JCV.

[0078] The antigen that is part of the disclosed VLPs can include one or more of the amino acid sequences set forth as SEQ ID NOs: 1-23 or 52-158 (or fragments thereof) and have the ability to spontaneously assemble into VLPs. In some examples, a VLP includes a BKV-I VP1 polypeptide (such as one of SEQ ID NOs: 1, 13, 14, or 15) and a BKV-I VP2 polypeptide (such as SEQ ID NO: 2) and/or BKV-I VP3 polypeptide (such as SEQ ID NO: 3). In other examples, a VLP includes a BKV-I VP1 polypeptide (such as one of SEQ ID NOs: 1, 13, 14, or 15) and a BKV-IV VP2 polypeptide (such as SEQ ID NO: 5) and/or BKV-IV VP3 polypeptide (such as SEQ ID NO: 6). In other examples, a VLP includes a BKV-II VP1 polypeptide (such as SEQ ID NO: 7) and a BKV-II VP2 polypeptide (such as SEQ ID NO: 8) and/or BKV-II VP3 polypeptide (such

as SEQ ID NO: 9). In other examples, a VLP includes a BKV-II VP1 polypeptide (such as SEQ ID NO: 7) and a BKV-IV VP2 polypeptide (such as SEQ ID NO: 5) and/or BKV-IV VP3 polypeptide (such as SEQ ID NO: 6). In additional examples, a VLP includes a BKV-III VP1 polypeptide (such as SEQ ID NO: 10) and a BKV-III VP2 polypeptide (such as SEQ ID NO: 11) and/or BKV-III VP3 polypeptide (such as SEQ ID NO: 12). In other examples, a VLP includes a BKV-III VP1 polypeptide (such as SEQ ID NO: 10) and a BKV-IV VP2 polypeptide (such as SEQ ID NO: 5) and/or BKV-IV VP3 polypeptide (such as SEQ ID NO: 6). In still further examples, a VLP includes a BKV-IV VP1 polypeptide (such as one of SEQ ID NOs: 4 and 16) and a BKV-IV VP2 polypeptide (such as SEQ ID NO: 5) and/or BKV-IV VP3 polypeptide (such as SEQ ID NO: 6). In another example, a VLP includes a JCV VP1 polypeptide (such as one of SEQ ID NOs: 17, 20, or 21) and a JCV VP2 polypeptide (such as SEQ ID NO: 22) and/or JCV VP3 polypeptide (such as SEQ ID NO: 23).

[0079] In further examples, a fragment of a disclosed polyomavirus capsid polypeptide retains the ability to spontaneously assemble into VLPs. Fragments (such as immunogenic fragments) and variants can be of varying length. For example, a fragment may consist of six or more, 25 or more, 50 or more, 75 or more, 100 or more, or 200 or more amino acid residues of a polyomavirus capsid amino acid sequence. This includes, for example, any polypeptide six or more amino acid residues in length that is capable of spontaneously assembling into VLPs. Methods to assay for VLP formation and isolation of VLPs are well known in the art (see, for example, Pastrana et al., PLoS Pathogens 5(9):e1000578, 2009).

[0080] Polynucleotides encoding the BKV capsid polypeptides disclosed herein are also provided. Exemplary nucleic acid sequences are set forth as SEQ ID NOs: 24-35. Polynucleotides encoding the JCV capsid polypeptides disclosed herein are also provided. Exemplary nucleic acid sequences are set forth as SEQ ID NOs: 36-38.

[0081] The nucleic acids encoding the BKV capsid polypeptides may be codon-optimized for expression in a heterologous system (such as mammalian cells, bacteria or yeast). Exemplary nucleic acid sequences codon-optimized for mammalian cells are set forth as SEQ ID NOs: 39-51 (although the codon-optimized sequences can still be expressed in other systems, such as bacteria).

[0082] As disclosed herein, the nucleic acid sequences encoding polyomavirus capsid polypeptides (such as BKV or JCV capsid polypeptides) of use in the methods disclosed herein have a sequence at least 85%, 90%, 95%, 96%, 97%, 98%, or 99%, such as 100% identical to the nucleic acid sequence set forth in one of SEQ ID NOs: 24-51. Exemplary sequences can be obtained using computer programs that are readily available on the internet and the nucleic acid sequences set forth herein. In one example, the polypeptide encoded by the nucleic acid sequence retains a function of the polyomavirus capsid polypeptide, such as binding to an antibody that specifically binds the polyomavirus epitope.

V. Pharmaceutical Compositions and Modes of Administration

[0083] The polyomavirus capsid polypeptides (or fragments thereof) disclosed herein, or nucleic acids encoding the polyomavirus capsid polypeptides, can be used to elicit an immune response in a subject. In several examples, the subject is infected with at least one BKV serotype or is at risk of being infected with a BKV serotype (such as one or more of BKV-I, BKV-II, BKV-III, or BKV-IV) and/or JCV. The methods may include administering to a subject a therapeutically effective amount of one or more of the polyomavirus capsid polypeptides (or fragments thereof) disclosed herein (or polynucleotides encoding these polypeptides) in order to elicit an immune response, such as, but not limited to, a protective immune response.

[0084] In the disclosed methods, compositions are administered to a subject in an amount sufficient to produce an immune response to a polyomavirus (for example, BKV). The disclosed BKV polypeptides, VLPs including the BKV polypeptides, or polynucleotides encoding these polypeptides, are of use to inhibit (or even prevent) an infection with BKV in a subject, inhibit (or even prevent) progression to disease in a subject having a latent BKV infection, or to inhibit or treat BKV-associated disorders (for example, PVAN or BKV-associated hemorrhagic cystitis) in a subject infected with BKV. In several examples, administration of a therapeutically effective amount of a composition including one or more BKV serotype-specific capsid polypeptides (or fragments thereof) disclosed herein (or polynucleotides encoding these polypeptides) induces a sufficient immune response to decrease a symptom of a disease due to BKV infection, to inhibit the development of one or more symptoms of BKV or a BKV-associated disorder, or to inhibit infection with BKV (such as a BKV serotype, for example, BKV-I, BKV-II, BKV-III, and/or BKV-IV).

[0085] In some examples, the compositions are of use in inhibiting or even preventing a future infection with BKV. Thus, in some examples, a therapeutically effective amount of the composition is administered to a subject at risk of becoming infected with BKV (for example, an immunocompromised subject or a subject who has received or is a candidate for an organ transplant). The composition inhibits the development of BKV, such as latent or active BKV infection, in the subject upon subsequent exposure to BKV, or loss of immunological control over an existing BKV infection (for example reactivation of a latent infection).

[0086] The methods may further include administering to a subject a therapeutically effective amount of one or more of the JCV capsid polypeptides (or fragment thereof) disclosed herein (or polynucleotides encoding these polypeptides) in order to elicit an immune response, such as, but not limited to, a protective immune response against JCV. In some examples, the compositions are of use in inhibiting or even preventing a future infection with JCV. Thus, in some examples, a therapeutically effective amount of the composition is administered to a subject at risk of becoming infected with JCV (for example, an immunocompromised subject or a subject who has or is a candidate for organ transplantation). The composition inhibits or prevents the development of JCV, such as latent or active JCV infection, in the subject upon subsequent exposure to JCV, or loss of immunological control over an existing JCV infection (for example reactivation of a latent infection). In some examples, the disclosed methods and compositions inhibit or treat JCV-associated disorders (for example, JCV-associated PML) in a

subject infected with JCV. In particular examples, the subject is at risk of developing JCV-associated PML, such as a subject infected with HIV, a subject on immune-suppressing therapy (for example, mycophenolate, fludarabine, methotrexate, rituximab, natalizumab, alemtuzumab, or efalizumab), or a subject who has, or is a candidate for, organ transplantation (such as a bone marrow transplant).

[0087] Amounts effective for these uses will depend upon the severity of the disease, the general state of the subject's health, and the robustness of the subject's immune system. In one example, a therapeutically effective amount of the compound is that which provides either subjective relief of a symptom or an objectively identifiable improvement as noted by the clinician or other qualified observer. In other examples, a therapeutically effective amount is an amount sufficient to inhibit an infection with BKV (such as BKV-I, BKV-II, BKV-III, and/or BKV-IV) in a subject upon subsequent exposure of the subject to one or more BKV serotypes. In additional examples, a therapeutically effective amount is an amount sufficient to inhibit development of one or more symptoms in a subject infected with BKV (for example, PVAN or BKV-associated hemorrhagic cystitis).

[0088] In further examples, a therapeutically effective amount is an amount sufficient to inhibit an infection with JCV in a subject upon subsequent exposure of the subject to one or more JCV serotypes or inhibit the emergence of an existing JCV infection from asymptomatic latency in a subject. In additional examples, a therapeutically effective amount is an amount sufficient to inhibit development of one or more symptoms in a subject infected with JCV (for example, JCV-associated PML).

[0089] In some examples, one or more polyomavirus capsid polypeptides (such as BKV or JCV capsid polypeptides) or fragments thereof described herein may be covalently linked to at least one other immunogenic protein, wherein the conjugate elicits an immune response to the polyomavirus capsid polypeptide in a subject. The other immunogenic protein (sometimes referred to as a "carrier" protein) ideally has the properties of being immunogenic by itself, usable in a subject, and of a size that can be easily purified and conjugated to at least one other protein or peptide. Suitable carrier proteins are known to one of skill in the art. In particular examples, the other immunogenic protein (carrier protein) is bovine serum albumin (BSA), ovalbumin, tetanus toxoid, diphtheria toxoid, cholera toxin, *Clostridium difficile* toxin A, *C. difficile* toxin B, Shiga toxin, or *Pseudomonas aeruginosa* recombinant exoprotein A.

[0090] A polyomavirus capsid polypeptide can be administered by any means known to one of skill in the art (see Banga, A., "Parenteral Controlled Delivery of Therapeutic Peptides and Proteins," in Therapeutic Peptides and Proteins, Technomic Publishing Co., Inc., Lancaster, PA, 1995) either locally or systemically, such as by intramuscular injection, subcutaneous injection, intraperitoneal injection, intravenous injection, oral administration, nasal administration, transdermal administration, or even anal administration. Administration may be by oral administration, subcutaneous injection, or intramuscular injection.

[0091] In one specific, non-limiting example, the polyomavirus capsid polypeptide is

administered in a manner to direct the immune response to a cellular response (that is, a helper T cell or cytotoxic T lymphocyte (CTL) response), rather than a humoral (antibody) response.

[0092] To extend the time during which the peptide or protein is available to stimulate a response, the peptide or protein can be provided as an implant, an oily injection, or as a particulate system. The particulate system can be a microparticle, a microcapsule, a microsphere, a nanocapsule, or similar particle, (see, e.g., Banga, *supra*). A particulate carrier based on a synthetic polymer has been shown to act as an adjuvant to enhance the immune response, in addition to providing a controlled release. Aluminum salts can also be used as adjuvants to produce an immune response.

[0093] Optionally, one or more cytokines, such as IL-2, IL-6, IL-12, RANTES, GM-CSF, TNF- α , or IFN- γ , one or more growth factors, such as GM-CSF or G-CSF; one or more molecules such as OX-40L or 4-1 BBL, or combinations of these molecules, can be used as biological adjuvants (see, for example, Salgaller et al., 1998, J. Surg. Oncol. 68(2):122-38; Lotze et al., 2000, Cancer J. Sci. Am. 6(Suppl 1):S61-6; Cao et al., 1998, Stem Cells 16(Suppl 1):251-60; Kuiper et al., 2000, Adv. Exp. Med. Biol. 465:381-90). These molecules can be administered systemically (or locally) to the host. In several examples, IL-2, RANTES, GM-CSF, TNF- α , IFN- γ , G-CSF, LFA-3, CD72, B7-1, B7-2, B7-1 B7-2, OX-40L, 4-1 BBL, and/or ICAM-1 are administered.

[0094] A pharmaceutical composition including one or more polyomavirus capsid polypeptide is thus provided. These compositions are of use to promote an immune response to polyomavirus, such as a BKV serotype-specific response. In some examples, the disclosed compositions include a BKV-IV capsid polypeptide (or a fragment thereof), a BKV-I capsid polypeptide (or a fragment thereof), and a pharmaceutically acceptable carrier. In particular examples, the compositions include a VLP including at least one BKV-IV capsid polypeptide, a VLP including at least one BKV-I capsid polypeptide, and a pharmaceutically acceptable carrier. In other examples, the composition includes a VLP including at least one BKV-Ia capsid polypeptide, a VLP including at least one BKV-Ib2 capsid polypeptide, a VLP including at least one BKV-IV capsid polypeptide, and a pharmaceutically acceptable carrier. In some examples, the compositions further include at least one BKV-II capsid polypeptide, at least one BKV-III capsid polypeptide and/or at least one JCV capsid polypeptide (such as one or more VLPs including at least one BKV-II capsid polypeptide, at least one BKV-III capsid polypeptide, and/or at least one JCV capsid polypeptide). In some embodiments, the compositions include one or more adjuvants.

[0095] For example, the polyomavirus capsid polypeptide can be mixed with an adjuvant containing two or more of a stabilizing detergent, a micelle-forming agent, and an oil. Suitable stabilizing detergents, micelle-forming agents, and oils are detailed in U.S. Patent No. 5,585,103; U.S. Patent No. 5,709,860; U.S. Patent No. 5,270,202; and U.S. Patent No. 5,695,770. A stabilizing detergent is any detergent that allows the components of the emulsion to remain as a stable emulsion. Such detergents include polysorbate, 80 (TWEEN) (Sorbitan-

mono-9-octadecenoate-poly(oxy-1,2-ethanediyl; manufactured by ICI Americas, Wilmington, DE), TWEEN 40™, TWEEN 20™, TWEEN 60™, ZWITTERGENT™ 3-12, TEEPOL HB7™, and SPAN 85™. These detergents are usually provided in an amount of approximately 0.05 to 0.5%, such as at about 0.2%. A micelle forming agent is an agent which is able to stabilize the emulsion formed with the other components such that a micelle-like structure is formed. Such agents generally cause some irritation at the site of injection in order to recruit macrophages to enhance the cellular response. Examples of such agents include polymer surfactants described by BASF Wyandotte publications, *e.g.*, Schmolka, J. Am. Oil. Chem. Soc. 54:110, 1977; and Hunter et al., J. Immunol. 127:1244-1250, 1981; for example, PLURONIC™ L62LF, L101, and L64, PEG1000, and TETRONIC™ 1501, 150R1, 701, 901, 1301, and 130R1. The chemical structures of such agents are well known in the art. In one embodiment, the agent is chosen to have a hydrophile-lipophile balance (HLB) of between 0 and 2, as defined by Hunter and Bennett, J. Immunol. 133:3167-3175, 1984. The agent can be provided in an effective amount, for example between 0.5 and 10%, or in an amount between 1.25 and 5%.

The oil included in the composition is chosen to promote the retention of the antigen in oil-in-water emulsion, such as to provide a vehicle for the desired antigen, and preferably has a melting temperature of less than 65°C such that emulsion is formed either at room temperature (about 20°C to 25°C), or once the temperature of the emulsion is brought down to room temperature. Examples of such oils include squalene, squalane, EICOSANE™, tetratetracontane, glycerol, and peanut oil or other vegetable oils. In one specific, non-limiting example, the oil is provided in an amount between 1 and 10%, or between 2.5 and 5%. The oil should be both biodegradable and biocompatible so that the body can break down the oil over time, and so that no adverse affects, such as granulomas, are evident upon use of the oil.

[0096] The example can be a mixture of stabilizing detergents, micelle-forming agent, and oil available under the name PROVAX® (IDEC Pharmaceuticals, San Diego, CA). An adjuvant can also be an immunostimulatory nucleic acid, such as a nucleic acid including a CpG motif, or a biological adjuvant (see above).

[0097] Controlled release parenteral formulations can be made as implants, oily injections, or as particulate systems. For a broad overview of protein delivery systems, see Banga, Therapeutic Peptides and Proteins: Formulation, Processing, and Delivery Systems, Technomic Publishing Company, Inc., Lancaster, PA, 1995. Particulate systems include microspheres, microparticles, microcapsules, nanocapsules, nanospheres, and nanoparticles. Microcapsules contain the therapeutic protein as a central core. In microspheres, the therapeutic agent is dispersed throughout the particle. Particles, microspheres, and microcapsules smaller than about 1 µm are generally referred to as nanoparticles, nanospheres, and nanocapsules, respectively. Capillaries have a diameter of approximately 5 µm so that only nanoparticles are administered intravenously. Microparticles are typically around 100 µm in diameter and are administered subcutaneously or intramuscularly (see Kreuter, Colloidal Drug Delivery Systems, J. Kreuter, ed., Marcel Dekker, Inc., New York, NY, pp. 219-342, 1994; Tice & Tabibi, Treatise on Controlled Drug Delivery, A. Kydonieus, ed., Marcel Dekker, Inc. New York, NY, pp. 315-339, 1992).

[0098] Polymers can be used for controlled release. Various degradable and nondegradable polymeric matrices for use in controlled drug delivery are known in the art (Langer, Accounts Chem. Res. 26:537, 1993). For example, the block copolymer, polaxamer 407 exists as a viscous yet mobile liquid at low temperatures but forms a semisolid gel at body temperature. It has shown to be an effective vehicle for formulation and sustained delivery of recombinant interleukin-2 and urease (Johnston et al., Pharm. Res. 9:425, 1992; and Pec, J. Parent. Sci. Tech. 44(2):58, 1990). Alternatively, hydroxyapatite has been used as a microcarrier for controlled release of proteins (Ijntema et al., Int. J. Pharm. 112:215, 1994). In yet another aspect, liposomes are used for controlled release as well as drug targeting of the lipid-capsulated drug (Betageri et al., Liposome Drug Delivery Systems, Technomic Publishing Co., Inc., Lancaster, PA, 1993). Numerous additional systems for controlled delivery of therapeutic proteins are known (e.g., U.S. Patent Nos. 5,055,303; 5,188,837; 4,235,871; 4,501,728; 4,837,028; 4,957,735; 5,019,369; 5,055,303; 5,514,670; 5,413,797; 5,268,164; 5,004,697; 4,902,505; 5,506,206; 5,271,961; 5,254,342; and 5,534,496).

[0099] Alternatively, a pharmaceutical composition can include a nucleic acid encoding a polyomavirus capsid polypeptide or fragment thereof (for example, a BKV or JCV capsid polypeptide or fragment). A therapeutically effective amount of the BKV or JCV capsid polynucleotide can be administered to a subject in order to generate an immune response.

[0100] One approach to administration of nucleic acids is direct immunization with plasmid DNA, such as with a mammalian expression plasmid. For example, the nucleotide sequence encoding a polyomavirus capsid polypeptide can be placed under the control of a promoter to increase expression of the molecule.

[0101] Immunization by nucleic acid constructs is well known in the art and taught, for example, in U.S. Patent No. 5,643,578 (which describes methods of immunizing vertebrates by introducing DNA encoding a desired antigen to elicit a cell-mediated or a humoral response), and U.S. Patent Nos. 5,593,972 and 5,817,637 (which describe operably linking a nucleic acid sequence encoding an antigen to regulatory sequences enabling expression). U.S. Patent No. 5,880,103 describes several methods of delivery of nucleic acids encoding immunogenic peptides or other antigens to an organism. The methods include liposomal delivery of the nucleic acids (or of the synthetic peptides themselves), and immune-stimulating constructs, or ISCOMS™ (negatively charged cage-like structures of 30-40 nm in size formed spontaneously on mixing cholesterol and saponin). Protective immunity has been generated in a variety of experimental models of infection, including toxoplasmosis and Epstein-Barr virus-induced tumors, using ISCOMS™ as the delivery vehicle for antigens (Mowat and Donachie, Immunol. Today 12:383, 1991). Doses of antigen as low as 1 µg encapsulated in ISCOMS™ have been found to produce Class I mediated CTL responses (Takahashi et al., Nature 344:873, 1990).

[0102] Optionally, one or more cytokines, such as IL-2, IL-6, IL-12, RANTES, GM-CSF, TNF-α, or IFN-γ, one or more growth factors, such as GM-CSF or G-CSF, one or more costimulatory molecules, such as ICAM-1, LFA-3, CD72, B7-1, B7-2, or other B7 related molecules; one or more molecules such as OX-40L or 4-1 BBL, or combinations of these molecules, can be used

as biological adjuvants (see, for example, Salgaller et al., 1998, J. Surg. Oncol. 68(2):122-38; Lotze et al., 2000, Cancer J. Sci. Am. 6(Suppl 1):S61-6; Cao et al., 1998, Stem Cells 16(Suppl 1):251-60; Kuiper et al., 2000, Adv. Exp. Med. Biol. 465:381-90). These molecules can be administered systemically to the host. It should be noted that these molecules can be co-administered via insertion of a nucleic acid encoding the molecules into a vector, for example, a recombinant pox vector (see, for example, U.S. Pat. No. 6,045,802). In various embodiments, the nucleic acid encoding the biological adjuvant can be cloned into same vector as the BKV polypeptide coding sequence, or the nucleic acid can be cloned into one or more separate vectors for co-administration.

[0103] Alternatively, a nucleic acid encoding a polyomavirus capsid polypeptide can be introduced directly into cells. For example, the nucleic acid can be loaded onto gold microspheres by standard methods and introduced into the skin by a device such as the Helios™ Gene Gun (Bio-Rad, Hercules, CA). The nucleic acids can be "naked," consisting of plasmids under control of a strong promoter. Typically, the DNA is injected into muscle, although it can also be injected directly into other sites. Dosages for injection are usually around 0.5 µg/kg to about 50 mg/kg, and typically are about 0.005 mg/kg to about 5 mg/kg (see, for example, U.S. Patent No. 5,589,466).

[0104] In one specific, non-limiting example, a pharmaceutical composition for intravenous administration would include about 0.1 µg to 100 mg of immunogenic polyomavirus capsid polypeptide (or fragment thereof) per patient per day. Dosages from 0.1 to about 100 mg per patient per day (for example, about 10 mg to 50 mg) can be used, particularly if the agent is administered to a secluded site and not into the circulatory or lymph system, such as into a body cavity or into a lumen of an organ. In other non-limiting examples, the pharmaceutical composition includes one or more VLPs including the disclosed polyomavirus capsid polypeptides, for example about 1-200 µg VLP (such as about 10 µg to 200 µg, about 20 µg to 100 µg, or about 20 µg to about 40 µg).

[0105] In some examples, the compositions include pharmaceutically acceptable carriers and/or one or more adjuvants. Actual methods for preparing administrable compositions will be known or apparent to those skilled in the art and are described in more detail in such publications as Remington: The Science and Practice of Pharmacy, The University of the Sciences in Philadelphia, Editor, Lippincott, Williams, & Wilkins, Philadelphia, PA, 21st Edition (2005).

[0106] The administration of the polyomavirus capsid polypeptides (or fragments thereof), VLPs including the polypeptides, or nucleic acids encoding the polypeptides can be sequential, simultaneous (concurrent), or substantially simultaneous. Sequential administration can be separated by any amount of time, so long as the desired effect is achieved. In some examples a BKV-I capsid polypeptide or fragment thereof and a BKV-IV capsid polypeptide or fragment thereof are administered to a subject sequentially. In other examples, a BKV-I capsid polypeptide or fragment thereof and a BKV-IV capsid polypeptide or fragment thereof are administered to a subject simultaneously or substantially simultaneously.

[0107] In some examples, the effectiveness of the therapeutic or preventive intervention is monitored by titering the BKV or JCV neutralizing potential of the subject's serum antibody responses over time. Subjects who are found to have been poorly responsive to initial therapeutic interventions, such as but not limited to immunization with BKV or JCV capsid proteins, are given one or more booster doses of the therapeutic intervention.

[0108] Multiple administrations of the compositions described herein are also contemplated. Single or multiple administrations of the compositions are administered, depending on the dosage and frequency as required and tolerated by the subject. The dosage may be administered once as a bolus, or alternatively can be applied periodically until a therapeutic result is achieved. The dose may be sufficient to treat or ameliorate symptoms or signs of BKV and/or JCV without producing unacceptable toxicity to the subject. The dose may be sufficient to inhibit infection with BKV upon subsequent exposure to BKV. The dose may be sufficient to inhibit infection with JCV upon subsequent exposure to JCV. The dose may be sufficient to inhibit a symptom of BKV in a subject with a latent BKV infection. In another embodiment, the dose is sufficient to inhibit a symptom of JCV in a subject with a latent JCV infection. Systemic or local administration can be utilized.

VI. Methods of Monitoring Immune Response to Polyomavirus

[0109] Also disclosed herein are methods of monitoring an immune response to polyomavirus, for example, following exposure (or potential exposure) to polyomavirus or following immunization against polyomavirus. In some examples, the methods include detecting the presence of polyomavirus antibodies in a subject that has been administered an immunogenic composition comprising at least one isolated BKV capsid polypeptide (or fragment thereof) or a nucleic acid encoding a BKV capsid polypeptide. In other examples, the methods include detecting the presence of polyomavirus antibodies in a subject that has been administered an immunogenic composition comprising at least one isolated JCV capsid polypeptide (or fragment thereof) or a nucleic acid encoding a JCV capsid polypeptide. In some examples, the method includes detecting the presence of polyomavirus antibodies (such as neutralizing antibodies) in a sample from a subject (such as a blood sample or serum sample). The polyomavirus antibodies include one or more of BKV-I antibodies (such as BKV-Ia antibodies, BKV-Ib2 antibodies, and/or BKV-Ic antibodies), BKV-II antibodies, BKV-III antibodies, BKV-IV antibodies (such as BKV-IVb1 antibodies and/or BKV-IVc2 antibodies), or JCV antibodies. In some examples, the antibodies are neutralizing antibodies. In some non-limiting examples, the antibodies are BKV-Ia neutralizing antibodies, BKV-Ib2 neutralizing antibodies, or BKV-IV neutralizing antibodies. Monitoring immune response to polyomavirus can indicate whether a subject has developed an immune response (for example, a protective immune response) to one or more polyomaviruses, for example, following administration of an immunogenic composition (for example, as described above). Monitoring immune response to polyomavirus can also indicate whether a subject has seroconverted for one or more polyomaviruses (for example, BKV-I and/or BKV-IV) following an organ transplant or immunosuppressive therapy.

In some examples, multiple samples from a subject are tested for presence of antibodies over time, for example prior to and at time points after (such as 1 week, 2 weeks, 1 month, 2 months, 3 months, 6 months, 9 months, 1 year, or more after) administration of an immunogenic composition, organ transplantation or start of immunosuppressive therapy.

[0110] Methods for detecting antibodies in a sample are known to one of skill in the art. Such methods include but are not limited to ELISA, immunofluorescence assay, radioimmunoassay, and micro-agglutination test. In some examples, the methods include detecting the presence of neutralizing antibodies (such as BKV serotype-specific neutralizing antibodies) in a sample from a subject. In some examples, assays for detecting neutralizing antibodies include plaque reduction neutralization test, cell killing, and reporter assays.

[0111] In a particular example, neutralizing antibodies are detected using a reporter assay. BKV or JCV reporter vectors (also known as pseudovirions) are produced by packaging a reporter plasmid in cells (such as 293 cells, for example 293TT cells or 293FT cells for BKV or SVG cells for JCV) expressing a BKV (such as BKV-I, BKV-II, BKV-III, or BKV-IV) or JCV capsid polypeptide (for example, VP1, VP2, and/or VP3). The reporter vector particles are then isolated and treated with serial dilutions of serum from a subject (such as a series of four-fold dilutions from 1:100 to $1:2.6 \times 10^7$ or a series of 10-fold dilutions from 1:100 to 1×10^7). The serum/reporter vector mixture is then applied to fresh cells (for example 293 cells for BKV or SVG cells for JCV) for a period of time (such as 72 hours). The cell culture is then assayed for production of a reporter protein encoded by the reporter plasmid packaged within the reporter vector. A decrease in reporter vector activity (for example, as compared to a control, such as a no serum control) indicates the presence of neutralizing antibodies in the sample. In one example, the reporter plasmid carries an SV40 origin of replication, which can mediate replicative amplification of the transduced plasmid in the target cell. In a specific example, the reporter vector is phGluc (*Gaussia princeps* luciferase under the control of a human elongation factor 1 alpha promoter) and activity is detected using *Gaussia* luciferase substrate (New England Biolabs). See, e.g., Pastrana et al., PLoS Pathogens 5(9):e1000578, 2009. One of ordinary skill in the art can select additional reporters of use in neutralizing antibody assays, such as green fluorescent protein, β -galactosidase, alkaline phosphatase, and others.

[0112] The present disclosure is illustrated by the following non-limiting Examples.

Example 1

Materials and Methods

[0113] Mice: Eight-week old female BALB/cAnNCr mice were immunized once subcutaneously with 5 μ g of BKV-I or BKV-IV viral-like particles (VLPs) in complete Freund's Adjuvant (CFA, Sigma-Aldrich, St. Louis, MO). Sera were obtained 4 weeks after immunization. The animals

were kept under pathogen-free conditions in compliance with institutional guidelines at the National Cancer Institute.

[0114] Sera: Samples from 108 renal transplant subjects from the "Randomized Prospective Controlled Clinical and Pharmacoeconomic Study of Cyclosporine vs. Tacrolimus in Adult Renal Transplant Recipients" of the Washington University, School of Medicine were used. The patients and clinical protocols from the study have previously been described in detail (Bohl et al., *Am. J. Transplant.* 5:2213-2221; Randhawa et al., *Clin. Vaccine Immunol.* 15:1564-1571, 2008). Patients were given an immunosuppressive regimen, which was discontinued if viremia was detected. Serum samples were collected at roughly 1, 4, 12, 26 and 52 weeks post-transplantation. None of the patients were observed to suffer from PVAN during the course of the collection period. Sera from healthy subjects visiting U.S. plasma donation centers have been described in detail before (Pastrana et al., *PLoS Pathog.* 5:e1000578, 2009).

[0115] VLPs and reporter vectors (pseudovirions): BKV reporter vectors were generated as previously described (Pastrana et al., *PLoS Pathog.* 5:e1000578, 2009). BKV-I reporter vectors were produced using plasmid pCAG-BKV (Nakanishi et al., *Virology* 379:110-117, 2008), which encodes the capsid proteins of BKV isolate KOM-5 (SEQ ID NOs: 1-3). KOM-5 is classified as a BKV type I subtype b-1 (Ib-1) genotype (Nishimoto et al., *J. Mol. Evol.* 63:341-352, 2006), and was transfected into 293TT cells (Buck et al., *J. Virol.* 78:751-757, 2004) using Lipofectamine 2000 (Invitrogen, Carlsbad, CA). Then, 48 hours after transfection the cells were suspended at >100 million cells/ml in Dulbecco's phosphate buffered saline (DPBS) and lysed by addition of 0.5% Triton X-100, 25 mM ammonium sulfate (diluted from a 1M stock adjusted to pH 9) and RNase A/T1 cocktail (Ambion, Austin, TX). The lysate was incubated at 37°C overnight to allow capsid maturation, then clarified by spinning twice for 10 minutes at 5,000 x g, with gentle agitation of the lysate between spins. Reporter vector particles were purified out of the clarified supernatant through a 27-33-39% iodixanol (OptiPrep®, Sigma-Aldrich, St. Louis, MO) step gradient (Buck and Thompson, *Curr. Protoc. Cell Biol.* Chapter 26, Unit 26.21, 2007).

[0116] For BKV-IV particles the sequence of BKV isolate A-66H (subtype IV-c2; Zhong et al., *J. Gen. Virol.* 90:144-152, 2009) was used to design synthetic codon-modified versions of the VP1, VP2 and VP3 genes (SEQ ID NOs: 39-41). The codon-modified genes were synthesized by Blue Heron Biotechnology (Bothell, WA) and cloned into Gateway (Invitrogen) adapted mammalian expression plasmids pGwf (for VP1) or pHGf (for VP2 and VP3) (Buck et al., *Proc. Natl. Acad. Sci. USA* 103:1516-1521, 2006). An additional pair of plasmids, pwB2b and pwB3b, were generated by transferring the BKV-IV VP2 or VP3 (respectively) gene into the SV40 promoter-driven expression cassette of pwB. For BKV-IV reporter vector production, cells were co-transfected with pwB2b, pwB3b, ph2b, ph3b and pHGluc at a 2:2:1:1:1 ratio. Initial particle stocks produced without ph2b or ph3b in the co-transfection mixture appeared to show poor VP2/3 occupancy and relatively poor infectivity. Transfection, harvesting and purification of BKV-IV reporter vectors were the same as for production of BKV-I reporter vectors.

[0117] For generation of VLPs, 293TT cells were transfected with pCAG-BKV (BKV-I) or a mixture of pwB2b and pwB3b (BKV-IV) without any reporter plasmid. Two days after

transfection, the cells were lysed with 0.5% Triton X-100 in DPBS supplemented with 25 mM ammonium sulfate, Benzonase (Sigma-Aldrich), Plasmid Safe (Epicentre, Madison, WI), and 1.2 U/ml neuraminidase V (Sigma-Aldrich, Catalog No. N2876). The lysates were incubated at 37°C overnight, then adjusted to 0.85 M NaCl, clarified as above, and subjected to purification over OptiPrep® gradients.

[0118] ELISAs: Immulon™ H2B plates (Thermo Fisher Scientific, Waltham, MA) were coated with 15 ng/well of VLPs in PBS overnight. PBS with 1% non-fat dry milk (blotto) was used to block the coated plates for 2 hours at room temperature, with orbital rotation. Sera from mice and healthy human subjects were serially diluted in blotto and incubated on blocked plates at room temperature for 1 hour, with orbital rotation. Washing was performed with PBS. Horseradish peroxidase conjugated goat anti-mouse IgG (BioRad) or donkey anti-human IgG (Jackson ImmunoResearch, West Grove, PA) diluted 1:7500 in blotto was used to detect bound sera. The plates were incubated with ABTS (2,2-azino-di-[3-ethylbenzthiazoline sulfonate) substrate (Roche Applied Science, Indianapolis, IN) and absorbance read at 405 nm with a reference read at 490 nm. The effective concentration 10% (EC₁₀) was calculated using Prism® software (GraphPad Software, La Jolla, CA) to fit a curve to the OD values for each serially-diluted serum sample. The top of each response curve was constrained based on the average of the calculated plateau maximum (B_{max}) values for strongly reactive sera. The B_{max} value was typically an OD value of around 2.0, such that the EC₁₀ value can be considered comparable to an OD cutoff value of 0.2.

[0119] Neutralization Assays: Neutralization assays were performed as previously reported (Pastrana et al., PLoS Pathog. 5:e1000578, 2009). Briefly, 293TT cells were seeded at a density of 3×10^4 cells per well and allowed to attach for 3-5 hours. Sera from mice and human subjects were serially diluted, and sera from renal transplant patients were tested in separate assays at 4 different dilutions: 1:100, 1:500, 1:5,000, and 1:50,000. Dilutions were performed in cell culture medium (DMEM without phenol red supplemented with 25 mM HEPES, 10% heat-inactivated fetal bovine serum, 1% MEM non-essential amino acids, 1% Glutamax™ supplement and 1% antibiotic-antimycotic, all from Invitrogen). Then 24 µl of diluted sera were mixed with 96 µl of diluted reporter vector stock and placed at 4°C for 1 hour. Cells were incubated with 100 µl of this mixture for 72 hours. Conditioned supernatants (25 µl) were harvested into white 96-well luminometry plates (Perkin Elmer, Waltham, MA). Gaussia Luciferase Assay Kit substrate (50 µl, New England Biolabs, Ipswich, MA) was injected immediately prior to luminometry using a BMG Labtech Polarstar Optima luminometer.

[0120] For mice and sera from healthy individuals, 50% neutralizing titers (EC₅₀) were calculated based on dose-response curves with top and bottom values constrained to the average values of "no serum" and "no reporter vector" control wells, respectively. For transplant patients, the following criteria for seropositivity and seronegativity were adopted: sera were considered negative at entry if the 1:100 dilution did not mediate at least a 95% reduction in Gaussia luciferase activity (measured in relative light units, RLUs) relative to the no serum control condition (>95% neutralization of the reporter vector). Seroconversion refers

to subjects who scored seronegative at the initial time point but whose sera were >95% neutralizing at the 1:500 dilution at any subsequent time point. A stricter definition of seroconversion, accounting for the possible low level cross-type neutralization, added the stipulation that the 95% neutralizing titer for BKV-IV differed from the BKV-I neutralizing titer by less than 1,000 fold.

[0121] Sequence analysis: VP1 sequences from BKV strains indicated in Table 3 (below) were downloaded from GenBank (Pastrana et al., PLoS Pathogens 8:e1002650, 2012). ClustalW alignments were performed with MacVector software version 11.1.2 using a Gonnet series matrix. Structural modeling of BKV VP1 amino acid variations was performed by aligning the sequences of JCV or SV40 VP1 to BKV, followed by inspection of homologous positions of interest in the JCV or SV40 VP1 X-ray crystal structures (PDB ID accession numbers 3NXD and 1SVA, respectively). Structure inspections were performed using Swiss PDB Viewer.

Example 2

BKV Cross-Neutralizing Responses in Mouse Sera

[0122] This example describes serological cross-reactivity in mice immunized with VLPs from BKV-I or BKV-IV serotypes.

[0123] To determine if reactivity to one BKV type would generate cross-reactive antibodies, mice were immunized with VLPs containing the VP1, VP2, and VP3 capsid proteins from the two most common serotypes: BKV-I (BKV-Ib1 isolate KOM-5) or BKV-IV (BKV-IVc2 isolate A-66H). A single sub-cutaneous dose in the presence of Freund's adjuvant resulted in the development of high-titer responses. As measured by ELISA, all mice but one responded with titers against BKV-I ranging from 9000 to 110,000 (FIG. 1, top panel). The response in BKV-IV immunized mice was similar, with titers ranging from 13,000 to 130,000. The sera exhibited varying amounts of cross-reactivity against the non-cognate BKV. The average ratio of homologous to heterologous titer was 21 for mice immunized with BKV-I and 110 for mice immunized with BKV-IV (FIG. 1, bottom panel). For this calculation the non-responsive mouse was eliminated, as the denominator was not a true titer, but arbitrarily set at 25, or the lowest concentration tested.

[0124] In order to obtain more information on the cross-neutralizing responses, a reporter-vector based neutralizing assay was also utilized. These recombinant production systems made it possible to generate infectious capsids composed of the VP1/2/3 capsid proteins of BKV primary isolates of genotypes I and IV that are not otherwise culturable. Using the reporter-based assays, the neutralizing potency of sera from BKV-I or BKV-IV vaccinated mice were titrated. The neutralizing assay BKV-I, when compared to ELISAs, has been shown to have a broader linear range for detection of serum titers (Pastrana et al., PLoS Pathog.

5:e1000578, 2009), and a similar neutralization assay has also shown improved specificity in the context of papillomaviruses (Pastrana et al., Virology 321:205-216, 2004). The neutralization assays showed a significantly greater degree of BKV type-specificity compared to the ELISAs. For BKV-I immunized mice, homologous titers ranged from 1100 to 3,000,000 (FIG. 1, middle panel). The mouse that was non-reactive by ELISA showed a titer, of 1100, which was 55-fold lower than the next mouse with lower BKV-I titers. Mice immunized with BKV-IV had titers ranging from 17,000 to 600,000. The ratio of homologous to heterologous titer was 910 for mice immunized with BKV-I and 620 for mice immunized with BKV-IV. A comparison of ELISA values to neutralization assay values is shown in FIG. 2.

[0125] To test the possibility that a booster vaccination might alter the degree of cross-neutralization of the two BKV types, a second dose of cognate VLPs was administered to the mice (in incomplete Freund's adjuvant) one month after priming. Repeat serology was performed a total of two months after the initial priming dose. Hyperimmune sera from the boosted animals showed neutralizing ratios similar to the initial testing.

[0126] In addition, mice vaccinated with VLPs based on BKV-Ib2 had serum antibody responses that robustly neutralized the cognate BKV-Ib2 reporter pseudovirus but failed to effectively neutralize the BKC-Ia pseudovirus (Table 2). This result confirms that genotypes BKV-Ia and BKV-Ib2 are distinct serotypes.

Table 2. Single immunization of mice with BKV variants

		Neutralizing titer (log)						
		Ia	Ib2	Ic	II	III	IVb1	IVc2
IMMUNIZATION	Ia	6.6	3.9	3.6	2.7	neg	2.6	2.0
	Ib2	neg	4.5	3.6	neg	neg	2.3	neg
	Ic	3.7	3.6	4.2	neg	neg	2.8	neg
	II	2.1	3.5	3.2	4.5	3.5	3.6	3.1
	III	neg	3.5	3.3	3.4	4.0	2.9	2.9
	IVb1	neg	2.9	3.1	2.5	neg	4.6	4.1
	IVc2	neg	3.4	3.5	3.0	2.2	3.8	4.2
	All 7 types	4.0	3.9	4.1	4.6	4.0	4.7	4.7

[0127] Taken together, the data suggest that the neutralization assay has a larger quantitative dynamic range than ELISA and the neutralization assay is on average about 10 times better at distinguishing BKV type-specific titers (FIG. 1, bottom panel). It is possible that non-neutralizing cross-reactive anti-BKV antibodies are being detected in the ELISA assay but not in the neutralization assay. However, in the context of kidney transplantation, detection of type-specific neutralizing antibodies is more relevant, as only neutralizing antibodies would inhibit de novo infections with a new serotype or suppress latent infections with an existing BKV serotype.

Example 3

BKV Titers in Healthy Adults

[0128] Sera from 48 healthy adults with a median age of 52.5 years were assessed for reactivity to BKV-I and BKV-IV in ELISAs. Seroprevalence of different BKV types in these individuals is shown in Table 3. Of these, 83% were seropositive for BKV-I (FIG. 3, top panel), a figure similar to what has been reported in the literature (Egli et al., J. Infect. Dis. 199:837-846, 2009; Knowles et al., J. Med. Virol. 71:115-123, 2003). The geometric mean titer for anti-BKV-I sera was 550 and it ranged from a low of 60 to a high of 7100. In contrast, 65% of volunteers were seropositive for BKV-IV, but their geometric mean titer was only 150, even when they had a similar range (60 to 17,000). In the BKV-IV ELISA, only 18% (9 sera) had a titer higher or equal to 500, while in the BKV-I ELISA 54% (26 sera) reached this titer. There was also a statistically significant correlation between BKV-I and BKV-IV titers (Spearman $r = 0.69$, $p < 0.0001$). This correlation, along with the lower geometric mean titers and the knowledge that previous studies have only found 6-7% prevalence of BKV-IV DNA (Krumbholz et al., J. Med. Virol. 78:1588-1598, 2006), indicates that much of the BKV-IV seropositivity is attributable to cross-reactivity in the ELISA assay. The sera were therefore evaluated in the neutralization assay.

Table 3. Seroprevalence of BKV types in 48 healthy individuals

	Ia	Ib2	Ic	II	III	IVb1	IVc2
% Prevalence	79	52	63	58	28	17	28

[0129] For the neutralization assays, serum samples were serially diluted starting at 1:100. This is the lowest naive (rabbit) serum dilution that is consistently devoid of non-specific neutralizing activity (Pastrana et al., PLoS Pathog. 5:e1000578, 2009). Therefore EC_{50} values below this dilution could not be accurately calculated and were arbitrarily designated to have an EC_{50} of 100. Only 3 volunteers (6%) were negative for BKV-I neutralization. In contrast, 37 (77%) were negative for BKV-IV (FIG. 3, bottom panel). The geometric mean EC_{50} titers for BKV-I were also significantly higher (5100) than BKV-IV titers (180). There were three individuals with titers of more than 60,000 for BKV-I that were completely negative for BKV-IV neutralization. In contrast to the ELISA results, there was not a statistically significant correlation between the subjects' BKV-I and BKV-IV neutralizing titers. There were two individuals with BKV-I neutralizing titers of >100,000 whose sera did not detectably neutralize BKV-IV at the lowest tested dilution (1:100). This indicates that these individuals displayed BKV type specificity ratios of at least 1,000. A comparison of ELISA values to neutralization assay values is shown in FIG. 4. Overall, the results for the human sera confirm the observations using murine sera, suggesting that the neutralization assays offer a significantly greater degree of sensitivity and specificity for serological analysis of exposure to BKV-I and BKV-IV.

Example 4

BKV Type-Specific Seroconversion in Kidney Transplant Recipients

[0130] The anti-BKV-I and BKV-IV titers of 108 kidney transplant recipients were determined. An archived set of sera collected at time points of roughly 1, 4, 12, 26, and 52 weeks post-transplantation were tested in the neutralization assay. Each sample was tested at four dilutions: 100, 500, 5,000, and 50,000. Because of this lack of full serial dilution, a more stringent neutralization cutoff of 95% for individual data points was utilized. Neutralization assay results for individual subjects are shown in FIGS. 5 and 6. At entry, 5 patients (5%) were seronegative (<95% neutralizing at the 1:100 serum dilution) in the BKV-I neutralization assay (Table 4). In contrast, there were 53 initially BKV-IV seronegative subjects (49%). The patients were then assessed for seroconversion, defined as a change from seronegative at the first time point to at least 95% neutralization at the 1:500 serum dilution at any subsequent time point. All of the 5 initially seronegative BKV-I patients seroconverted for BKV-I, and 23 (43%) of the initially BKV-IV seronegative patients seroconverted for BKV-IV (Table 4).

Table 4. Seroconversion of kidney transplant recipients

Negative at entry (% total)		Seroconversion (% initial negative)		Stringent Seroconversion (% initial negative)	
BKV-I	BKV-IV	BKV-I	BKV-IV	BKV-I	BKV-IV
5 (5%)	53 (49%)	5 (100%)	23 (43%)	5 (100%)	12 (23%)

[0131] The average BKV type-specificity ratio for sera from immunized mice was 1359 (FIG. 1). Two human subjects likewise showed type-specificity ratios >1000 (FIG. 3). To address the possibility that BKV-IV neutralization might be partly attributable to cross-reactivity of high titer antibody responses elicited by BKV-I, a more stringent definition of seroconversion was applied, in which the ratio of the BKV-I titer versus the BKV-IV titer (or vice-versa) must be less than 1000 at least one time point to be considered a clear type-specific seroconversion event. Even with these stricter criteria, 12 (23%) of the BKV-IV negative patients seroconverted within a year of transplantation (Table 2). Based on the results shown in FIGS. 1 and 3, the occurrence of BKV type-specificity ratios of 10 or less seems highly unlikely. Five patients (5%) underwent BKV-IV-specific seroconversion by the extremely strict criterion of having a BKV-I to BKV-IV titer ratio ≤ 10 .

[0132] On average, the patients' BKV-I and BKV-IV neutralizing titers both increased substantially by one year after renal transplantation (FIG. 7). In some instances, titer increases occurred even in patients who showed moderate neutralizing antibody titers at study entry (FIGS. 5 and 6).

Example 5

BKV VP1 Protein Sequence Analysis

[0133] Full-length non-identical BKV VP1 peptide sequences available via GenBank were aligned (FIG. 8). The GenBank Accession numbers utilized to generate the alignment are provided in Table 5. Because it is not possible to distinguish between Ia and Ib1 subtypes based on VP1 amino acid sequences, BKV-Ia indicates genotypes Ia/Ib1 and BKV-Ib indicates genotype Ib2. It is also not possible to distinguish between BKV-IV subtypes based on VP1 amino acid sequences. Therefore, BKV-IV indicates genotypes IV-b1/IV-c2.

Table 5. GenBank Accession numbers of aligned BKV VP1 sequences

BKV type	GenBank Accession Number	SEQ ID NO:
Ia	BAE96059	52
Ia	CAA40239	53
Ia	BAF02957	54
Ia	AAT47395	55
Ia	AAT47401	56
Ia	BAF42979	57
Ia	ABI94689	58
Ia	ABI94671	59
Ia	AAT47365	60
Ia	AAT47389	61
Ia	YP_717939	62
Ia	AAT47371	63
Ia	CAA24307	64
Ia	AAT47413	65
Ia	AAT47419	66
Ia	BAF42937	67
Ia	ABI94725	68
Ia	AFA41877	69
Ia	AFA41907	70
Ia	AAT47425	71
Ia	AAT47431	72
Ia	CAA40243	73
Ia	AEK21505	74

BKV type	GenBank Accession Number	SEQ ID NO:
Ib	ABI94623	75
Ib	AFA41920	76
Ib	ABI94611	77
Ib	BAF42907	78
Ib	ABD04662	79
Ib	ABI94713	80
Ib	CBX88302	81
Ib	AFA41880	82
Ib	BAF93325	83
Ib	CAA40247	84
Ib	CBX88314	85
Ib	ABI94617	86
Ib	BAF93319	87
Ib	AAT47347	88
Ib	BAF93283	89
Ib	BAF03085	90
Ib	AFA41909	91
Ib	BAF03097	92
Ib	ABI94695	93
Ic	BAE53660	94
Ic	BAE53648	95
Ic	CAA40235	96
Ic	BAI43588	97
Ic	BAE53642	98
Ic	BAG75361	99
Ic	BAG75283	100
Ic	BAF76196	101
Ic	ABI94635	102
Ic	BAF02975	103
II	BAF42901	104
II	BAF42925	105
II	CAA79596	106
III	BAF03017	107
III	P14996	108
III	AEO89615	109

BKV type	GenBank Accession Number	SEQ ID NO:
IV	BAF03115	110
IV	BAE53654	111
IV	BAF75138	112
IV	BAE96077	113
IV	BAG75277	114
IV	BAF75102	115
IV	BAF03029	116
IV	BAF75180	117
IV	AFA41889	118
IV	BAF75096	119
IV	BAF75114	120
IV	AFA41881	121
IV	AFA41883	122
IV	AFA41885	123
IV	BAG84476	124
IV	BAF03035	125

[0134] With respect to the BKV-I consensus, BKV-IV isolates tend to carry a variety of substitutions: E61N, N62D, F66Y, K69R, S71T, N74T, D75A, S77D, E82D, Q117K, H139N, I178V, F225Y, A284P, R340Q, K353R, and L362V. Mapping of these BKV-I/BKV-IV variant residues onto homologous positions in the X-ray crystal structures of JCV (Neu et al., Cell Host Microbe 8:309-319, 2010) and SV40 (Stehle et al., Structure 4:165-182, 1996) suggested that, with the exception of positions 117, 225, 284, and 340, each of these BKV-I/BKV-IV variant residues is likely to be exposed on the exterior surface of the capsid. With the exception of residues 353 and 362, which are exposed along the floor of the canyons between capsomer knobs, all the exposed variations map to sites on the apical surface and apical rim of the capsomer knob. Many of the variations are adjacent to residues predicted to be involved in binding the cellular glycolipids that serve as receptors during BKV infectious entry (Dugan et al., J. Virol. 81:11798-11808, 2007; Low et al., J. Virol. 80:1361-1366, 2006). This is consistent with the idea that BKV-I/BKV-IV variations may alter epitopes recognized by antibodies that neutralize infectivity via steric occlusion of the receptor binding site.

[0135] In addition to the differences between BKV-I and BKV-IV, several positions differ stereotypically among BKV-I subtypes. For example, BKV subtype Ib-2 isolates tend to carry V42L, E82D, D175E, V210I, R340K, and L362V differences, with respect to subtypes Ia and Ib-1. Likewise, subtype Ic isolates frequently carry E20D, F225L, and R340K differences. Although these intra-genotype-I surface variations are chemically subtle, without being bound by theory, it is possible that the differences reflect selective pressure to escape neutralizing

antibodies.

[0136] In human subjects, it was found that 6 of 48 subjects with BKV-Ia neutralizing antibodies were not able to neutralize a BKV-Ib2 isolate (including VP1 polypeptide with the amino acid sequence of SEQ ID NO: 14). Analysis of mutant pseudoviruses that are recombinant chimeras of types Ia and Ib2, identified key amino acid residues that allow the Ib2 isolate to escape from Ia-neutralizing antibody response. The variations were in the VP1 BC loop and included E73K and E82D (Ia to Ib2 variations). Several other Ib2 variants and genotype Ic BC loop variations were partially resistant to Ia-neutralizing human sera. These additional variants included E73Q, S77N, E82Q, or combinations of these variations. These results suggest that an optimal BKV vaccine should include at least BKV-Ia and BKV-Ib2 VP1 polypeptides, in order to elicit antibodies capable of neutralizing all BKV-I variants. Furthermore, validation of a candidate vaccine should include screening serum from vaccinated subjects for neutralization of multiple BKV-I subtypes (such as at least BKV-Ia and BKV-Ib2 subtypes).

Example 6

Additional BKV VP1 Polypeptides

[0137] Additional BKV serotypes may remain to be discovered and fully sequenced. GenBank accession numbers CCF70703-CCF70735 report a portion of the VP1 protein encompassing the BC and EF loops. Some of these sequences contain previously unknown variations in the BC and EF loops. In some instances, the sequence fragments are more divergent from all published BKV VP1 sequences than BKV-I is from BKV-IV (FIG. 9). Based on the an alignment of these additional sequences with BKV-Ia, BKV-Ib, BKV-Ic, BKV-II, BKV-III, BKV-IVb1, and BKV-IVc2 VP1 sequences (FIG. 10), accession numbers CCF70725 (SEQ ID NO: 154), CCF70727 (SEQ ID NO: 153), CCF70729 (SEQ ID NO: 158), and CCF70730 (SEQ ID NO: 157) appear to represent portions of distinct BKV serotypes. The GenBank Accession numbers utilized to generate the alignment are provided in Table 6. The serological distinctiveness of these recently reported sequences can be determined, for example by isolating the remainder of these VP1 sequences and using the methods described in Examples 1 and 2. Polypeptides comprising these additional BKV VP1 polypeptides can be utilized in the disclosed methods and compositions. In some cases, the disclosed methods and compositions include one or more of SEQ ID NOs: 126-158.

Table 6. GenBank Accession Nos. of additional partial BKV VP1 sequences

GenBank Accession No.	SEQ ID NO:
CCF70703	126
CCF70704	127
CCF70705	128
CCF70706	129

GenBank Accession No.	SEQ ID NO:
CCF70707	130
CCF70708	131
CCF70709	132
CCF70710	133
CCF70711	134
CCF70712	135
CCF70713	136
CCF70714	137
CCF70715	138
CCF70716	139
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CCF70722	144
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CCF70726	147
CCF70728	148
CCF70732	149
CCF70733	150
CCF70734	151
CCF70735	152
CCF70727	153
CCF70725	154
CCF70731	155
CCF70721	156
CCF70730	157
CCF70729	158

Example 7**Methods of Eliciting an Immune Response to BKV**

[0138] This example provides exemplary methods for eliciting an immune response to one or more BKV serotypes in a subject. However, one of ordinary skill in the art will appreciate that methods that deviate from these specific methods can also be used to successfully elicit an immune response to BKV in a subject.

[0139] In particular examples, the method includes selecting a subject in need of enhanced immunity to BKV. Subjects in need of enhanced immunity to BKV include individuals who are immunocompromised and individuals who have had or are candidates for organ transplantation, for example a renal transplant or bone marrow transplant. Subjects in need of enhanced immunity to BKV also include individuals who are seronegative for at least one BKV serotype.

[0140] Subjects selected for treatment are administered a therapeutically effective amount of a disclosed immunogenic composition. In some examples, a therapeutically effective amount of one or more BKV-I capsid polypeptides (or fragments thereof) or one or more polynucleotides encoding the BKV-I capsid polypeptides and a therapeutically effective amount of one or more BKV-IV capsid polypeptides (or fragments thereof) or one or more polynucleotides encoding the BKV-IV capsid polypeptides is administered to the subject at doses of about 0.1 µg to 10 mg of each BKV capsid polypeptide or polynucleotide encoding the polypeptide or about 20-40 µg VLP per type for pentamers. However, the particular dose can be determined by a skilled clinician. The disclosed BKV capsid polypeptides (or a fragment thereof) or polynucleotide encoding the BKV capsid polypeptides or fragment thereof can be administered in one or several doses, for example continuously, daily, weekly, or monthly. When administered sequentially, the time separating the administration can be seconds, minutes, hours, days, or even weeks.

[0141] The mode of administration can be any used in the art, including but not limited to subcutaneous or intramuscular administration. The amount of agent administered to the subject can be determined by a clinician, and may depend on the particular subject treated. Specific exemplary amounts are provided herein (but the disclosure is not limited to such doses).

[0142] The development of immune response (such as development of antibodies, such as neutralizing antibodies) in a subject is monitored at time points following administration of the immunogenic composition. Methods of detecting antibodies in a sample (such as a blood or serum sample) include those known in the art, for example, ELISA methods. In some examples, the development of neutralizing antibodies to a BKV-Ia and/or BKV-Ib1 subtype and development of neutralizing antibodies to BKV-Ib2 subtype are monitored.

Example 8

Methods of Treating or Inhibiting PVAN

[0143] This example provides exemplary methods for treating or inhibiting PVAN in a subject. However, one of ordinary skill in the art will appreciate that methods that deviate from these specific methods can also be used to successfully treat or inhibit PVAN in a subject.

[0144] In particular examples, the method includes selecting a subject having, thought to have, or at risk of having PVAN. Subjects having or thought to have PVAN include those with >10 inclusion bearing epithelial cells ("decoy cells") in a urine sample per 10 high power fields, $>10^7$ BKV copies per 10 mL urine, or histopathological identification of viral alterations in a renal biopsy. Subjects at risk of PVAN include those who have had or are candidates for organ transplantation (such as renal transplant or bone marrow transplant), and immunocompromised individuals. In some examples, subjects who are candidates for renal transplant are selected. The selected subject can be a subject who does not have BKV-IV neutralizing antibodies.

[0145] Subjects selected for treatment are administered a therapeutically effective amount of a disclosed immunogenic composition. In some examples, a therapeutically effective amount of one or more BKV-IV capsid polypeptides or a polynucleotide encoding the BKV-IV capsid polypeptide(s) is administered to the subject at doses of about 0.1 μ g to 10 mg of each BKV-IV capsid polypeptide or polynucleotide encoding the polypeptide or about 20-40 μ g VLP per type for pentamers. However, the particular dose can be determined by a skilled clinician. The disclosed BKV-IV capsid polypeptides (or a fragment thereof) or polynucleotide encoding the BKV-IV capsid polypeptides or fragment thereof can be administered in one or several doses, for example continuously, daily, weekly, or monthly, with at least one dose at least 2 weeks prior to transplant. When administered sequentially, the time separating the administration can be seconds, minutes, hours, days, or even weeks.

[0146] The mode of administration can be any used in the art, including but not limited to subcutaneous or intramuscular administration. The amount of agent administered to the subject can be determined by a clinician, and may depend on the particular subject treated. Specific exemplary amounts are provided herein (but the disclosure is not limited to such doses).

[0147] The development of immune response (such as development of antibodies, such as neutralizing antibodies) in a subject is monitored at time points following administration of the immunogenic composition. Methods of detecting antibodies in a sample (such as a blood or serum sample) include those known in the art, for example, ELISA methods. A renal transplant is performed after an immune response is detected. The subject is also monitored for development of PVAN, for example by testing for presence of virus in urine or renal biopsy.

Example 9

Methods of Identifying a Renal Transplant Donor

[0148] This example provides exemplary methods for identifying a renal transplant donor, such as an individual who does not have serum antibodies capable of neutralizing one or more BKV types. However, one of ordinary skill in the art will appreciate that methods that deviate from these specific methods can also be used to successfully identify a renal transplant donor.

[0149] A blood sample is collected from a subject who is considered a possible renal transplant donor. Serum is prepared from the sample and serial dilutions of the serum are prepared (e.g., ten serial dilutions of four-fold ranging from 1:100 to 2.6×10^7). The diluted serum is mixed with a diluted BKV reporter vector carrying a reporter plasmid encoding *Gaussia princeps* luciferase under the control of a human elongation factor 1 alpha promoter and incubated on ice or at 4°C for 1 hour. Then, the virus/serum mixture is added to 293TT cells plated in a 96-well plate at 3×10^4 cells/well. After 3 days, 25 µl of conditioned medium is collected and transferred to a luminometry plate. *Gaussia* luciferase substrate (50 µl NEB *Gaussia* luciferase assay kit substrate) is added and light emission is detected using a luminometer. Effective concentration 50% (EC₅₀) is calculated for the serum dilution series. An EC₅₀ of less than 100 indicates that the subject does not have BKV-IV neutralizing antibodies. A subject who does not have BKV-IV neutralizing antibodies is selected as a renal transplant donor.

[0150] A candidate renal transplant recipient can also be screened for the presence of BKV-IV neutralizing antibodies as described above. A candidate renal transplant recipient who is negative for BKV-IV neutralizing antibodies is considered a good candidate for receiving a kidney from a renal transplant donor who is negative for BKV-IV neutralizing antibodies.

[0151] Similar screening can be done for the presence of other BKV type-specific neutralizing antibodies in potential renal transplant donors and/or recipients. A potential renal transplant donor who does not have particular type-specific (such as BKV-I, BKV-II, or BKV-III) neutralizing antibodies is identified and selected as a renal transplant donor, particularly for a renal transplant recipient who also does not have the same type-specific neutralizing antibodies.

[0152] In view of the many possible embodiments to which the principles of the claimed invention may be applied, it should be recognized that the illustrated embodiments are only examples and should not be taken as limiting the scope of the invention. Rather, the scope of the invention is defined by the following claims. We therefore claim as our invention all that comes within the scope of these claims.

SEQUENCE LISTING

[0153]

<110> The United States of America, as Represented by the Secretary, Department of Health and Human Services

Buck, Christopher B

Pastrana, Diana V

<120> METHODS AND COMPOSITIONS FOR INHIBITING POLYOMAVIRUS-ASSOCIATED PATHOLOGY

<130> 4239-87376-02

<150> US 61/508,897

<151> 2011-07-18

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30

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

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305	310										315				320			
Arg	Arg	Val	Ser	Arg	Gly	Ser	Ser	Gln	Lys	Ala	Lys	Gly	Thr	Arg	Ala			
				325					330					335				
Ser	Ala	Lys	Thr	Thr	Asn	Lys	Arg	Arg	Ser	Arg	Ser	Ser	Arg	Ser				
			340					345					350					
<210> 9																		
<211> 232																		
<212> PRT																		
<213> BK virus																		
<400> 9																		
Met	Ala	Leu	Glu	Leu	Phe	Asn	Pro	Asp	Glu	Tyr	Tyr	Asp	Ile	Leu	Phe			
1				5					10					15				
Pro	Gly	Val	Asn	Thr	Phe	Val	Asn	Asn	Ile	Gln	Tyr	Leu	Asp	Pro	Arg			
			20					25					30					
His	Trp	Gly	Pro	Ser	Leu	Phe	Ala	Thr	Ile	Ser	Gln	Ala	Leu	Trp	His			
		35					40					45						
Val	Ile	Arg	Asp	Asp	Ile	Pro	Ala	Ile	Thr	Ser	Gln	Glu	Leu	Gln	Arg			
	50					55					60							
Arg	Thr	Glu	Arg	Phe	Phe	Arg	Asp	Ser	Leu	Ala	Arg	Phe	Leu	Glu	Glu			
65					70					75					80			
Thr	Thr	Trp	Thr	Ile	Val	Asn	Ala	Pro	Val	Asn	Phe	Tyr	Asn	Tyr	Ile			
				85					90					95				
Gln	Asp	Tyr	Tyr	Ser	Asn	Leu	Ser	Pro	Ile	Arg	Pro	Ser	Met	Val	Arg			
			100					105					110					
Gln	Val	Ala	Glu	Arg	Glu	Gly	Thr	His	Val	Asn	Phe	Gly	His	Thr	Tyr			
		115					120					125						
Ser	Ile	Asp	Asp	Ala	Asp	Ser	Ile	Glu	Glu	Val	Thr	Gln	Arg	Ile	Glu			
	130					135					140							
Leu	Arg	Asn	Lys	Glu	Ser	Val	His	Ser	Gly	Glu	Phe	Ile	Glu	Lys	Thr			
145					150					155					160			
Ile	Ala	Pro	Gly	Gly	Ala	Asn	Gln	Arg	Thr	Ala	Pro	Gln	Trp	Met	Leu			
				165					170					175				
Pro	Leu	Leu	Leu	Gly	Leu	Tyr	Gly	Thr	Val	Thr	Pro	Ala	Leu	Glu	Ala			
			180					185					190					
Tyr	Glu	Asp	Gly	Pro	Asn	Gln	Lys	Lys	Arg	Arg	Val	Ser	Arg	Gly	Ser			
		195					200					205						
Ser	Gln	Lys	Ala	Lys	Gly	Thr	Arg	Ala	Ser	Ala	Lys	Thr	Thr	Asn	Lys			
	210					215					220							

Arg Arg Ser Arg Ser Ser Arg Ser
225 230

<210> 10

<211> 362

<212> PRT

<213> BK virus

<400> 10

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Asp His Leu Arg
50 55 60

Gly Tyr Ser Gln His Leu Thr Ala Glu Asn Ala Phe Asp Ser Asp Ser
65 70 75 80

Pro Asp Lys Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
100 105 110

Ala Val Thr Val Lys Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu Asn Gly Gly Gly Lys Pro
130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Gln Gly
165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
195 200 205

Trp Ile Pro Asp Pro Ser Lys Asn Glu Asn Thr Arg Tyr Phe Gly Thr
210 215 220

Tyr Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225 230 235 240

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Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Lys Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Gln Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Arg Gln Gly Gln Leu Gln Thr Lys Met Val
355 360

<210> 11

<211> 351

<212> PRT

<213> BK virus

<400> 11

Met Gly Ala Ala Leu Ala Leu Leu Gly Asp Leu Val Ala Ser Val Ser
1 5 10 15

Glu Ala Ala Ala Ala Thr Gly Phe Ser Val Ala Glu Ile Ala Ala Gly
20 25 30

Glu Ala Ala Ala Ala Ile Glu Val Gln Ile Ala Ser Leu Ala Thr Val
35 40 45

Glu Gly Ile Thr Thr Thr Ser Glu Ala Ile Ala Ala Ile Gly Leu Thr
50 55 60

Pro Gln Thr Tyr Ala Val Ile Ala Gly Ala Pro Gly Ala Ile Ala Gly
65 70 75 80

Phe Ala Ala Leu Ile Gln Thr Val Thr Gly Ile Ser Ser Leu Ala Gln
85 90 95

Val Gly Tyr Arg Phe Phe Ser Asp Trp Asp His Lys Val Ser Thr Val
100 105 110

Gly Leu Tyr Gln Gln Ser Gly Met Ala Leu Glu Leu Phe Asn Pro Asp
115 120 125

Glu Tyr Tyr Asp Ile Leu Phe Pro Gly Val Asn Thr Phe Val Asn Asn
130 135 140

Ile Gln Tyr Leu Asp Pro Arg His Trp Gly Pro Ser Leu Phe Ala Thr
145 150 155 160

Ile Ser Gln Ala Leu Trp His Val Ile Arg Asp Asp Ile Pro Ala Ile
165 170 175

Thr Ser Gln Glu Leu Gln Arg Arg Thr Glu Arg Phe Phe Arg Asp Ser
180 185 190

Leu Ala Arg Phe Leu Glu Glu Thr Thr Trp Thr Ile Val Asn Ala Pro
195 200 205

Ile Asn Phe Tyr Asn Tyr Ile Gln Asp Tyr Tyr Ser Asn Leu Ser Pro
210 215 220

Ile Arg Pro Ser Met Val Arg Gln Val Ala Glu Arg Glu Gly Thr His
225 230 235 240

Val Asn Phe Gly His Thr Tyr Ser Ile Asp Asn Ala Asp Ser Ile Glu
245 250 255

Glu Val Thr Gln Arg Met Asp Leu Arg Asn Lys Glu Ser Val His Ser
260 265 270

Gly Glu Phe Ile Glu Lys Thr Ile Ala Pro Gly Gly Ala Asn Gln Arg
275 280 285

Thr Ala Pro Gln Trp Met Leu Pro Leu Leu Leu Gly Leu Tyr Gly Thr
290 295 300

Val Thr Pro Ala Leu Glu Ala Tyr Glu Asp Gly Pro Asn Gln Lys Lys
305 310 315 320

Arg Arg Val Ser Arg Gly Ser Ser Gln Lys Ala Lys Gly Thr Arg Ala
325 330 335

Ser Ala Lys Thr Thr Asn Lys Arg Arg Ser Arg Ser Ser Arg Ser
340 345 350

<210> 12

<211> 232

<212> PRT

<213> BK virus

<400> 12

Met Ala Leu Glu Leu Phe Asn Pro Asp Glu Tyr Tyr Asp Ile Leu Phe
1 5 10 15

Pro Gly Val Asn Thr Phe Val Asn Asn Ile Gln Tyr Leu Asp Pro Arg
20 25 30

His Trp Gly Pro Ser Leu Phe Ala Thr Ile Ser Gln Ala Leu Trp His
35 40 45

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

50 55 60
 Arg Thr Glu Arg Phe Phe Arg Asp Ser Leu Ala Arg Phe Leu Glu Glu
 65 70 75 80
 Thr Thr Trp Thr Ile Val Asn Ala Pro Ile Asn Phe Tyr Asn Tyr Ile
 85 90 95
 Gln Asp Tyr Tyr Ser Asn Leu Ser Pro Ile Arg Pro Ser Met Val Arg
 100 105 110
 Gln Val Ala Glu Arg Glu Gly Thr His Val Asn Phe Gly His Thr Tyr
 115 120 125
 Ser Ile Asp Asn Ala Asp Ser Ile Glu Glu Val Thr Gln Arg Met Asp
 130 135 140
 Leu Arg Asn Lys Glu Ser Val His Ser Gly Glu Phe Ile Glu Lys Thr
 145 150 155 160
 Ile Ala Pro Gly Gly Ala Asn Gln Arg Thr Ala Pro Gln Trp Met Leu
 165 170 175
 Pro Leu Leu Leu Gly Leu Tyr Gly Thr Val Thr Pro Ala Leu Glu Ala
 180 185 190
 Tyr Glu Asp Gly Pro Asn Gln Lys Lys Arg Arg Val Ser Arg Gly Ser
 195 200 205
 Ser Gln Lys Ala Lys Gly Thr Arg Ala Ser Ala Lys Thr Thr Asn Lys
 210 215 220
 Arg Arg Ser Arg Ser Ser Arg Ser
 225 230
 <210> 13
 <211> 362
 <212> PRT
 <213> BK virus
 <400> 13
 Met Ala Pro Thr Lys Arg Lys Gly Glu Cys Pro Gly Ala Ala Pro Lys
 1 5 10 15
 Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30
 Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
 35 40 45
 Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
 50 55 60
 Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser

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

<210> 14
 <211> 362
 <212> PRT
 <213> BK virus

<400> 14
 Met Ala Pro Thr Lys Arg Lys Gly Glu Cys Pro Gly Ala Ala Pro Lys

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

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
355 360

<210> 15

<211> 362

<212> PRT

<213> BK virus

<400> 15

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
50 55 60

Gly Phe Ser Leu Lys Leu Ser Val Glu Asn Asp Phe Ser Ser Asp Ser
65 70 75 80

Pro Gln Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Leu Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
 260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
 275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
 290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
 305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
 325 330 335

Gly Thr Glu Lys Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
 340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
 355 360

<210> 16

<211> 362

<212> PRT

<213> BK virus

<400> 16

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Asn Asp Leu Arg
 50 55 60

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

<210> 17
 <211> 354
 <212> PRT
 <213> JC virus

<400> 17

Met Ala Pro Thr Lys Arg Lys Gly Glu Arg Lys Asp Pro Val Gln Val
 1 5 10 15

Pro Lys Leu Leu Ile Arg Gly Gly Val Glu Val Leu Glu Val Lys Thr
 20 25 30

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

Gly Asp Pro Asp Glu His Leu Arg Gly Phe Ser Lys Ser Ile Ser Ile
 50 55 60

Ser Asp Thr Phe Glu Ser Asp Ser Pro Asn Arg Asp Met Leu Pro Cys
 65 70 75 80

Tyr Ser Val Ala Arg Ile Pro Leu Pro Asn Leu Asn Glu Asp Leu Thr
 85 90 95

Cys Gly Asn Ile Leu Met Trp Glu Ala Val Thr Leu Lys Thr Glu Val
 100 105 110

Ile Gly Val Thr Ser Leu Met Asn Val His Ser Asn Gly Gln Ala Thr
 115 120 125

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

Phe Ser Val Gly Gly Glu Ala Leu Glu Leu Gln Gly Val Leu Phe Asn
 145 150 155 160

Tyr Arg Thr Lys Tyr Pro Asp Gly Thr Ile Phe Pro Lys Asn Ala Thr
 165 170 175

Val Gln Ser Gln Val Met Asn Thr Glu His Lys Ala Tyr Leu Asp Lys
 180 185 190

Asn Lys Ala Tyr Pro Val Glu Cys Trp Val Pro Asp Pro Thr Arg Asn
 195 200 205

Glu Asn Thr Arg Tyr Phe Gly Thr Leu Thr Gly Gly Glu Asn Val Pro
 210 215 220

Pro Val Leu His Ile Thr Asn Thr Ala Thr Thr Val Leu Leu Asp Glu
 225 230 235 240

Phe Gly Val Gly Pro Leu Cys Lys Gly Asp Asn Leu Tyr Leu Ser Ala
 245 250 255

Val Asp Val Cys Gly Met Phe Thr Asn Arg Ser Gly Ser Gln Gln Trp
260 265 270

Arg Gly Leu Ser Arg Tyr Phe Lys Val Gln Leu Arg Lys Arg Arg Val
275 280 285

Lys Asn Pro Tyr Pro Ile Ser Phe Leu Leu Thr Asp Leu Ile Asn Arg
290 295 300

Arg Thr Pro Arg Val Asp Gly Gln Pro Met Tyr Gly Met Asp Ala Gln
305 310 315 320

Val Glu Glu Val Arg Val Phe Glu Gly Thr Glu Glu Leu Pro Gly Asp
325 330 335

Pro Asp Met Met Arg Tyr Val Asp Lys Tyr Gly Gln Leu Gln Thr Lys
340 345 350

Met Leu

<210> 18

<211> 344

<212> PRT

<213> JC virus

<400> 18

Met Gly Ala Ala Leu Ala Leu Leu Gly Asp Leu Val Ala Thr Val Ser
1 5 10 15

Glu Ala Ala Ala Ala Thr Gly Phe Ser Val Ala Glu Ile Ala Ala Gly
20 25 30

Glu Ala Ala Ala Thr Ile Glu Val Glu Ile Ala Ser Leu Ala Thr Val
35 40 45

Glu Gly Ile Thr Ser Thr Ser Glu Ala Ile Ala Ala Ile Gly Leu Thr
50 55 60

Pro Glu Thr Tyr Ala Val Ile Thr Gly Ala Pro Gly Ala Val Ala Gly
65 70 75 80

Phe Ala Ala Leu Val Gln Thr Val Thr Gly Gly Ser Ala Ile Ala Gln
85 90 95

Leu Gly Tyr Arg Phe Phe Ala Asp Trp Asp His Lys Val Ser Thr Val
100 105 110

Gly Leu Phe Gln Gln Pro Ala Met Ala Leu Gln Leu Phe Asn Pro Glu
115 120 125

Asp Tyr Tyr Asp Ile Leu Phe Pro Gly Val Asn Ala Phe Val Asn Asn
130 135 140

Ile His Thr Leu Asn Pro Arg His Thr Gly Pro Ser Leu Phe Ser Thr

Ile His Tyr Leu Asp Phe Arg His Trp Gly Phe Ser Leu Phe Ser Thr
145 150 155 160

Ile Ser Gln Ala Phe Trp Asn Leu Val Arg Asp Asp Leu Pro Ala Leu
165 170 175

Thr Ser Gln Glu Ile Gln Arg Arg Thr Gln Lys Leu Phe Val Glu Ser
180 185 190

Leu Ala Arg Phe Leu Glu Glu Thr Thr Trp Ala Ile Val Asn Ser Pro
195 200 205

Ala Asn Leu Tyr Asn Tyr Ile Ser Asp Tyr Tyr Ser Arg Leu Ser Pro
210 215 220

Val Arg Pro Ser Met Val Arg Gln Val Ala Gln Arg Glu Gly Thr Tyr
225 230 235 240

Ile Ser Phe Gly His Ser Tyr Thr Gln Ser Ile Asp Asp Ala Asp Ser
245 250 255

Ile Gln Glu Val Thr Gln Arg Leu Asp Leu Lys Thr Pro Asn Val Gln
260 265 270

Ser Gly Glu Phe Ile Glu Arg Ser Ile Ala Pro Gly Gly Ala Asn Gln
275 280 285

Arg Ser Ala Pro Gln Trp Met Leu Pro Leu Leu Leu Gly Leu Tyr Gly
290 295 300

Thr Val Thr Pro Ala Leu Glu Ala Tyr Glu Asp Gly Pro Asn Lys Lys
305 310 315 320

Lys Arg Arg Lys Glu Gly Pro Arg Ala Ser Ser Lys Thr Ser Tyr Lys
325 330 335

Arg Arg Ser Arg Ser Ser Arg Ser
340

<210> 19

<211> 225

<212> PRT

<213> JC virus

<400> 19

Met Ala Leu Gln Leu Phe Asn Pro Glu Asp Tyr Tyr Asp Ile Leu Phe
1 5 10 15

Pro Gly Val Asn Ala Phe Val Asn Asn Ile His Tyr Leu Asp Pro Arg
20 25 30

His Trp Gly Pro Ser Leu Phe Ser Thr Ile Ser Gln Ala Phe Trp Asn
35 40 45

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

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

Thr Thr Trp Ala Ile Val Asn Ser Pro Ala Asn Leu Tyr Asn Tyr Ile
85 90 95

Ser Asp Tyr Tyr Ser Arg Leu Ser Pro Val Arg Pro Ser Met Val Arg
100 105 110

Gln Val Ala Gln Arg Glu Gly Thr Tyr Ile Ser Phe Gly His Ser Tyr
115 120 125

Thr Gln Ser Ile Asp Asp Ala Asp Ser Ile Gln Glu Val Thr Gln Arg
130 135 140

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

Ser Ile Ala Pro Gly Gly Ala Asn Gln Arg Ser Ala Pro Gln Trp Met
165 170 175

Leu Pro Leu Leu Leu Gly Leu Tyr Gly Thr Val Thr Pro Ala Leu Glu
180 185 190

Ala Tyr Glu Asp Gly Pro Asn Lys Lys Lys Arg Arg Lys Glu Gly Pro
195 200 205

Arg Ala Ser Ser Lys Thr Ser Tyr Lys Arg Arg Ser Arg Ser Ser Arg
210 215 220

Ser
225

<210> 20

<211> 354

<212> PRT

<213> JC virus

<400> 20

Met Ala Pro Thr Lys Arg Lys Gly Glu Arg Lys Asp Pro Val Gln Val
1 5 10 15

Pro Lys Leu Leu Ile Arg Gly Gly Val Glu Val Leu Glu Val Lys Thr
20 25 30

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

Gly Asp Pro Asp Glu His Leu Arg Gly Phe Ser Lys Ser Ile Ser Ile
50 55 60

Ser Asp Thr Phe Glu Ser Asp Ser Pro Asn Lys Asp Met Leu Pro Cys
65 70 75 80

Tyr Ser Val Ala Arg Ile Pro Leu Pro Asn Leu Asn Glu Asp Leu Thr
85 90 95

Cys Gly Asn Ile Leu Met Trp Glu Ala Val Thr Leu Lys Thr Glu Val
100 105 110

Ile Gly Val Thr Thr Leu Met Asn Val His Ser Asn Gly Gln Ala Thr
115 120 125

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

Phe Ser Val Gly Gly Glu Ala Leu Glu Leu Gln Gly Val Val Phe Asn
145 150 155 160

Tyr Arg Thr Lys Tyr Pro Asp Gly Thr Ile Phe Pro Lys Asn Ala Thr
165 170 175

Val Gln Ser Gln Val Met Asn Thr Glu His Lys Ala Tyr Leu Asp Lys
180 185 190

Asn Lys Ala Tyr Pro Val Glu Cys Trp Val Pro Asp Pro Thr Arg Asn
195 200 205

Glu Asn Thr Arg Tyr Phe Gly Thr Leu Thr Gly Gly Glu Asn Val Pro
210 215 220

Pro Val Leu His Ile Thr Asn Thr Ala Thr Thr Val Leu Leu Asp Glu
225 230 235 240

Phe Gly Val Gly Pro Leu Cys Lys Gly Asp Asn Leu Tyr Leu Ser Ala
245 250 255

Val Asp Val Cys Gly Met Phe Thr Asn Arg Ser Gly Ser Gln Gln Trp
260 265 270

Arg Gly Leu Ser Arg Tyr Phe Lys Val Gln Leu Arg Lys Arg Arg Val
275 280 285

Lys Asn Pro Tyr Pro Ile Ser Phe Leu Leu Thr Asp Leu Ile Asn Arg
290 295 300

Arg Thr Pro Arg Val Asp Gly Gln Pro Met Tyr Gly Met Asp Ala Gln
305 310 315 320

Val Glu Glu Val Arg Val Phe Glu Gly Thr Glu Glu Leu Pro Gly Asp
325 330 335

Pro Asp Met Met Arg Tyr Val Asp Arg Tyr Gly Gln Leu Gln Thr Lys
340 345 350

Met Leu

<210> 21

<211> 354

<212> PRT

<213> JC virus

<400> 21

Met	Ala	Pro	Thr	Lys	Arg	Lys	Gly	Glu	Arg	Lys	Asp	Pro	Val	Gln	Val
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Pro	Lys	Leu	Leu	Ile	Arg	Gly	Gly	Val	Glu	Val	Leu	Glu	Val	Lys	Thr
			20					25					30		

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

Gly	Asp	Pro	Asp	Glu	His	Phe	Arg	Gly	Phe	Ser	Lys	Ser	Ile	Ser	Ile
	50					55					60				

Ser	Asp	Thr	Phe	Glu	Ser	Asp	Ser	Pro	Asn	Lys	Asp	Met	Leu	Pro	Cys
65					70					75					80

Tyr	Ser	Val	Ala	Arg	Ile	Pro	Leu	Pro	Asn	Leu	Asn	Glu	Asp	Leu	Thr
				85					90					95	

Cys	Gly	Asn	Ile	Leu	Met	Trp	Glu	Ala	Val	Thr	Leu	Lys	Thr	Glu	Val
			100					105					110		

Ile	Gly	Val	Thr	Thr	Leu	Met	Asn	Val	His	Ser	Asn	Gly	Gln	Ala	Thr
		115					120					125			

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

Phe	Ser	Val	Gly	Gly	Glu	Ala	Leu	Glu	Leu	Gln	Gly	Val	Val	Phe	Asn
145					150					155					160

Tyr	Arg	Thr	Thr	Tyr	Pro	Asp	Gly	Thr	Ile	Phe	Pro	Lys	Asn	Ala	Thr
				165					170					175	

Val	Gln	Ser	Gln	Val	Met	Asn	Thr	Glu	His	Lys	Ala	Tyr	Leu	Asp	Lys
			180					185					190		

Asn	Lys	Ala	Tyr	Pro	Val	Glu	Cys	Trp	Val	Pro	Asp	Pro	Thr	Arg	Asn
		195					200					205			

Glu	Asn	Thr	Arg	Tyr	Phe	Gly	Thr	Leu	Thr	Gly	Gly	Glu	Asn	Val	Pro
	210					215					220				

Pro	Val	Leu	His	Ile	Thr	Asn	Thr	Ala	Thr	Thr	Val	Leu	Leu	Asp	Glu
225					230					235					240

Phe	Gly	Val	Gly	Pro	Leu	Cys	Lys	Gly	Asp	Asn	Leu	Tyr	Leu	Ser	Ala
				245					250					255	

Val	Asp	Val	Cys	Gly	Met	Phe	Thr	Asn	Arg	Ser	Gly	Ser	Gln	Gln	Trp
			260					265					270		

Arg Gly Leu Ser Arg Tyr Phe Lys Val Gln Leu Arg Lys Arg Arg Val
275 280 285

Lys Asn Pro Tyr Pro Ile Ser Phe Leu Leu Thr Asp Leu Ile Asn Arg
290 295 300

Arg Thr Pro Arg Val Asp Gly Gln Pro Met Tyr Gly Met Asp Ala Gln
305 310 315 320

Ile Glu Glu Val Arg Val Phe Glu Gly Thr Glu Gln Leu Pro Gly Asp
325 330 335

Pro Asp Met Met Arg Tyr Val Asp Arg Tyr Gly Gln Leu Gln Thr Lys
340 345 350

Met Leu

<210> 22

<211> 344

<212> PRT

<213> JC virus

<400> 22

Met Gly Ala Ala Leu Ala Leu Leu Gly Asp Leu Val Ala Thr Val Ser
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Glu Ala Ala Ala Ala Thr Gly Phe Ser Val Ala Glu Ile Ala Ala Gly
20 25 30

Glu Ala Ala Ala Thr Ile Glu Val Glu Ile Ala Ser Leu Ala Thr Val
35 40 45

Glu Gly Ile Thr Ser Thr Ser Glu Ala Ile Ala Ala Ile Gly Leu Thr
50 55 60

Pro Glu Thr Tyr Ala Val Ile Thr Gly Ala Pro Gly Ala Val Ala Gly
65 70 75 80

Phe Ala Ala Leu Val Gln Thr Val Thr Gly Gly Ser Ala Ile Ala Gln
85 90 95

Leu Gly Tyr Arg Phe Phe Ala Asp Trp Asp His Lys Val Ser Thr Val
100 105 110

Gly Leu Phe Gln Gln Pro Ala Met Ala Leu Gln Leu Phe Asn Pro Glu
115 120 125

Asp Tyr Tyr Asp Ile Leu Phe Pro Gly Val Asn Ala Phe Val Asn Asn
130 135 140

Ile His Tyr Leu Asp Pro Arg His Trp Gly Pro Ser Leu Phe Ser Thr
145 150 155 160

Ile Ser Gln Ala Phe Trp Asn Leu Val Arg Asp Asp Leu Pro Ser Leu

				165					170						175
Thr	Ser	Gln	Glu	Ile	Gln	Arg	Arg	Thr	Gln	Lys	Leu	Phe	Val	Glu	Ser
			180					185					190		
Leu	Ala	Arg	Phe	Leu	Glu	Glu	Thr	Thr	Trp	Ala	Ile	Val	Asn	Ser	Pro
		195					200					205			
Val	Asn	Leu	Tyr	Asn	Tyr	Ile	Ser	Asp	Tyr	Tyr	Ser	Arg	Leu	Ser	Pro
	210					215					220				
Val	Arg	Pro	Ser	Met	Val	Arg	Gln	Val	Ala	Gln	Arg	Glu	Gly	Thr	Tyr
225					230					235					240
Ile	Ser	Phe	Gly	His	Ser	Tyr	Thr	Gln	Ser	Ile	Asp	Asp	Ala	Asp	Ser
				245					250					255	
Ile	Gln	Glu	Val	Thr	Gln	Arg	Leu	Asp	Leu	Lys	Thr	Pro	Asn	Val	Gln
			260					265					270		
Ser	Gly	Glu	Phe	Ile	Glu	Lys	Ser	Ile	Ala	Pro	Gly	Gly	Ala	Asn	Gln
		275					280					285			
Arg	Ser	Ala	Pro	Gln	Trp	Met	Leu	Pro	Leu	Leu	Leu	Gly	Leu	Tyr	Gly
	290					295						300			
Thr	Val	Thr	Pro	Ala	Leu	Glu	Ala	Tyr	Glu	Asp	Gly	Pro	Asn	Lys	Lys
305					310					315					320
Lys	Arg	Arg	Lys	Glu	Gly	Pro	Arg	Ala	Ser	Ser	Lys	Thr	Ser	Tyr	Lys
				325					330					335	
Arg	Arg	Ser	Arg	Ser	Ser	Arg	Ser								
			340												
<210>	23														
<211>	225														
<212>	PRT														
<213>	JC virus														
<400>	23														
Met	Ala	Leu	Gln	Leu	Phe	Asn	Pro	Glu	Asp	Tyr	Tyr	Asp	Ile	Leu	Phe
1				5					10					15	
Pro	Gly	Val	Asn	Ala	Phe	Val	Asn	Asn	Ile	His	Tyr	Leu	Asp	Pro	Arg
			20					25					30		
His	Trp	Gly	Pro	Ser	Leu	Phe	Ser	Thr	Ile	Ser	Gln	Ala	Phe	Trp	Asn
		35					40					45			
Leu	Val	Arg	Asp	Asp	Leu	Pro	Ser	Leu	Thr	Ser	Gln	Glu	Ile	Gln	Arg
	50					55					60				
Arg	Thr	Gln	Lys	Leu	Phe	Val	Glu	Ser	Leu	Ala	Arg	Phe	Leu	Glu	Glu
65					70					75					80

Thr Thr Trp Ala Ile Val Asn Ser Pro Val Asn Leu Tyr Asn Tyr Ile
85 90 95

Ser Asp Tyr Tyr Ser Arg Leu Ser Pro Val Arg Pro Ser Met Val Arg
100 105 110

Gln Val Ala Gln Arg Glu Gly Thr Tyr Ile Ser Phe Gly His Ser Tyr
115 120 125

Thr Gln Ser Ile Asp Asp Ala Asp Ser Ile Gln Glu Val Thr Gln Arg
130 135 140

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

Ser Ile Ala Pro Gly Gly Ala Asn Gln Arg Ser Ala Pro Gln Trp Met
165 170 175

Leu Pro Leu Leu Leu Gly Leu Tyr Gly Thr Val Thr Pro Ala Leu Glu
180 185 190

Ala Tyr Glu Asp Gly Pro Asn Lys Lys Lys Arg Arg Lys Glu Gly Pro
195 200 205

Arg Ala Ser Ser Lys Thr Ser Tyr Lys Arg Arg Ser Arg Ser Ser Arg
210 215 220

Ser
225

<210> 24

<211> 1089

<212> DNA

<213> BK virus

<400> 24

atggccccc	aa ccaaaagaaa	aggagagtgt	ccaggggcag	ctccccaaaa	gccaaaggaa	60
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ggggtagatg	ctataacaga	ggtagaatgc	ttcctaaacc	cagaaatggg	ggatccagat	180
gaaaacctta	ggggcttttag	tctaaagcta	agtgctgaaa	atgacttttag	cagtgatagc	240
ccagaaagaa	aaatgcttcc	ctgttacagc	acagcaagaa	ttcccctccc	caattttaat	300
gaggacctaa	cctgtggaaa	tctactgatg	tgggaggctg	taactgtaca	aacagaggtc	360
attggaataa	ctagcatgct	taaccttcat	gcagggtcac	aaaaagtgca	tgagcatggt	420
ggaggtaaac	ctattcaagg	cagtaatttc	cacttctttg	ctgttggtgg	agacccttg	480
gaaatgcagg	gagtgcta	gaattacagg	accaagtacc	cagatgggtac	tataacccca	540
aaaaacccaa	cagcccagtc	ccaggtaatg	aatactgacc	ataaggccta	tttggacaaa	600
aacaatgctt	atccagttga	gtgctggggt	cctgatccta	gtagaaatga	aaatactagg	660
tattttggga	ctttcacagg	aggggaaaat	gttccccag	tacttcatgt	gaccaacaca	720

gctaccacag tgttgctaga tgaacagggg gtggggcctc tttgtaaagc tgatagcctg	780
tatgttttcag ctgctgatat ttgtggcctg tttactaaca gctctggaac acaacagtgg	840
agaggccttg caagatattt taagattcgc ctgagaaaaa gatctgtaaa aaatccttac	900
ccaatttcct ttttgctaag tgaccttata aacaggagaa cccagagagt ggatgggcag	960
cctatgtatg gtatggaatc ccaggtagaa gaggttaggg tgtttgatgg cacagaaaga	1020
cttccagggg acccagatat gataagatat attgataaac aaggacaatt gcaaaccaaa	1080
atgcttttaa	1089

<210> 25

<211> 1056

<212> DNA

<213> BK virus

<400> 25

atgggtgctg ctctagcact tttggggggac ctagttgcca gtgtatctga ggctgctgct	60
gccacaggat tttcagtggc tgaaattgct gctggggagg ctgctgctgc tatagaagtt	120
caaattgcat cccttgctac tgtagagggc ataacaagta cctcagaggc tatagctgct	180
ataggcctaa ctccctcaaac atatgctgta attgctgggtg ctccctggggc tattgctggg	240
tttgctgctt taattcaaac tgttactggt attagttcct tggctcaagt agggatatagg	300
tttttttagtg attgggatca caaagtttcc actgtaggcc tctatcagca atcaggcatg	360
gctttggaat tgtttaaccc agatgagtac tatgatattt tgtttcctgg tgtaaatact	420
tttgtaaata atattcaata ccttgatcct aggcattggg gtccttcctt gtttgctact	480
atttcccagg ctttgtggca tgttattagg gatgatatac ctgctataac ctcaacaaga	540
ttgcaaagaa gaacagaaag atttttttaga gactccttgg ctagattttt ggaggaaact	600
acctggacaa ttgtaaatgc ccctataaac ttttataatt atattcaaga atattattct	660
gatctttccc ctattaggcc ctcaatgggt agacaagtgg ctgaaaggga aggtaccctg	720
gtacattttg gccatactta tagtatagat gatgctgaca gtatagaaga agttacacaa	780
agaatggact taagaaatca acaaactgta cattcaggag agtttataga aaaaactatt	840
gccccaggag gtgctaataca aagaactgct cctcaatgga tgttgccctt acttctaggg	900
ctgtacggga ctgtaacacc tgctcttgaa gcatatgaag atggccccaa ccaaaagaaa	960
aggagagtgt ccagggggcag ctcccaaaaa gccaaaggaa cccgtgcaag tgccaaaact	1020
actaataaaa ggaggagtag aagttctaga agttaa	1056

<210> 26

<211> 699

<212> DNA

<213> BK virus

<400> 26

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acttttgtaa ataattattca ataccttgat cctaggcatt ggggtccttc cttgtttgct	120

actatattccc	aggctttgtg	gcatgttatt	agggatgata	tacctgctat	aacctcacia	180
gaattgcaaa	gaagaacaga	aagatttttt	agagactcct	tggctagatt	tttggaggaa	240
actacctgga	caattgtaaa	tgccccctata	aactttttata	attatattca	agaatattat	300
tctgatcttt	cccctattag	gccctcaatg	gttagacaag	tggctgaaag	ggaaggtagc	360
cgtgtacatt	ttggccatac	ttatagtata	gatgatgctg	acagtataga	agaagttaca	420
caaagaatgg	acttaagaaa	tcaacaaact	gtacattcag	gagagtttat	agaaaaaact	480
attgccccag	gaggtgctaa	tcaaagaact	gctcctcaat	ggatggttgc	tttacttcta	540
ggcctgtacg	ggactgtaac	acctgctctt	gaagcatatg	aagatggccc	caaccaaaag	600
aaaaggagag	tgtccagggg	cagctcccaa	aaagccaaag	gaaccctgtc	aagtgccaaa	660
actactaata	aaaggaggag	tagaagttct	agaagttaa			699

<210> 27

<211> 1089

<212> DNA

<213> BK virus

<400> 27

atggccccaa	ccaaaagaaa	aggagagtgt	ccaggggagc	ctccccaaaa	gccaaaggaa	60
cccgtgcaag	tgccaaaact	actaataaaa	ggaggagtag	aagttctaga	agttaaaact	120
ggggtagatg	ctataacaga	agtagaatgc	tttctaaatc	cagaaatggg	ggatccagat	180
aatgacctta	ggggctatag	tctaagacta	actgctgaaa	ctgcctttga	cagtgatagc	240
ccagacagaa	aaatgcttcc	ctgttacagc	acagcaagaa	ttccactacc	taatttgaat	300
gaggatctaa	cctgtggaaa	tctactaatg	tgggaggctg	tgactgtaaa	aacagagggt	360
attggaataa	ctagtatgct	taaccttcat	gcagggtcac	agaaagtaca	tgaaaatggt	420
ggaggcaaac	ctattcaagg	cagcaatttt	cacttttttg	ctgtgggtgg	ggacccttg	480
gaaatgcagg	gagtacttat	gaactacaga	acaaagtacc	cagaaggtag	tgtcacccca	540
aaaaatccca	cagctcagtc	ccaggtaatg	aatactgacc	ataaggccta	cttggacaaa	600
aacaatgctt	atccagttga	atgctggatt	cctgacccta	gtaaaaatga	aaataactaga	660
tatttttgaa	catacacagg	aggggaaaat	gttccccagc	tacttcatgt	aaccaacaca	720
gctaccacag	tgttgctgga	tgaacagggt	gtggggcctc	tgtgtaaagc	tgatagcctg	780
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aggggccttc	caagatattt	taagattcgc	ctgagaaaaa	gatctgtaaa	gaacccttac	900
ccaatttcct	ttttgcttag	tgaccttata	aacaggagaa	cccagagagt	ggatgggcag	960
cctatgtatg	gtatggagtc	tcagggtggag	gaggtcaggg	tgtttgatgg	cacagaacag	1020
cttccagggg	accagatat	gataagatat	attgacagac	agggacaatt	gcaaacaaaa	1080
atggttttaa						1089

<210> 28

<211> 1056

<212> DNA

<213> BK virus

<400> 28

atgggtgctg ctctagcaact tttggggggac ctagttgccg gtgtatctga ggctgctgct	60
gccacaggat tttcagtggc tgaaattgct gctggggagg ctgctgctgc tatagaagtt	120
caaattgcat cccttgctac tgtagagggc ataacaagta cctcagaggc tatagctgct	180
ataggcctaa ctcccaaac atatgctgta attgctggtg ctccaggggc tattgctggg	240
tttgctgctt taattcaaac tgttactggt attagttctt tggctcaagt agggatatagg	300
tttttttagtg attgggatca caaagtctcc actgtaggcc tttatcagca atcaggcatg	360
gcattggaat tgtttaaccc agatgagtag tatgatattt tgtttcctgg tgtaaatact	420
tttgtaaata atattcaata cctagatcct aggcattggg gtccttcttt gtttgctact	480
atttcccagg ctttgtggca tgttattagg gatgatatac ctgctataac ttcacaagaa	540
ttgcaaagaa gaacagagag attctttaga gactccttgg ctagattttt ggaagaaact	600
acctggacaa ttgtaatgc ccctgtaac ttttataatt atattcagga ttattattct	660
aatttgctcc ctattaggcc ttcaatggtt aggcaagttg ctgaaaggga aggaaccag	720
gtaaattttg gccataccta cagaatagat gatgctgaca gtatacaaga agttacccaa	780
agaatggagt taagaaataa agagaatgta cattcaggag agtttataga aaaaactatt	840
gccccaggag gtgctaataa aagaactgct cctcaatgga tgttgctctt gcttctaggc	900
ctgtacggga ctgtaacacc tgctcttgaa gcatatgaag atggcccca ccaaaagaaa	960
aggagagtgt ccagggggcag ctcccaaaaa gccaaaggaa cccgtgcaag tgccaaaact	1020
actaataaaa ggaggagtag aagttctaga agttaa	1056

<210> 29

<211> 699

<212> DNA

<213> BK virus

<400> 29

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acttttgtaa ataattttca atacctagat cctaggcatt ggggtccttc tttgtttgct	120
actatttccc aggctttgtg gcatgttatt agggatgata tacctgctat aacttcacaa	180
gaattgcaaa gaagaacaga gagattcttt agagactcct tggctagatt tttggaagaa	240
actacctgga caattgtaaa tgcccctgta aacttttata attatattca ggattattat	300
tctaatttgt cccctattag gccttcaatg gttaggcaag ttgctgaaag ggaaggaacc	360
caggtaaatt ttggccatac ctacagaata gatgatgctg acagtataca agaagttacc	420
caaagaatgg agttaagaaa taaagagaat gtacattcag gagagtttat agaaaaaact	480
attgccccag gaggtgctaa tcaaagaact gtcctcaat ggatgttgcc tttgcttcta	540
ggcctgtacg ggactgtaac acctgctctt gaagcatatg aagatggccc caaccaaaag	600
aaaaggagag tgtccagggg cagctcccaa aaagccaaag gaaccctgc aagtgccaaa	660

actactaata aaaggaggag tagaagttct agaagttaa 699

<210> 30

<211> 1089

<212> DNA

<213> BK virus

<400> 30

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ggggtagatg ctataacaga ggtagaatgc tttctaaatc cagaaatggg ggatccagat	180
aatgacctta ggggctatag tctaaagcta actgctgaaa atgcctttga cagtgatagc	240
ccagacaaaa aaatgcttcc ttgttacagc acagcaagaa ttccactgcc caatctaaat	300
gaggacctaa cctgtggaaa tctactaatg tgggaggctg taactgtaaa aacagaggtt	360
attggaataa ctagcatgct taaccttcat gcagggtccc aaaaagttca tgagaatggg	420
ggaggcaaac ctgtgcaagg cagtaatttc cacttctttg ctgtgggtgg agacccttg	480
gaaatgcagg gagtgctaata gaattacaga acaaagtacc cacaaggtag tataaccct	540
aaaaacccta cagctcagtc ccaggtaatg aatactgctc ataaggccta tttggacaaa	600
aacaatgctt atccagttga gtgctggatt cctgaccta gtagaaatga aaatactagg	660
tatttttgaa cttacacagg aggggaaaat gttccccag tacttcatgt taccaacaca	720
gctaccacag tgttgctgga tgaacagggt gtggggcctc tatgtaaagc tgacagcctg	780
tatgtttcag ctgctgatat ttgtgggctg tttactaaca gctctgggac acaacagtgg	840
agaggccttg caagatattt taagattcgc ctgagaaaaa gatctgtgaa gaatccttac	900
ccaatttcct ttttgctaag tgaccttata aacaggagaa ccaaaaaagt ggatgggcag	960
cctatgtatg gtatggaatc tcagggtgag gaggtgaggg tgtttgatgg cacagaacag	1020
cttcaggggg acccagatat gataagatat attgacagac aaggacaatt gcaaacaaaa	1080
atggttttaa	1089

<210> 31

<211> 1056

<212> DNA

<213> BK virus

<400> 31

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gccacaggat tttcagtggc tgaaattgct gctggggagg ctgctgctgc catagaagtt	120
caaattgcat cccttgctac tgtagagggc ataacaacta cctcagaggc tatagctgct	180
ataggcctaa cacctcaaac atatgctgta attgctggtg ctccaggggc tattgctggg	240
tttgctgctt taattcaaac tgttactggg attagttctt tggtcgaagt agggatatagg	300
tttttttagtg attgggatca caaagtttcc actgtaggcc tttatcagca atcaggcatg	360
gcttttgaat tctttaagcc agatgactac tatgatattt tctttcctgg tctaaatact	420

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gccccgggaa  cgcctcaaccc  agacgagcaac  cctgcaacccc  cgcctccctgg  cgcctcaaccc  120
tttgtaaata  atattcaata  tctagatcct  aggcatggg  gtccttcttt  gtttgctact  480
atttctcagg  ctttgtggca  tgttattaga  gatgatatac  ctgctataac  ttcacaagaa  540
ttgcaaagga  gaacagaaag  attttttagg  gactctttgg  ctagattttt  ggaagaaacc  600
acctggacaa  ttgtaaatgc  ccctgtaaac  ttttataatt  atattcagga  ttattattct  660
aatttgctcc  ctattaggcc  ttcaatgggt  aggcaagtag  ctgaaaggga  aggtacccat  720
gtaaattttg  gccataccta  cagcatagat  gatgctgaca  gtatagaaga  agttacccaa  780
agaatagagt  taagaaataa  ggaaagtgt  cattcaggag  agtttataga  aaaaactatt  840
gccccaggag  gtgctaata  aagaactgct  cctcaatgga  tggtgccttt  gcttctaggg  900
ctgtacggga  ctgtaacacc  tgctcttgaa  gcatatgaag  atggccccc  ccaaaagaaa  960
aggagagtgt  ccaggggcag  ctcccaaaaa  gccaaaggaa  cccgtgcaag  tgccaaaact  1020
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<210> 32

<211> 699

<212> DNA

<213> BK virus

<400> 32

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actattttct  aggctttgtg  gcatgttatt  agagatgata  tacctgctat  aacttcacaa  180
gaattgcaaa  ggagaacaga  aagatttttt  agggactctt  tggctagatt  tttggaagaa  240
accacctgga  caattgtaaa  tgcccctgta  aacttttata  attatattca  ggattattat  300
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catgtaaatt  ttggccatac  ctacagcata  gatgatgctg  acagtataga  agaagttacc  420
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attgccccag  gaggtgctaa  tcaaagaact  gctcctcaat  ggatgttgcc  tttgcttcta  540
ggcctgtacg  ggactgtaac  acctgctctt  gaagcatatg  aagatggccc  caaccaaag  600
aaaaggagag  tgtccagggg  cagctcccaa  aaagccaaag  gaaccctgct  aagtgcctaa  660
actactaata  aaaggaggag  tagaagttct  agaagttaa  699

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<210> 33

<211> 1089

<212> DNA

<213> BK virus

<400> 33

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atggccccc  ccaaaagaaa  aggagagtgt  ccaggggcag  ctcccaaaaa  gccaaaggaa  60
cccgtgcaag  tgccaaaact  actaataaaa  ggaggagtag  aagttctaga  agttaaaact  120
ggggtagatg  ctataacaga  ggtagaatgc  tttctaaacc  cagaaatggg  ggatccagat  180
gatcacctta  ggggctatag  tcagcaccta  actgctgaaa  atgcctttga  cagtgatagc  240

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ccagacaaaa aaatgcttcc ttgttacagt acagcaagaa ttccactgcc caacctaata 300
gaggaccta cctgtggaaa tctactaatg tgggaggctg taactgtaaa aacagagggt 360
attggaataa ctagcatgct taaccttcat gcaggggtccc aaaaagttca tgagaatggt 420
ggaggtaaac ctgtccaagg cagtaatttc cacttctttg ctgtgggtgg agacccttg 480
gaaatgcagg gagtgctaata gaattacaga acaaagtacc cacaaggtag tataaccct 540
aaaaacccta cagctcagtc ccaggtaatg aatactgata ataaggccta tttggacaaa 600
aacaatgctt atccagttga gtgctggatt cctgatacta gtaaaaatga aaatactagg 660
tatttttgaa cttacacagg aggggaaaat gttcctccag tacttcatgt taccaacaca 720
gctaccacag tgttgctgga tgaacagggt gtggggcctc tgtgtaaagc tgatagcctg 780
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ccaatttcct ttttgctaag tgacctata aacaggagaa cccaaaaagt ggatgggcag 960
cctatgtatg gtatggaatc tcagggtgag gaggtaaggg tgtttgatgg cacagaacag 1020
cttccagggg acccagatat gataagatat attgacagac aaggacaatt gcaaacaaaa 1080
atggtttaa 1089

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<210> 34

<211> 1056

<212> DNA

<213> BK virus

<400> 34

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atgggtgctg ctctagcaact tttgggggac ctagttgcca gtgtatctga ggctgctgct 60
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caaattgcat cccttgctac tgtagagggc ataacaacta cctcagaggc tatagctgct 180
ataggccta cactcaaac atatgctgta attgctggtg ctccaggggc tattgctggg 240
tttctgctt taattcaaac tgttactggt attagttctt tggctcaagt agggatatagg 300
tttttttagtg attgggatca caaagtttcc actgtaggcc tttatcagca atcaggcatg 360
gctttggaat tgtttaacc agatgagtag tatgatattt tgtttcctgg tgtaaataacc 420
tttggttaata atattcaata tctagatcct aggcattggg gtcccttctt gtttgctact 480
atttcccagg ctttgtggca tgttattaga gatgatatac ctgctataac ttcacaagaa 540
ttgcaaagga gaacagagag attttttagg gactctttgg ctagattttt ggaagaaacc 600
acctggacaa ttgtaaatgc cccataaac ttttataatt atattcagga ttattattct 660
aatttgctcc ctattaggcc ttcaatgggt aggcaagtag ctgaaaggga aggtacccat 720
gtaaattttg gccataccta cagcatagat aatgctgaca gtatagaaga agttacccaa 780
agaatggatt taagaaataa ggaaagtgt cattcaggag agtttataga aaaaactatt 840
gcccaggag gtgctaatac aagaactgct cctcaatgga tgttgccctt gcttctaggc 900
ctgtacggga ctgtaacacc tgcctctgaa gcatatgaag atggccccc ccaaaagaaa 960

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aggagagtgt ccaggggcag cccccaaaa gccaaaggaa cccgtgcaag tgccaaaact 1020
 actaataaaa ggaggagtag aagttctaga agttaa 1056

<210> 35
 <211> 699
 <212> DNA
 <213> BK virus

<400> 35
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 acctttgtta ataatttca atatctagat cctaggcatt ggggtccttc tttgtttgct 120
 actatttccc aggctttgtg gcatgttatt agagatgata tacctgctat aacttcacaa 180
 gaattgcaaa ggagaacaga gagatTTTTT agggactctt tggctagatt tttggaagaa 240
 accacctgga caattgtaaa tgccccata aacttttata attatattca ggattattat 300
 tctaatttgt cccctattag gccttcaatg gttaggcaag tagctgaaag ggaaggtaac 360
 catgtaaatt ttggccatac ctacagcata gataatgctg acagtataga agaagttacc 420
 caaagaatgg atttaagaaa taaggaaagt gtacattcag gagagtttat agaaaaaact 480
 attgccccag gaggtgctaa tcaaagaact gctcctcaat ggatgttgcc tttgcttcta 540
 ggctgtacg ggactgtaac acctgctctt gaagcatatg aagatggccc caaccaaag 600
 aaaaggagag tgtccagggg cagctcccaa aaagccaaag gaaccctgc aagtgccaaa 660
 actactaata aaaggaggag tagaagttct agaagttaa 699

<210> 36
 <211> 1065
 <212> DNA
 <213> JC virus

<400> 36
 atggccccaa caaaaagaaa aggagaaagg aaggaccccg tgcaagttcc aaaacttctt 60
 ataagaggag gagtagaagt tctagaagtt aaaactgggg ttgactcaat tacagaggta 120
 gaatgctttt taactccaga aatgggtgac ccagatgagc atcttagggg ttttagtaag 180
 tcaatatcta tatcagatac atttgaaagt gactcccaa ataggacat gcttccttgt 240
 tacagtgtgg ccagaattcc actaccaat ctaaagagg atctaacctg tggaaatata 300
 ctcatgtggg aggctgtgac cttaaaaact gaggttatag gggtgacaag tttgatgaat 360
 gtgcactcta atgggcaagc aactcatgac aatgggtgag ggaagccagt gcagggcacc 420
 agctttcatt ttttttctgt tgggggggag gctttagaat tacagggggg gctttttaat 480
 tacagaacaa agtaccaga tggacaatt tttccaaaga atgccacagt gcaatctcaa 540
 gtcatgaaca cagagcacia ggcgtaacta gataagaaca aagcatatcc tgttgaatgt 600
 tgggttcctg atcccaccag aaatgaaaac acaagatatt ttgggacact aacaggagga 660
 gaaaatgttc ctccagttct tcatataaca aacactgcca caacagtgtt gcttgatgaa 720
 tttggtgttg ggccactttg caaagggtgac aacttatact tgtcagctgt tgatgtctgt 780

ggcatgttta caaacaggtc tggttcccag cagtggagag gactctccag atattttaag	840
gtgcagctaa ggaaaaggag ggtaaaaaac ccctacccaa tttctttcct tcttactgat	900
ttaattaaca gaaggactcc tagagttgat gggcagccta tgtatggcat ggatgctcaa	960
gtagaggagg ttagagtttt tgagggaaca gaggagcttc caggggaccc agacatgatg	1020
agatacgttg acaaatatgg acagttgcag acaaaaatgc tgtaa	1065

<210> 37

<211> 1035

<212> DNA

<213> JC virus

<400> 37

atgggtgccg cacttgcaact tttgggggac ctagttgcta ctgtttctga ggctgctgct	60
gccacaggat tttcagtagc tgaaattgct gctggagagg ctgctgctac tatagaagtt	120
gaaattgcat cccttgctac tgtagagggg attacaagta cctctgaggc tatagctgct	180
ataggcctta ctccctgaaac atatgctgta ataactggag ctccgggggc tgtagctggg	240
tttgctgcat tggttcaaac tgtaactggt ggtagtgcta ttgctcagtt gggatataga	300
ttttttgctg actgggatca taaagtttca acagttgggc tttttcagca gccagctatg	360
gctttacaat tatttaatcc agaagactac tatgatattt tatttcctgg agtgaatgcc	420
tttgtttaaca atattcacta tttagatcct agacattggg gcccgctcctt gttctccaca	480
atctcccagg ctttttgga tcttgttaga gatgatttgc cagccttaac ctctcaggaa	540
attcagagaa gaacccaaaa actatttggt gaaagttag caaggttttt ggaagaaact	600
acttgggcaa tagttaattc accagctaac ttatataatt atatttcaga ctattattct	660
agattgtctc cagttaggcc ctctatggta aggcaagttg cccaaaggga gggaacctat	720
atttcttttg gccactcata cacccaaagt atagatgatg cagacagcat tcaagaagtt	780
acccaaaggc tagattttaa aaccccaa atgtgcaatctg gtgaatttat agaaagaagt	840
attgcaccag gaggtgcaaa tcaaagatct gctcctcaat ggatgttgcc tttactttta	900
gggttgtagc ggactgtaac acctgctctt gaagcatatg aagatggccc caacaaaaag	960
aaaaggagaa aggaaggacc ccgtgcaagt tccaaaactt cttataagag gaggagtaga	1020
agttctagaa gttaa	1035

<210> 38

<211> 678

<212> DNA

<213> JC virus

<400> 38

atggctttac aattatttaa tccagaagac tactatgata ttttatttcc tggagtgaat	60
gcctttgtta acaatattca ctatttagat cctagacatt ggggcccgtc cttgttctcc	120
acaatctccc aggctttttg gaatcttggt agagatgatt tgccagcctt aacctctcag	180
gaaattcaga gaagaacca aaaactatatt gttgaaagtt tagcaagggt tttggaagaa	240
actacttccc caataattaa ttcaccagct aacttatata attatatttc aaactattat	300

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tctagattgt ctccagttag gccctctatg gtaaggcaag ttgcccaaag ggagggaacc 360
tatatttctt ttggccactc atacacccaa agtatagatg atgcagacag cattcaagaa 420
gttacccaaa ggctagattt aaaaacccca aatgtgcaat ctggtgaatt tatagaaaga 480
agtattgcac caggaggtgc aaatcaaaga tctgctcctc aatggatgtt gcctttactt 540

ttagggttgt acgggactgt aacacctgct cttgaagcat atgaagatgg cccaacaaa 600
aagaaaagga gaaaggaagg accccgtgca agttccaaaa cttcttataa gaggaggagt 660
agaagttcta gaagttaa 678

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<210> 39

<211> 1089

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-optimized BKV-IVc2 VP1

<400> 39

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atggcaccca caaagcgcaa gggcggaatgc cccggcgccg ccccaaagaa acccaaggag 60
ccagtcacagg tccccaagtt gctgatcaag ggcggcgtgg aggtcctgga ggtcaagacc 120
ggcgtggacg ccatcaccca ggtggagtgt ttcttgaacc ccgagatggg cgaccccgac 180
aacgatctgc gcgggtacag cttgcgcctg accgccgaga ccgcattcga ttccgactca 240
cccgatcgca agatgttgcc atgctattcc accgcccgca tcccactgcc caacctcaac 300
gaagacttga catgcggcaa cctgctgatg tgggaagccg tcaccgtgaa gaccgaagtc 360
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ggcgggaagc ccatccaggg gtcaaacttc catttcttcg ccgtcggcgg cgatccactc 480
gagatgcaag gcgtgttgat gaactatcgc accaagtatc ccgagggcac cgtgacaccc 540
aagaacccaa ccgcccacaa tcagggtcatg aacaccgatc acaaagcata tctcgataag 600
aataacgcct accccgtcga gtgttggatc cccgatccat ccaagaacga gaacaccgcg 660
tacttcggca cctataccgg cggcgagaac gtcccacccg tggtgcacgt gacaaatacc 720
gccacaaccg tcctgctcga cgagcaaggc gtcggcccac tctgcaaggc agacagcctc 780
tacgtcagcg ccgccgacat ctgcggactg ttcaccaatt caageggcac ccagcaatgg 840
cgcggggttg cccgctactt caaaatcagg ctccgcaagc gcagcgtgaa gaatccctat 900
ccaatcagtt tcctgctgtc cgatttgatc aatcgccgca cacaacgcgt cgacggccag 960
cccatgtacg gcatggaaag ccaagtcgaa gaagtgcgcg tcttcgacgg gaccgagcag 1020
ttgcccggcg atcccacat gatccgctac atcgatcgcc aaggccagct ccaaaccaag 1080
atggtctga 1089

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<210> 40

<211> 1056

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-optimized BKV-IVc2 VP2

<400> 40

atgggagcag ctctggcatt gctcggagat ctggtcgcat ctgtgtccga agcagccgct	60
gcaactggat tcagcgtcgc cgagatcgct gccggcgaag cagctgccgc aatcgaggtc	120
cagatcgcaa gtctggccac tgtggaaggg atcacctcta caagcgaagc catcgctgcc	180
atcggattga cccctcaaac ctacgccgtg atcgctggcg cacctggcgc aatcgctggt	240
ttcgccgcac tgatccagac tgtcaccgga atctcgagcc tcgcccaggt cggatatcgg	300
ttctttctcg actgggacca taaggctcagt accgtggggg tgtaccaaca aagcgggatg	360
gccctcgagc tcttcaatcc cgacgaatac tacgacatcc tgttccctgg cgtgaacacc	420
ttcgtgaaca acatccagta tctggacccc cgccactggg gaccaagcct gttcgccaca	480
atcagtcaag ccctctggca cgtcatccgc gacgacatcc ccgcatcac aagccaggag	540
ctccagcgcc gcaccgaaag gtttttccgc gatagtctcg caagattcct cgaggagacc	600
acatggacca tcgtgaacgc acccgtgaat ttctacaact acatccaaga ctactactcc	660
aacctgagtc ccatccgccc aagcatggtc cgccaagtcg ccgagcgcgga gggcacacaa	720
gtgaacttcg ggcacacata tcgcatcgac gacgccgatt ccatccagga ggtcacacag	780
cgcattggaac tgcgcaacaa ggaaaacgtg cacagcggcg aattcatcga gaagaccatc	840
gcacccggcg gcgccaacca gcgcaccgcc ccacaatgga tgctcccact cttgctgggg	900
ctctatggca ccgtgacccc tgccctggag gcctacgagg acgggcaaaa tcagaaaaag	960
cgccgcgtca gtcgcgggtc aagtcagaag gcaaagggca caagggcctc cgcaaagacc	1020
accaacaagc gccgctcccg gtogagccgc tcatga	1056

<210> 41

<211> 699

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-optimized BKV-IVc2 VP3

<400> 41

atggccctcg agctcttcaa tcccagcgaa tactacgaca tcctgttccc tggcgtgaac	60
accttcgtga acaacatcca gtatctggac ccccgccact ggggaccaag cctgttcgcc	120
acaatcagtc aagccctctg gcacgtcatc cgcgacgaca tccccgccat cacaagccag	180
gagctccagc gccgcaccga aagggttttc cgcgatagtc tcgcaagatt cctcgaggag	240
accacatgga ccatcgtgaa cgcacccgtg aatttctaca actacatcca agactactac	300
tccaacctga gtcccatccg cccaagcatg gtccgccaag tcgccgagcg cgagggcaca	360
caagtgaact tcgggcacac atatcgcatc gacgacgccg attccatcca ggaggtcaca	420
cagcgcattg aactgcgcaa caaggaaaac gtgcacagcg gcgaattcat cgagaagacc	480

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atcgaccccg gcggcgccaa ccagcgcacc gccccacaat ggatgctccc actcttgctg      540
gggctctatg gcaccgtgac ccctgccctg gaggcctacg aggacggggc aaatcagaaa      600
aagcgccgcg tcagtcgcgg gtcaagtcag aaggcaaagg gcacaagggc ctccgcaaag      660
accaccaaca agcgccgctc ccggtcgagc cgctcatga      699

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<210> 42

<211> 1089

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-optimized BKV-Ia VP1

<400> 42

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atggcaccca caaagcgcaa gggcgaatgc cccggcgccg ccccaaagaa acccaaggag      60
ccagtccagg tccccaagtt gctgatcaag ggcggcgtgg aggtcctgga ggtcaagacc      120
ggcgtggacg ccatcaccga ggtggagtgt ttcttgaacc ccgagatggg cgaccccgac      180
gagaacctgc gcgggttcag cttgaagctg agcgccgaga acgacttcag ctccgactca      240
cccgaacgca agatgttgcc atgctattcc accgcccgca tcccaactgc caacctcaac      300
gaagacttga catgcggcaa cctgctgatg tgggaagccg tcaccgtgca gaccgaagtc      360
atcggcatca cctccatggt gaatctgcac gccggaagcc aaaaggtgca cgagcacggc      420
ggcgggaagc ccatccaggg gtcaaacttc catttcttcg ccgtcggcgg cgatccactc      480
gagatgcaag gcgtgttgat gaactatcgc accaagtatc ccgacggcac catcacaccc      540
aagaacccaa ccgccc aaag tcaggtcatg aacaccgatc acaaagcata tctcgataag      600
aataacgcct accccgtcga gtgttgggtc cccgatccat cccggaacga gaacacccgc      660
tacttcggca cctttaccgg cggcgagaaac gtcccacccg tgttgcacgt gacaaatacc      720
gccacaaccg tcctgctcga cgagcaaggc gtcggcccac tctgcaaggc agacagcctc      780
tacgtcagcg ccgccgacat ctgcggactg ttcaccaatt caagcggcac ccagcaatgg      840
cgcggggttg cccgctactt caaaatcagg ctccgcaagc gcagcgtgaa gaatccctat      900
ccaatcagtt tcctgctgtc cgatttgatc aatcgccgca cacaacgcgt cgacggccag      960
cccatgtacg gcatggaaag ccaagtcgaa gaagtgcgcg tcttcgacgg gaccgagcgg      1020
ttgcccggcg atcccgacat gatccgctac atcgataagc aaggccagct ccaaaccaag      1080
atgctgtga      1089

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<210> 43

<211> 1089

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-optimized BKV-Ib2 VP1

<400> 43

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atggcaccca caaagcgcaa gggcgaatgc cccggcgccg ccccaaagaa acccaaggag      60
ccagtccagg tccccaagtt gctgatcaag ggcggcgtgg aggtcctgga ggtcaagacc      120
ggcctggacg ccatcaccga ggtggagtgt ttcttgaacc ccgagatggg cgaccccgac      180
gagaacctgc gcgggttcag cttgaagctg agcgccaaga acgacttcag ctccgactca      240
cccgaccgca agatgttgcc atgctattcc accgcccgca tcccactgcc caacctcaac      300
gaagacttga catgcggcaa cctgctgatg tgggaagccg tcaccgtgca gaccgaagtc      360
atcggcatca cctccatggt gaatctgcac gccggaagcc aaaaggtgca cgagcacggc      420
ggcgggaagc ccatccaggg gtcaaacttc catttcttcg ccgtcggcgg cgatccactc      480
gagatgcaag gcgtgttgat gaactatcgc accaagtatc ccgaaggcac catcacaccc      540
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tacttcggca cctttaccgg cggcgagaac gtcccaccgg tgttgcaagt gacaaatacc      720
gccacaaccg tcctgctcga cgagcaaggc gtcggcccac tctgcaaggc agacagcctc      780
tacgtcagcg ccgcccacat ctgcggactg ttcaccaatt caagcggcac ccagcaatgg      840
cgcggggttg cccgctactt caaaatcagg ctccgcaagc gcagcgtgaa gaatccctat      900
ccaatcagtt tcctgctgtc cgatttgatc aatcgccgca cacaacgcgt cgacggccag      960
cccatgtacg gcatggaaag ccaagtcgaa gaagtgcgcg tcttcgacgg gaccgagcgg     1020
ttgcccggcg atcccgacat gatccgctac atcgataagc aaggccagct ccaaaccaag     1080
atgctgtga                                     1089

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<210> 44

<211> 1089

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-optimized BKV-Ic VP1

<400> 44

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atggcaccca caaagcgcaa gggcgaatgc cccggcgccg ccccaaagaa acccaaggag      60
ccagtccagg tccccaagtt gctgatcaag ggcggcgtgg aggtcctgga ggtcaagacc      120
ggcgtggacg ccatcaccga ggtggagtgt ttcttgaacc ccgagatggg cgaccccgac      180
gagaacctgc gcgggttcag cttgaagctg agcgtcgaga acgacttcag ctccgactca      240
ccccaacgca agatgttgcc atgctattcc accgcccgca tcccactgcc caacctcaac      300
gaagacttga catgcggcaa cctgctgatg tgggaagccg tcaccgtgca gaccgaagtc      360
atcggcatca cctccatggt gaatctgcac gccggaagcc aaaaggtgca cgagcacggc      420
ggcgggaagc ccatccaggg gtcaaacttc catttcttcg ccgtcggcgg cgatccactc      480
gagatgcaag gcgtgttgat gaactatcgc accaagtatc ccgaaggcac catcacaccc      540
aagaacccaa cccccc aaag tcagatcatg aacaccgatc acaaagcata tctcgataag      600

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aataacgcct accccgtcga gtggttgatc cccgatccat cccggaacga gaacacccgc 660
tacttcggca ccttgaccgg cggcgagaaac gtcccacccg tggtgcacgt gacaaatacc 720
gccacaaccg tcctgctcga cgagcaaggc gtcggcccac tctgcaaggc agacagcctc 780
tacgtcagcg ccgccgacat ctgcggactg ttcaccaatt caagcggcac ccagcaatgg 840
cgcggggttg cccgctactt caaaatcagg ctccgcaagc gcagcgtgaa gaatccctat 900
ccaatcagtt tcctgctgtc cgatttgatc aatcgccgca cacaacgcgt cgacggccag 960
cccatgtacg gcatggaaag ccaagtcgaa gaagtgcgcg tcttcgacgg gaccgagaag 1020
ttgcccggcg atcccgacat gatccgctac atcgataagc aaggccagct ccaaaccaag 1080
atgctgtga 1089

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<210> 45

<211> 1089

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-optimized BKV-II VP1

<400> 45

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atggcaccca caaagcgcaa gggcggaatgc cccggcgccg ccccaaagaa acccaaggag 60
ccagtccagg tccccaagtt gctgatcaag ggcggcgtgg aggtcctgga ggtcaagacc 120
ggcgtggacg ccatcaccga ggtggagtgt ttcttgaacc ccgagatggg cgaccccgac 180
aacgatctgc gcgggtacag cttgaagctg accgcccaga acgcattcga ttccgactca 240
cccgataaga agatgttgcc atgctattcc accgcccgca tcccactgcc caacctcaac 300
gaagacttga catgcggcaa cctgctgatg tgggaagccg tcaccgtgaa gaccgaagtc 360
atcggcatca cctccatgtt gaatctgcac gccggaagcc aaaaggtgca cgagaacggc 420
ggcgggaagc ccgtccaggg gtcaaacttc catttcttcg ccgtcggcgg cgatccactc 480
gagatgcaag gcgtgttgat gaactatcgc accaagtatc cccaaggcac catcacaccc 540
aagaacccaa ccgccc aaag tcaggatcatg aacaccgatc acaaagcata tctcgataag 600
aataacgcct accccgtcga gtggttgatc cccgatccat cccggaacga gaacacccgc 660
tacttcggca cctataccgg cggcgagaaac gtcccacccg tggtgcacgt gacaaatacc 720
gccacaaccg tcctgctcga cgagcaaggc gtcggcccac tctgcaaggc agacagcctc 780
tacgtcagcg ccgccgacat ctgcggactg ttcaccaatt caagcggcac ccagcaatgg 840
cgcggggttg cccgctactt caaaatcagg ctccgcaagc gcagcgtgaa gaatccctat 900
ccaatcagtt tcctgctgtc cgatttgatc aatcgccgca caaaaagggt cgacggccag 960
cccatgtacg gcatggaaag ccaagtcgaa gaagtgcgcg tcttcgacgg gaccgagcag 1020
ttgcccggcg atcccgacat gatccgctac atcgatcgcc aaggccagct ccaaaccaag 1080
atggtctga 1089

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<210> 46

<211> 1089

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-optimized BKV-III VP1

<400> 46

atggcaccca caaagcgcaa gggcgaatgc cccggcgccg ccccaaagaa acccaaggag	60
ccagtccagg tccccaagtt gctgatcaag ggcggcgtgg aggtcctgga ggtcaagacc	120
ggcgtggacg ccatcacca ggtggagtgt ttcttgaacc ccgagatggg cgaccccgac	180
gaccatctgc gcgggtacag ccagcacctg accgccgaga acgcattcga ttccgactca	240
cccgataaga agatgttgcc atgctattcc accgcccgca tcccactgcc caacctcaac	300
gaagacttga catgcggcaa cctgctgatg tgggaagccg tcaccgtgaa gaccgaagtc	360
atcggcatca cctccatgtt gaatctgcac gccggaagcc aaaaggtgca cgagaacggc	420
ggcgggaagc ccgtccaggg gtcaaacttc catttcttcg ccgtcggcgg cgatccactc	480
gagatgcaag gcgtgttgat gaactatcgc accaagtatc cccaaggcac catcacaccc	540
aagaacccaa ccgccc aaag tcagggtcatg aacaccgatc acaaagcata tctcgataag	600
aataacgcct accccgtcga gtgttggatc cccgatccat ccaagaacga gaacaccgcg	660
tacttcggca cctataccgg cggcgagaac gtcccacccg tgttgcacgt gacaaatacc	720
gccacaaccg tcctgctcga cgagcaaggc gtcggccac tctgcaaggc agacagcctc	780
tacgtcagcg ccgccgacat ctgcggactg ttcaccaatt caagcggcac ccagcaatgg	840
cgcgggttgg cccgctactt caaaatcagg ctccgcaagc gcagcgtgaa gaatccctat	900
ccaatcagtt tcctgctgtc cgatttgatc aatcgccgca cacaaaaggt cgacggccag	960
cccatgtacg gcatggaaag ccaagtcgaa gaagtgcgcg tcttcgacgg gaccgagcag	1020
ttgcccggcg atcccgacat gatccgctac atcgatcgcc aaggccagct ccaaaccaag	1080
atggtctga	1089

<210> 47

<211> 1089

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-optimized BKV-IVb1 VP1

<400> 47

atggcaccca caaagcgcaa gggcgaatgc cccggcgccg ccccaaagaa acccaaggag	60
ccagtccagg tccccaagtt gctgatcaag ggcggcgtgg aggtcctgga ggtcaagacc	120
ggcgtggacg ccatcacca ggtggagtgt ttcttgaacc ccgagatggg cgaccccgac	180
aacgatctgc gcgggtacag cttgcgcctg accgccgaga ccgcattcaa ttccgactca	240

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cccgatcgca agatgttgcc atgctattcc accgcccgca tcccactgcc caacctcaac      300
gaagacttga catgcggcaa cctgctgatg tgggaagccg tcaccgtgaa gaccgaagtc      360
atcggcatca cctccatggt gaatctgcac gccggaagcc aaaaggtgca cgacaacggc      420
ggcgggaagc ccatccaggg gtcaaacttc catttcttcg ccgtcggcgg cgatccactc      480
gagatgcaag gcgtgttgat gaactatcgc accaagtatc ccgagggcac cgtgacaccc      540
aagaacccaa ccgccc aaag tcagggtcatg aacaccgatc acaaagcata tctcgataag      600
aataacgcct accccgtcga gtgttggtat cccgatccat cccgaaacga gaacaccgcg      660
tacttcggca cctataccgg cggcgagaac gtcccacccg tgttgacagt gacaaatacc      720
gccacaaccg tcctgctcga cgagcaaggc gtccggccac tctgcaaggc agacagcctc      780
tacgtcagcg ccgccgacat ctgcggactg ttcaccaatt caagcggcac ccagcaatgg      840
cgcggttgc cccgctactt caaaatcagg ctccgcaagc gcagcgtgaa gaatccctat      900
ccaatcagtt tcctgctgtc cgatttgatc aatcgccgca cacaacgcgt cgacggccag      960
cccatgtacg gcattgaaag ccaagtcgaa gaagtgcgcg tcttcgacgg gaccgagaag     1020
ttgcccgcg atcccgacat gatccgctac atcgatcgcc aaggccagct ccaaaccaag     1080
atggtctga                                     1089

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<210> 48

<211> 1065

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-optimized JCV-2A VP1

<400> 48

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atggcaccca caaagcgcaa gggcgaacgc aaggaccagc tcaggtccc caagttgctg      60
atcaggggcg gcgtggaggt cctggaggtc aagaccggcg tggactccat caccgaggtg     120
gagtgtttct tgacaccgga gatgggcgac cccgacgagc acctgcgcgg gttcagcaag     180
agcatcagca tcagcgacac attcgagtcg gactcaccda ataaggacat gttgccatgc     240
tattccgtcg cccgcatccc actgccc aac ctcaacgaag acttgacatg cggcaacatc     300
ctgatgtggg aagccgtcac actgaagacc gaagtcatcg gcgtcaccac cctgatgaat     360
gtgcactcca acggccaagc gacgcacgac aacggcgccg ggaagccagt ccaggggaca     420
agcttccatt tcttcagcgt cggcggcgag gcactcgagc tgcaaggcgt ggtgttcaac     480
tatcgcacca agtatcccga cggcaccata ttccc aaga acgcaaccgt ccaaagtcag     540
gtcatgaaca ccgagcacia agcatatctc gataagaata aggcctaccc cgtcgagtgt     600
tgggtccccg atccaaccag gaacgagaac acccgctact tcggcaccct gaccggcggc     660
gagaacgtcc caccgtggtt gcacatcaca aataccgcca caaccgtcct gctcgacgag     720
ttcggcgctc gccactctg caaggagac aacctctacc tgagcgccgt cgacgtctgc     780
ggaatgttca ccaatcgaag cggcagccag caatggcgcg ggttgtccc ctacttcaa     840

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gtccagctcc gcaagcgccg cgtgaagaat ccctatccaa tcagtttcct gctgaccgat	900
ttgatcaatc gccgcacacc acgcgtcgac ggccagccca tgtacggcat ggacgccc	960
gtcgaagaag tgcgcgtatt cgaggggacc gaggagttgc ccggcgatcc cgacatgatg	1020
cgctacgtcg atcgctacgg ccagctccaa accaagatgc tatga	1065

<210> 49

<211> 1065

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-optimzed JCV-3B VP1

<400> 49

atggcacc	caaagcgcaa	gggcgaacgc	aaggaccag	tccaggtccc	caagttgctg	60
atcagggg	gcgtggaggt	cctggaggtc	aagaccggcg	tggactccat	caccgaggtg	120
gagtgttt	tgacaccoga	gatggg	cgac	acttccgcgg	gttcagcaag	180
agcatcag	ca	tcagcgacac	attcgagtcc	gactcacc	ataaggacat	240
gttgccatgc						
tattccgtcg	cccgc	atccc	actgccc	aaac	ctcaacgaag	300
acttgacatg	cggcaacatc					
ctgatgtggg	aagccgtcac	actgaagacc	gaagtc	atcg	gcgtcaccac	360
cctgatgaat						
gtgcactcca	acggccaagc	gacgcacgac	aacggcgccg	cgaagccagt	ccaggggaca	420
agcttccatt	tcttcagcgt	cggcggcgag	gcactcgagc	tgcaaggcgt	ggtgttcaac	480
tatcgacca	cgtatcccga	cggcaccata	ttccc	caaga	acgcaaccgt	540
ccaaagtcag						
gtcatgaaca	ccgagc	acaa	agcatatctc	gataagaata	aggcctaccc	600
cgtcgagtgt						
tgggtccccg	atccaaccag	gaacgagaac	acccgctact	tcggcaccct	gaccggcggc	660
gagaacgtcc	cacc	cg	tgtt	gcacatcaca	aataccgcca	720
caaccgtcct	gctcgacgag					
ttcggcgtcg	gccactctg	caagggagac	aacctctacc	tgagcgccgt	cgacgtctgc	780
ggaatgttca	ccaatcgaag	cggcagccag	caatggcgcg	ggttgtccc	gtacttcaaa	840
gtccagctcc	gcaagcgccg	cgtgaagaat	ccctatccaa	tcagtttcct	gctgaccgat	900
ttgatcaatc	gccgcacacc	acgcgtcgac	ggccagccca	tgtacggcat	ggacgccc	960
atcgaagaag	tgcgcgtatt	cgaggggacc	gagcagttgc	ccggcgatcc	cgacatgatg	1020
cgctacgtcg	atcgctacgg	ccagctccaa	accaagatgc	tatga		1065

<210> 50

<211> 1035

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-optimized JCV VP2 consensus

<400> 50

atggg	gcgag	ctctggc	ctt	gctcggcgat	ctggctgcca	ccgtcagcga	agccgcagcc	60
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gcaaccggat tcagcgtggc cgagatcgca gccggagaag ctgcagccac aatcgaggtc	120
gagatcgcca gtttggccac tgtggaaggc atcacctcca caagcgaagc catcgctgcc	180
atcggactga cacccgagac ctacgccgtg atcactggcg cacccgagc cgtggcagga	240
ttcgccgcac tcgtccaaac cgtgaccggc ggctccgcca tcgcccact cgggtaccgg	300
ttcttcgccg attgggacca caaggtcagc accgtcggct tgttccaaca acccgcaatg	360
gcactgcagc tgttcaaccc cgaggactac tacgacatcc tgttcccggg cgtcaacgca	420
ttcgtcaaca acatccatta cctggaccca cgccactggg ggcccagcct gttttcgacc	480
attagtcaag cattctggaa cttggtccgc gacgacctgc caagcctgac cagccaagag	540
atccagcgcc gcacacagaa gttgttcgtc gagtccctgg cccgcttcct ggaagagaca	600
acctgggcca tcgtcaacag ccccgctaat ctgtacaact acatcagcga ttactactcg	660
cgactcagcc ccgtccgccc aagcatggtc cgccaagtcg cacagcgcgga aggcacatac	720
atcagtttcg ggcatagcta tacacagtcc atcgacgacg ccgattcaat ccaggaggtc	780
acacagcgct tggacctgaa gacacccaac gtccagagcg gcgagttcat cgaaaagtcc	840
atcgcccctg gcggagcaaa ccagcgcagc gcaccacaat ggatgctgcc actggtgctg	900
ggcctctatg gcaccgtgac cccagcactg gaggcctacg aggacggacc aaacaagaaa	960
aagcgccgca aggaaggccc aagggcatcc agcaagacca gctacaaacg tcggtccagg	1020
tccagccgct cctga	1035

<210> 51

<211> 678

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-optimized JCV VP3 consensus

<400> 51

atggcactgc agctgttcaa ccccgaggac tactacgaca tcctgttccc gggcgtcaac	60
gcattcgtca acaacatcca ttacctggac ccacgccact gggggcccag cctgttttcg	120
accattagtc aagcattctg gaacttggtc cgcgacgacc tgccaagcct gaccagccaa	180
gagatccagc gccgcacaca gaagttgttc gtcgagtccc tggcccgtt cctggaagag	240
acaacctggg ccatcgtcaa cagccccgtc aatctgtaca actacatcag cgattactac	300
tcgcgactca gcccgtccg cccaagcatg gtccgccaag tcgcacagcg cgaaggcaca	360
tacatcagtt tcgggcatag ctatacacag tccatcgacg acgccgattc aatccaggag	420
gtcacacagc gcttggacct gaagacaccc aacgtccaga gcggcgagtt catcgaaaag	480
tccatcgccc ctggcggagc aaaccagcgc agcgcaccac aatggatgct gccactgttg	540
ctgggcctct atggcaccgt gaccccagca ctggaggcct acgaggacgg accaaacaag	600
aaaaagcgcc gcaaggaagg cccaagggca tccagcaaga ccagctacaa acgtcggctc	660
aggtccagcc gctcctga	678

<210> 52
 <211> 362
 <212> PRT
 <213> BK virus

<400> 52

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

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-      260      -      265      -      -      -      270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
 275                               280                               285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
 290                               295                               300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305                               310                               315                               320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
      325                               330                               335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
      340                               345                               350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
 355                               360

<210> 53
<211> 362
<212> PRT
<213> BK virus

<400> 53
Met Ala Pro Thr Lys Arg Lys Gly Glu Cys Pro Gly Ala Ala Pro Lys
 1      5      10      15

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
      20      25      30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
      35      40      45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
      50      55      60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
65      70      75      80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
      85      90      95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
      100      105      110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
      115      120      125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
      130      135      140

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

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Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Asp Gly
165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
195 200 205

Trp Val Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
355 360

<210> 54

<211> 362

<212> PRT

<213> BK virus

<400> 54

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Ile Gly Asp Pro Asp Glu Asn Leu Arg
50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
 65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Asp Gly
 165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Val Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
 260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
 275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
 290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
 305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
 325 330 335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
 340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu

117 355 360

<210> 55
 <211> 362
 <212> PRT
 <213> BK virus

<400> 55
 Met Ala Pro Thr Lys Arg Lys Gly Glu Cys Pro Gly Ala Ala Pro Lys
 1 5 10 15
 Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30
 Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
 35 40 45
 Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
 50 55 60
 Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
 65 70 75 80
 Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95
 Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110
 Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Pro Asn
 115 120 125
 Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
 130 135 140
 Ile Gln Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asp Pro Leu
 145 150 155 160
 Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Asp Gly
 165 170 175
 Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190
 Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205
 Trp Val Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220
 Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240
 Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
355 360

<210> 56

<211> 362

<212> PRT

<213> BK virus

<400> 56

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

Lys Pro Glu Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
130 135 140

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

140 150 160 170
 Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Asp Gly
 165 170 175
 Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190
 Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205
 Trp Val Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220
 Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240
 Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255
 Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
 260 265 270
 Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
 275 280 285
 Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
 290 295 300
 Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
 305 310 315 320
 Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
 325 330 335
 Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
 340 345 350
 Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
 355 360
 <210> 57
 <211> 362
 <212> PRT
 <213> BK virus
 <400> 57
 Met Ala Pro Thr Lys Arg Lys Gly Glu Cys Pro Gly Ala Ala Pro Lys
 1 5 10 15
 Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30
 Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
 50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
 65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Leu Asn Tyr Arg Thr Lys Tyr Pro Asp Gly
 165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Val Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
 260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
 275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
 290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
 305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
 325 330 335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
 340 345 350

340

345

350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
 355 360

<210> 58

<211> 362

<212> PRT

<213> BK virus

<400> 58

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
 50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
 65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Asp Gly
 165 170 175

Thr Val Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Val Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
355 360

<210> 59

<211> 362

<212> PRT

<213> BK virus

<400> 59

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Ser Asp Glu Asn Leu Arg
50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Asp Gly
165 170 175

Thr Val Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
195 200 205

Trp Val Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys

275

280

285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
355 360

<210> 60

<211> 362

<212> PRT

<213> BK virus

<400> 60

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val

35	40	45														
Glu	Cys	Phe	Leu	Asn	Pro	Glu	Met	Gly	Asp	Pro	Asp	Glu	Asn	Leu	Arg	
50						55					60					
Gly	Phe	Ser	Leu	Lys	Leu	Ser	Ala	Glu	Asn	Asp	Phe	Ser	Ser	Asp	Ser	
65					70					75					80	
Pro	Glu	Arg	Lys	Met	Leu	Pro	Cys	Tyr	Ser	Thr	Ala	Arg	Ile	Pro	Leu	
				85					90					95		
Pro	Asn	Leu	Asn	Glu	Asp	Leu	Thr	Cys	Gly	Asn	Leu	Leu	Met	Trp	Glu	
			100					105					110			
Ala	Val	Thr	Val	Gln	Thr	Glu	Val	Ile	Gly	Ile	Thr	Ser	Met	Leu	Asn	
		115					120					125				
Leu	His	Ala	Gly	Ser	Gln	Lys	Val	His	Glu	His	Gly	Gly	Gly	Lys	Pro	
130						135					140					
Ile	Gln	Gly	Ser	Asn	Phe	His	Phe	Phe	Ala	Val	Gly	Gly	Asp	Pro	Leu	
145					150					155					160	
Glu	Met	Gln	Gly	Val	Leu	Met	Asn	Tyr	Arg	Thr	Lys	Tyr	Pro	Asp	Gly	
				165					170					175		
Thr	Ile	Thr	Pro	Lys	Asn	Pro	Thr	Ala	Gln	Ser	Gln	Val	Met	Asn	Thr	
			180					185					190			
Asp	His	Lys	Ala	Tyr	Leu	Asp	Lys	Asn	Asn	Ala	Tyr	Pro	Val	Glu	Cys	
		195					200					205				
Trp	Val	Pro	Asp	Pro	Ser	Arg	Asn	Glu	Asn	Thr	Arg	Tyr	Phe	Gly	Thr	
210						215					220					
Phe	Thr	Gly	Gly	Glu	Asn	Val	Pro	Pro	Val	Leu	His	Val	Thr	Asn	Thr	
225					230					235					240	
Ala	Thr	Thr	Val	Leu	Leu	Asp	Glu	Gln	Gly	Val	Gly	Pro	Leu	Cys	Lys	
				245					250					255		
Ala	Asp	Ser	Leu	Tyr	Val	Ser	Ala	Ala	Asp	Ile	Cys	Gly	Leu	Phe	Thr	
			260				265						270			
Asn	Ser	Ser	Gly	Thr	Gln	Gln	Trp	Arg	Gly	Leu	Ala	Arg	Tyr	Phe	Lys	
		275					280					285				
Ile	Arg	Leu	Arg	Lys	Arg	Ser	Val	Lys	Asn	Pro	Tyr	Pro	Ile	Ser	Phe	
290						295					300					
Leu	Leu	Ser	Asp	Leu	Ile	Asn	Arg	Arg	Thr	Gln	Arg	Val	Asp	Gly	Gln	
305					310					315					320	
Pro	Met	Tyr	Gly	Met	Glu	Ser	Gln	Val	Glu	Glu	Val	Arg	Val	Phe	Asp	
				325					330					335		

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
 340 345 350

Arg Gln Gly Gln Leu Gln Thr Lys Met Leu
 355 360

<210> 61

<211> 362

<212> PRT

<213> BK virus

<400> 61

Met Ala Pro Thr Lys Arg Lys Gly Glu Cys Pro Gly Ala Ala Pro Lys

1 5 10 15

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
 50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
 65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Asp Gly
 165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Val Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Thr Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
355 360

<210> 62

<211> 362

<212> PRT

<213> BK virus

<400> 62

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Ser Lys Tyr Pro Asp Gly
165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
195 200 205

Trp Val Pro Asp Pro Ser Arg Asn Glu Asn Ala Arg Tyr Phe Gly Thr
210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
355 360

<210> 63

<211> 362

<212> PRT

<213> BK virus

<400> 63

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
 50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
 65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Asp Gly
 165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Val Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
 260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Arg
 275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
 290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
 305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Gly Glu Val Arg Val Phe Asp
 325 330 335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
 340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
 355 360

<210> 64

<211> 362

<212> PRT

<213> BK virus

<400> 64

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
 50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
 65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn

115

120

125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Asp Gly
 165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Val Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Leu Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
355 360

<210> 65

<211> 362

<212> PRT

<213> BK virus

<400> 65

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
100 105 110

Ala Val Thr Val Gln Thr Glu Val Thr Gly Ile Thr Ser Met Leu Asn

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

<210> 66

<211> 362

<212> PRT

<213> BK virus

<400> 66

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Gln Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
 50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
 65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
 130 135 140

Ile Arg Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asp Pro Leu
 145 150 155 160

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
 165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Val Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
 260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
 275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
 290 295 300

Ser Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
 305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
 325 330 335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
 340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
 355 360

<210> 67

<211> 362

<212> PRT

<213> BK virus

<400> 67

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
 50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
 65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
 165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Val Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
355 360

<210> 68

<211> 362

<212> PRT

<213> BK virus

<400> 68

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Tyr Asp Phe Ser Ser Asp Ser
65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
85 90 95

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

<210> 69

<211> 362

<212> PRT

<213> BK virus

<400> 69

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asn Glu Asn Leu Arg
 50 55 60

Gly Phe Ser Leu Met Leu Ser Ala Glu Asn Asp Phe Asn Ser Asp Ser
 65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Asp Gly
 165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Val Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
 260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
 275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe

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290          295          300
Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305          310          315          320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
          325          330          335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
          340          345          350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
          355          360

<210> 70
<211> 362
<212> PRT
<213> BK virus

<400> 70
Met Ala Pro Thr Lys Arg Lys Gly Glu Cys Pro Gly Ala Ala Pro Lys
1          5          10          15

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
          20          25          30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
          35          40          45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asn Glu Asn Leu Arg
          50          55          60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
65          70          75          80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
          85          90          95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
          100          105          110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
          115          120          125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
          130          135          140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Asp Gly
          165          170          175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
          180          185          190

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Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Val Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
 260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
 275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
 290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
 305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
 325 330 335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp

340

345

350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
 355 360

<210> 71

<211> 362

<212> PRT

<213> BK virus

<400> 71

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
 50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Gln Asn Asp Phe Ser Ser Asp Ser
 65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

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

<210> 72

<211> 362

<212> PRT

<213> BK virus

<400> 72

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
 50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Gln Asn Asp Phe Ser Ser Asp Ser

65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Trp Thr Lys Tyr Pro Glu Gly
 165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Val Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
 260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
 275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
355 360

<210> 73

<211> 362

<212> PRT

<213> BK virus

<400> 73

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Lys Asn Asp Phe Ser Ser Asp Ser
65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Asp Gly
165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
195 200 205

Trp Val Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
355 360

<210> 74

<211> 362

<212> PRT

<213> BK virus

<400> 74

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Thr Ser Phe Ala Arg Ile Pro Leu

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P10 Glu Arg Lys Met Leu P10 Cys Tyr Ser Thr Ala Arg Ile P10 Leu
      85                                90                                95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
      100                                105                                110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
      115                                120                                125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
      130                                135                                140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Asp Gly
      165                                170                                175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
      180                                185                                190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
      195                                200                                205

Trp Val Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
      210                                215                                220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
      225                                230                                235                                240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
      245                                250                                255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
      260                                265                                270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
      275                                280                                285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
      290                                295                                300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
      305                                310                                315                                320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
      325                                330                                335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
      340                                345                                350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
      355                                360

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<210> 75

<211> 362

<212> PRT

<213> BK virus

<400> 75

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Leu Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Lys Asn Asp Phe Ser Ser Asp Ser
65 70 75 80

Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr

180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
355 360

<210> 76

<211> 362

<212> PRT

<213> BK virus

<400> 76

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Leu Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Gln Asn Asp Phe Asn Ser Asp Ser
65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu Asn Gly Gly Gly Lys Pro
130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Lys Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
355 360

<210> 77

<211> 362

<212> PRT

<213> BK virus

<400> 77

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Leu Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser

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

<210> 78
 <211> 362
 <212> PRT
 <213> BK virus

<400> 78

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Leu Asp Ala Ile Thr Glu Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
 50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
 65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
 165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
 260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
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275 280 285
 Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe

 290 295 300
 Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
 305 310 315 320
 Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
 325 330 335
 Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
 340 345 350
 Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
 355 360

 <210> 79
 <211> 362
 <212> PRT
 <213> BK virus

 <400> 79
 Met Ala Pro Thr Lys Arg Lys Gly Glu Cys Pro Gly Ala Ala Pro Lys
 1 5 10 15

 Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

 Val Glu Val Leu Glu Val Lys Thr Gly Leu Asp Ala Ile Thr Glu Val
 35 40 45

 Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asn Glu Asn Leu Arg
 50 55 60

 Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
 65 70 75 80

 Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

 Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

 Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

 Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
 130 135 140

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

 Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
 165 170 175

165	170	175
Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr		
180	185	190
Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys		
195	200	205
Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr		
210	215	220
Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr		
225	230	235
Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys		
245	250	255
Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr		
260	265	270
Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys		
275	280	285
Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe		
290	295	300
Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln		
305	310	315
Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp		
325	330	335
Gly Thr Glu Lys Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp		
340	345	350
Lys Gln Gly Gln Leu Gln Thr Lys Met Leu		
355	360	

<210> 80

<211> 362

<212> PRT

<213> BK virus

<400> 80

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly

20

25

30

Val Glu Val Leu Glu Val Lys Thr Gly Leu Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
50 55 60

50 30 60
 Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
 65 70 75 80
 Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95
 Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110
 Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125
 Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
 130 135 140
 Ile Gln Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asp Pro Leu
 145 150 155 160
 Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
 165 170 175
 Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190
 Asp His Met Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205
 Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220
 Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240
 Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255
 Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
 260 265 270
 Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
 275 280 285
 Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
 290 295 300
 Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
 305 310 315 320
 Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
 325 330 335
 Gly Thr Glu Lys Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
 340 345 350
 Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
 355 360

<210> 81
 <211> 362
 <212> PRT
 <213> BK virus

<400> 81

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Leu Asp Ala Ile Thr Glu Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
 50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
 65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
 165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Ile Pro Asp Pro Thr Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Ile Thr Asn Thr
 225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr

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-      260      -      265      -      -      -      270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
 275                               280                               285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
 290                               295                               300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
 305                               310                               315                               320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
      325                               330                               335

Gly Thr Glu Lys Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
      340                               345                               350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
      355                               360

<210> 82
<211> 362
<212> PRT
<213> BK virus

<400> 82
Met Ala Pro Thr Lys Arg Lys Gly Glu Cys Pro Gly Ala Ala Pro Lys
 1              5              10              15

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
      20              25              30

Val Glu Val Leu Glu Val Lys Thr Gly Leu Asp Ala Ile Thr Glu Val
      35              40              45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
      50              55              60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
 65              70              75              80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
      85              90              95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
      100             105             110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
      115             120             125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
      130             135             140

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

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Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
 165 170 175
 Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190
 Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205
 Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220
 Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240
 Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255
 Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
 260 265 270
 Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
 275 280 285
 Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
 290 295 300
 Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
 305 310 315 320
 Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
 325 330 335
 Gly Thr Glu Lys Ser Ser Arg Asp Pro Asp Met Ile Arg Tyr Ile Asp
 340 345 350
 Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
 355 360
 <210> 83
 <211> 362
 <212> PRT
 <213> BK virus
 <400> 83
 Met Ala Pro Thr Lys Arg Lys Gly Glu Cys Pro Gly Ala Ala Pro Lys
 1 5 10 15
 Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30
 Val Glu Val Leu Glu Val Lys Thr Gly Leu Asp Ala Ile Thr Glu Val
 35 40 45
 Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
 50 55 60

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

Lys Gln Gly Gln Leu Gln Thr Lys Met Val
355 360

<210> 84

<211> 362

<212> PRT

<213> BK virus

<400> 84

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Leu Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys

				245						250						255			
Ala	Asp	Ser	Leu	Tyr	Val	Ser	Ala	Ala	Asp	Ile	Cys	Gly	Leu	Phe	Thr				
			260					265					270						
Asn	Ser	Ser	Gly	Thr	Gln	Gln	Trp	Arg	Gly	Leu	Ala	Arg	Tyr	Phe	Lys				
		275					280					285							
Ile	Arg	Leu	Arg	Lys	Arg	Ser	Val	Lys	Asn	Pro	Tyr	Pro	Ile	Ser	Phe				
	290					295					300								
Leu	Leu	Ser	Asp	Leu	Ile	Asn	Arg	Arg	Thr	Gln	Arg	Val	Asp	Gly	Gln				
305					310					315					320				
Pro	Met	Tyr	Gly	Met	Glu	Ser	Gln	Val	Glu	Glu	Val	Arg	Val	Phe	Asp				
				325					330					335					
Gly	Thr	Glu	Arg	Leu	Pro	Gly	Asp	Pro	Asp	Met	Ile	Arg	Tyr	Ile	Asp				
			340					345					350						
Lys	Gln	Gly	Gln	Leu	Gln	Thr	Lys	Met	Val										
		355					360												

<210> 85

<211> 362

<212> PRT

<213> BK virus

<400> 85

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

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Val
355 360

<210> 86

<211> 362

<212> PRT

<213> BK virus

<400> 86

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

Lys Pro Lys Glu Pro Met Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Glu Leu Asp Ala Ile Thr Glu Val

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val Glu val Leu Glu val Lys Ile Gly Leu Asp Ala Ile Ile Glu val
    35                40                45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
    50                55                60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
    65                70                75                80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
                85                90                95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
    100                105                110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
    115                120                125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
    130                135                140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
    165                170                175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
    180                185                190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
    195                200                205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
    210                215                220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
    225                230                235                240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
                245                250                255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
    260                265                270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
    275                280                285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
    290                295                300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
    305                310                315                320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
    325                330                335

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325

330

335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
 340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Val
 355 360

<210> 87

<211> 362

<212> PRT

<213> BK virus

<400> 87

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Leu Asp Ala Ile Thr Glu Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
 50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
 65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
 165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asn Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Val
355 360

<210> 88

<211> 362

<212> PRT

<213> BK virus

<400> 88

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Leu Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
 165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
 260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
 275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
 290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Gly Thr Gln Arg Val Asp Gly Gln
 305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
 325 330 335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
 340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Val
 355 360

<210> 89

<211> 362

<212> PRT

<213> BK virus

<400> 89

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Leu Asp Ala Ile Thr Glu Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
 50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
 65 70 75 80

Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
 165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
 260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
 275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
 290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
 305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
 325 330 335

Gly Thr Glu Lys Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
 340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu

355 360

<210> 90
 <211> 362
 <212> PRT
 <213> BK virus

<400> 90

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Leu Asp Ala Ile Thr Glu Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
 50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
 65 70 75 80

Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
 165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
355 360

<210> 91

<211> 362

<212> PRT

<213> BK virus

<400> 91

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Leu Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
50 55 60

Gly Phe Ser Leu Arg Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu

85

90

95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Lys Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
355 360

<210> 92

<211> 362

<212> PRT

<213> BK virus

<400> 92

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly

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-      -      20      25      30      -      -
Val Glu Val Leu Glu Val Lys Thr Gly Leu Asp Ala Ile Thr Glu Val
  35      40      45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
  50      55      60

Gly Phe Ser Leu Lys Val Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
  65      70      75      80

Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
      85      90      95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
      100      105      110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
      115      120      125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
      130      135      140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
      165      170      175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
      180      185      190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
      195      200      205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
      210      215      220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
      225      230      235      240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
      245      250      255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
      260      265      270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
      275      280      285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
      290      295      300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
      305      310      315      320

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Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
 325 330 335

Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
 340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
 355 360

<210> 93

<211> 362

<212> PRT

<213> BK virus

<400> 93

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Leu Asp Ala Ile Thr Glu Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
 50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
 65 70 75 80

Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
 165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

210 215 220
 Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240
 Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255
 Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
 260 265 270
 Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
 275 280 285
 Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
 290 295 300
 Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
 305 310 315 320
 Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
 325 330 335
 Gly Thr Glu Arg Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
 340 345 350
 Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
 355 360
 <210> 94
 <211> 362
 <212> PRT
 <213> BK virus
 <400> 94
 Met Ala Pro Thr Lys Arg Lys Gly Glu Cys Pro Gly Ala Ala Pro Lys
 1 5 10 15
 Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30
 Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
 35 40 45
 Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
 50 55 60
 Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
 65 70 75 80
 Pro Asp Lys Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95
 Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
 165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Leu Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
 260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
 275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
 290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
 305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
 325 330 335

Gly Thr Glu Lys Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
 340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
 355 360

<210> 95

<211> 362

<212> PRT

<213> BK virus

<400> 95

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

Lys Pro Lys Asp Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Lys Asn Leu Arg
 50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
 65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
 165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Leu Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
 260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
 275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
 290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Lys Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
355 360

<210> 96

<211> 362

<212> PRT

<213> BK virus

<400> 96

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

Lys Pro Lys Asp Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asp Asp Ala Thr Pro Val Glu Cys

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Phe Val Glu Cys
195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
210 215 220

Leu Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Lys Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
355 360

<210> 97

<211> 362

<212> PRT

<213> BK virus

<400> 97

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

Lys Pro Lys Asp Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asn Glu Asn Leu Arg
50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
 165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Leu Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
 260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
 275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
 290 295 300

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

305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
 325 330 335

Gly Thr Glu Lys Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
 340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
 355 360

<210> 98

<211> 362

<212> PRT

<213> BK virus

<400> 98

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

Lys Pro Lys Asp Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
 50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
 65 70 75 80

Pro Gln Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
 165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Leu Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
 260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
 275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Thr Pro Ile Ser Phe

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Phe Tyr Phe Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Lys Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
355 360

<210> 99

<211> 362

<212> PRT

<213> BK virus

<400> 99

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

Lys Pro Lys Asp Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val

35

40

45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
65 70 75 80

Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Leu Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
 260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
 275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
 290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
 305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
 325 330 335

Gly Thr Glu Lys Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
 340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
 355 360

<210> 100

<211> 362

<212> PRT

<213> BK virus

<400> 100

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
 50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
 65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

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Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
      100                      105                      110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
      115                      120                      125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
      130                      135                      140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
      165                      170                      175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
      180                      185                      190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
      195                      200                      205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
      210                      215                      220

Leu Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
      225                      230                      235                      240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
      245                      250                      255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
      260                      265                      270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
      275                      280                      285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
      290                      295                      300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
      305                      310                      315                      320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
      325                      330                      335

Gly Thr Glu Lys Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
      340                      345                      350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
      355                      360

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<210> 101

<211> 362

<212> PRT

<213> BK virus

<400> 101

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

Lys Pro Lys Asp Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
 50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
 65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
 165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
 260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
 275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Lys Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
355 360

<210> 102

<211> 362

<212> PRT

<213> BK virus

<400> 102

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
50 55 60

Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser Asp Ser
65 70 75 80

Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
100 105 110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
130 135 140

Ile Gln Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asp Pro Leu

145 150 155 160

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
210 215 220

Phe Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Lys Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
355 360

<210> 103

<211> 362

<212> PRT

<213> BK virus

<400> 103

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
50 55 60

Gly Phe Ser Leu Lys Leu Ser Val Glu Asn Asp Phe Ser Ser Asp Ser
65 70 75 80

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Pro Gln Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
      85                      90                      95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
      100                    105                    110

Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
      115                    120                    125

Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly Lys Pro
      130                    135                    140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
      165                    170                    175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
      180                    185                    190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
      195                    200                    205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
      210                    215                    220

Leu Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
      225                    230                    235                    240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
      245                    250                    255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
      260                    265                    270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
      275                    280                    285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
      290                    295                    300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
      305                    310                    315                    320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
      325                    330                    335

Gly Thr Glu Lys Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
      340                    345                    350

Lys Gln Gly Gln Leu Gln Thr Lys Met Leu
      355                    360

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<210> 104

<211> 362

<212> PRT

<213> BK virus

<400> 104

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

Lys	Pro	Lys	Glu	Pro	Val	Gln	Val	Pro	Lys	Leu	Leu	Ile	Lys	Gly	Gly
			20					25					30		

Val	Glu	Val	Leu	Glu	Val	Lys	Thr	Gly	Val	Asp	Ala	Ile	Thr	Glu	Val
		35					40					45			

Glu	Cys	Phe	Leu	Asn	Pro	Glu	Met	Gly	Asp	Pro	Asp	Glu	Asn	Leu	Arg
	50					55					60				

Gly	Tyr	Ser	Leu	Lys	Leu	Thr	Ala	Glu	Asn	Ala	Phe	Asp	Ser	Asp	Ser
65					70					75					80

Pro	Asp	Lys	Lys	Met	Leu	Pro	Cys	Tyr	Ser	Thr	Ala	Arg	Ile	Pro	Leu
				85					90					95	

Pro	Asn	Leu	Asn	Glu	Asp	Leu	Thr	Cys	Gly	Asn	Leu	Leu	Met	Trp	Glu
			100					105					110		

Ala	Val	Thr	Val	Lys	Thr	Glu	Val	Ile	Gly	Ile	Thr	Ser	Met	Leu	Asn
		115					120					125			

Leu	His	Ala	Gly	Ser	Gln	Lys	Val	His	Glu	Asn	Gly	Gly	Gly	Lys	Pro
	130					135					140				

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

Glu	Met	Gln	Gly	Val	Leu	Met	Asn	Tyr	Arg	Thr	Lys	Tyr	Pro	Gln	Gly
				165					170					175	

Thr	Ile	Thr	Pro	Lys	Asn	Pro	Thr	Ala	Gln	Ser	Gln	Val	Met	Asn	Thr
			180					185					190		

Asp	His	Lys	Ala	Tyr	Leu	Asp	Lys	Asn	Asn	Ala	Tyr	Pro	Val	Glu	Cys
		195					200					205			

Trp	Ile	Pro	Asp	Pro	Ser	Arg	Asn	Glu	Asn	Thr	Arg	Tyr	Phe	Gly	Thr
	210					215					220				

Tyr	Thr	Gly	Gly	Glu	Asn	Val	Pro	Pro	Val	Leu	His	Val	Thr	Asn	Thr
225					230					235					240

Ala	Thr	Thr	Val	Leu	Leu	Asp	Glu	Gln	Gly	Val	Gly	Pro	Leu	Cys	Lys
				245					250					255	

Ala	Asp	Ser	Leu	Tyr	Val	Ser	Ala	Ala	Asp	Ile	Cys	Gly	Leu	Phe	Thr
			260					265					270		

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
 275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
 290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Lys Val Asp Gly Gln
 305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
 325 330 335

Gly Thr Glu Gln Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
 340 345 350

Arg Gln Gly Gln Leu Gln Thr Lys Met Val
 355 360

<210> 105

<211> 362

<212> PRT

<213> BK virus

<400> 105

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Asn Asp Leu Arg
 50 55 60

Gly Tyr Ser Leu Lys Leu Thr Ala Glu Asn Ala Phe Asp Ser Asp Ser
 65 70 75 80

Pro Asp Lys Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Lys Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu Asn Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Gln Gly
 165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
210 215 220

Tyr Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr

260

265

270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Lys Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Gln Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Arg Gln Gly Gln Leu Gln Thr Lys Met Val
355 360

<210> 106

<211> 362

<212> PRT

<213> BK virus

<400> 106

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Asp Asn Leu Arg
50 55 60

Ala - - - - - Thr - - - - - Val - - - - -

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

<210> 107

<211> 362

<212> PRT

<213> BK virus

<400> 107

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20      25      30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
35      40      45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Asp His Leu Arg
50      55      60

Gly Tyr Ser Gln His Leu Thr Ala Glu Asn Ala Phe Asp Ser Asp Ser
65      70      75      80

Pro Asp Lys Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
85      90      95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
100     105     110

Ala Val Thr Val Lys Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
115     120     125

Leu His Ala Gly Ser Gln Lys Val His Glu Asn Gly Gly Gly Lys Pro
130     135     140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Gln Gly
165     170     175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
180     185     190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
195     200     205

Trp Ile Pro Asp Pro Ser Lys Asn Glu Asn Thr Arg Tyr Phe Gly Thr
210     215     220

Tyr Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225     230     235     240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245     250     255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260     265     270

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Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Lys Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Gln Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Arg Gln Gly Gln Leu Gln Thr Lys Met Val
355 360

<210> 108

<211> 362

<212> PRT

<213> BK virus

<400> 108

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Asp Asn Leu Arg
50 55 60

Gly Tyr Ser Gln His Leu Ser Ala Glu Asn Ala Phe Glu Ser Asp Ser
65 70 75 80

Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
100 105 110

Ala Val Thr Val Lys Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu Asn Gly Gly Gly Lys Pro
130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Gln Gly
165 170 175

Thr Ile Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
210 215 220

Tyr Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Ala Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Lys Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Gln Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Arg Gln Gly Gln Leu Gln Thr Lys Met Val
355 360

<210> 109

<211> 362

<212> PRT

<213> BK virus

<400> 109

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn Leu Arg
50 55 60

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

355 360
 <210> 110
 <211> 362
 <212> PRT
 <213> BK virus

 <400> 110
 Met Ala Pro Thr Lys Arg Lys Gly Glu Cys Pro Gly Ala Ala Pro Lys
 1 5 10 15

 Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

 Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
 35 40 45

 Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Asn Asp Leu Arg
 50 55 60

 Gly Tyr Ser Leu Arg Leu Thr Ala Glu Thr Ala Phe Asp Ser Asp Ser
 65 70 75 80

 Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

 Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu

 100 105 110

 Ala Val Thr Val Lys Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

 Leu His Ala Gly Ser Gln Lys Val His Glu Asn Gly Gly Gly Lys Pro
 130 135 140

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

 Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
 165 170 175

 Thr Val Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

 Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

 Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

 Tyr Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240

 Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Pro Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Gln Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Arg Gln Gly Gln Leu Gln Thr Lys Met Val
355 360

<210> 111

<211> 362

<212> PRT

<213> BK virus

<400> 111

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Asn Asp Leu Arg
50 55 60

Gly Tyr Ser Leu Arg Leu Thr Ala Glu Thr Ala Phe Asp Ser Asp Ser
65 70 75 80

Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
100 105 110

Ala Val Thr Val Lys Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
115 120 125

Leu His Ala Gly Ser Gln Lys Val His Asp Asn Gly Gly Gly Lys Pro
130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
165 170 175

Thr Val Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
210 215 220

Tyr Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Pro Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Lys Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Arg Gln Gly Gln Leu Gln Thr Lys Met Val
355 360

<210> 112

<211> 362

<212> PRT

<213> BK virus

<400> 112

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Asn Asp Leu Arg
50 55 60

Gly Tyr Ser Leu Arg Leu Thr Ala Glu Thr Ala Phe Asp Ser Asp Ser
65 70 75 80

Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
100 105 110

Ala Val Thr Val Lys Thr Glu Val Met Gly Ile Thr Ser Met Leu Asn
115 120 125

Leu His Ala Gly Ser Gln Lys Val His Asp Asn Gly Gly Gly Lys Pro
130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
165 170 175

Thr Val Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
210 215 220

Tyr Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Pro Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Gln Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Arg Gln Gly Gln Leu Gln Thr Lys Met Val

Arg Gln Gly Gln Leu Gln Thr Lys Met Val
355 360

<210> 113

<211> 362

<212> PRT

<213> BK virus

<400> 113

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Asn Asp Leu Arg
50 55 60

Gly Tyr Ser Leu Arg Leu Thr Ala Glu Thr Ala Phe Asp Ser Asp Ser
65 70 75 80

Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
100 105 110

Ala Val Thr Val Lys Thr Glu Val Met Gly Ile Thr Ser Met Leu Asn
115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu Asn Gly Gly Gly Lys Pro
130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
165 170 175

Thr Val Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr

210

215

220

Tyr Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Pro Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Gln Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Arg Gln Gly Gln Leu Gln Thr Lys Met Val
355 360

<210> 114

<211> 362

<212> PRT

<213> BK virus

<400> 114

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Asn Asp Leu Arg
50 55 60

Gly Tyr Ser Leu Arg Leu Thr Ala Glu Thr Ala Phe Asp Ser Asp Ser
65 70 75 80

Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
100 105 110

Ala Val Thr Val Lys Thr Glu Val Met Gly Ile Thr Ser Met Leu Asn
115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu Asn Gly Gly Gly Lys Pro
130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
165 170 175

Thr Val Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
210 215 220

Tyr Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Ile
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Pro Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Gln Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Arg Gln Gly Gln Leu Gln Thr Lys Met Val
355 360

<210> 115

<211> 362

<212> PRT

<213> BK virus

<400> 115

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val

35	40	45														
Glu	Cys	Phe	Leu	Asn	Pro	Glu	Met	Gly	Asp	Pro	Asp	Asn	Asp	Leu	Arg	
50						55					60					
Gly	Tyr	Ser	Leu	Arg	Leu	Thr	Ala	Glu	Thr	Ala	Phe	Asp	Ser	Asp	Ser	
65					70					75					80	
Pro	Asp	Arg	Lys	Met	Leu	Pro	Cys	Tyr	Ser	Thr	Ala	Arg	Ile	Pro	Leu	
				85					90					95		
Pro	Asn	Leu	Asn	Glu	Asp	Leu	Thr	Cys	Gly	Asn	Leu	Leu	Met	Trp	Glu	
			100					105					110			
Ala	Val	Thr	Val	Lys	Thr	Glu	Val	Ile	Gly	Ile	Thr	Ser	Met	Leu	Asn	
		115						120				125				
Leu	His	Ala	Gly	Ser	Gln	Lys	Val	His	Gln	Asn	Gly	Gly	Gly	Lys	Pro	
130						135					140					
Val	Gln	Gly	Ser	Asn	Phe	His	Phe	Phe	Ala	Val	Gly	Gly	Asp	Pro	Leu	
145					150					155					160	
Glu	Met	Gln	Gly	Val	Leu	Met	Asn	Tyr	Arg	Thr	Lys	Tyr	Pro	Glu	Gly	
				165					170					175		
Thr	Val	Thr	Pro	Lys	Asn	Pro	Thr	Ala	Gln	Ser	Gln	Val	Met	Asn	Thr	
			180					185					190			
Asp	His	Lys	Ala	Tyr	Leu	Asp	Lys	Asn	Asn	Ala	Tyr	Pro	Val	Glu	Cys	
		195					200					205				
Trp	Ile	Pro	Asp	Pro	Ser	Arg	Asn	Glu	Asn	Thr	Arg	Tyr	Phe	Gly	Thr	
210						215					220					
Tyr	Thr	Gly	Gly	Glu	Asn	Val	Pro	Pro	Val	Leu	His	Val	Thr	Asn	Thr	
225					230					235					240	
Ala	Thr	Thr	Val	Leu	Leu	Asp	Glu	Gln	Gly	Val	Gly	Pro	Leu	Cys	Lys	
				245					250					255		
Ala	Asp	Ser	Leu	Tyr	Val	Ser	Ala	Ala	Asp	Ile	Cys	Gly	Leu	Phe	Thr	
			260					265					270			
Asn	Ser	Ser	Gly	Thr	Gln	Gln	Trp	Arg	Gly	Leu	Pro	Arg	Tyr	Phe	Lys	
		275					280					285				
Ile	Arg	Leu	Arg	Lys	Arg	Ser	Val	Lys	Asn	Pro	Tyr	Pro	Ile	Ser	Phe	
290						295					300					
Leu	Leu	Ser	Asp	Leu	Ile	Asn	Arg	Arg	Thr	Gln	Arg	Val	Asp	Gly	Gln	
305					310					315					320	
Pro	Met	Tyr	Gly	Met	Glu	Ser	Gln	Val	Glu	Glu	Val	Arg	Val	Phe	Asp	
				325					330					335		

Gly Thr Glu Gln Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
 340 345 350

Arg Gln Gly Gln Leu Gln Thr Lys Met Val
 355 360

<210> 116

<211> 362

<212> PRT

<213> BK virus

<400> 116

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

Lys Pro Lys Asp Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Asn Asp Leu Arg
 50 55 60

Gly Tyr Ser Leu Arg Leu Thr Ala Glu Thr Ala Phe Asp Ser Asp Ser
 65 70 75 80

Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Lys Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu Asn Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
 165 170 175

Thr Val Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Tyr Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Pro Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp

325

330

335

Gly Thr Glu Gln Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Arg Gln Gly Gln Leu Gln Thr Lys Met Val
355 360

<210> 117

<211> 362

<212> PRT

<213> BK virus

<400> 117

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

Lys Pro Lys Asp Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Asn Asp Leu Arg
50 55 60

Gly Tyr Ser Leu Arg Leu Thr Ala Glu Thr Ala Phe Asp Ser Asp Ser
65 70 75 80

Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
100 105 110

Ala Val Thr Val Lys Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu Asn Gly Gly Gly Lys Pro

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

<210> 118
 <211> 362
 <212> PRT
 <213> BK virus

<400> 118

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Ser Asp Leu Arg
 50 55 60

Gly Tyr Ser Leu Arg Leu Thr Ala Glu Thr Ala Phe Asp Ser Asp Ser
 65 70 75 80

Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Lys Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu Asn Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
 165 170 175

Thr Val Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Tyr Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
 260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Pro Arg Tyr Phe Lys
 275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
 290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
 305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
 325 330 335

Gly Thr Glu Gln Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
 340 345 350

Arg Gln Gly Gln Leu Gln Thr Lys Met Val
 355 360

<210> 119

<211> 362

<212> PRT

<213> BK virus

<400> 119

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Asn Asp Leu Arg
 50 55 60

Gly Tyr Ser Leu Arg Leu Thr Ala Glu Thr Ala Phe Asp Ser Asp Ser
 65 70 75 80

Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Lys Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu Asn Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
 165 170 175

Thr Val Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

Tyr Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240

220 230 235 240
 Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255
 Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
 260 265 270
 Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Pro Arg Tyr Phe Lys
 275 280 285
 Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
 290 295 300
 Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
 305 310 315 320
 Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
 325 330 335
 Gly Thr Glu Gln Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
 340 345 350
 Arg Gln Gly Gln Leu Gln Thr Lys Met Val
 355 360
 <210> 120
 <211> 362
 <212> PRT
 <213> BK virus

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

Leu His Ala Gly Ser Gln Lys Val His Glu Asn Gly Gly Gly Lys Pro
 130 135 140
 Ile Gln Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asp Pro Leu
 145 150 155 160
 Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
 165 170 175
 Thr Val Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190
 Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205
 Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220
 Tyr Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240
 Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255
 Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
 260 265 270
 Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Pro Arg Tyr Phe Lys
 275 280 285
 Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
 290 295 300
 Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
 305 310 315 320
 Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
 325 330 335
 Gly Thr Glu Gln Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
 340 345 350
 Arg Gln Gly Gln Leu Gln Thr Lys Met Val
 355 360
 <210> 121
 <211> 362
 <212> PRT
 <213> BK virus
 <400> 121
 Met Ala Pro Thr Lys Arg Lys Gly Glu Cys Pro Gly Ala Ala Pro Lys
 1 5 10 15
 Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

Val	Glu	Val	Leu	Glu	Val	Lys	Thr	Gly	Val	Asp	Ala	Ile	Thr	Glu	Val
		35					40					45			
Glu	Cys	Phe	Leu	Asn	Pro	Glu	Met	Gly	Asp	Pro	Asp	Asn	Asp	Leu	Arg
	50					55					60				
Gly	Tyr	Ser	Leu	Arg	Leu	Thr	Ala	Glu	Thr	Ala	Phe	Lys	Ser	Asp	Ser
65					70					75					80
Pro	Asp	Arg	Lys	Met	Leu	Pro	Cys	Tyr	Ser	Thr	Ala	Arg	Ile	Pro	Leu
				85					90					95	
Pro	Asn	Leu	Asn	Glu	Asp	Leu	Thr	Cys	Gly	Asn	Leu	Leu	Met	Trp	Glu
			100					105					110		
Ala	Val	Thr	Val	Lys	Thr	Glu	Val	Ile	Gly	Ile	Thr	Ser	Met	Leu	Asn
		115					120					125			
Leu	His	Ala	Gly	Ser	Gln	Lys	Val	His	Glu	Asn	Gly	Gly	Gly	Lys	Pro
	130					135					140				
Ile	Gln	Gly	Ser	Asn	Phe	His	Phe	Phe	Ala	Val	Gly	Gly	Asp	Pro	Leu
145					150					155					160
Glu	Met	Gln	Gly	Val	Leu	Met	Asn	Tyr	Arg	Thr	Lys	Tyr	Pro	Glu	Gly
				165					170					175	
Thr	Val	Thr	Pro	Lys	Asn	Pro	Thr	Ala	Gln	Ser	Gln	Val	Met	Asn	Thr
			180					185					190		
Asp	His	Lys	Ala	Tyr	Leu	Asp	Lys	Asn	Asn	Ala	Tyr	Pro	Val	Glu	Cys
		195					200					205			
Trp	Ile	Pro	Asp	Pro	Ser	Arg	Asn	Glu	Asn	Thr	Arg	Tyr	Phe	Gly	Thr
	210					215					220				
Tyr	Thr	Gly	Gly	Glu	Asn	Val	Pro	Pro	Val	Leu	His	Val	Thr	Asn	Thr
225					230					235					240
Ala	Thr	Thr	Val	Leu	Leu	Asp	Glu	Gln	Gly	Val	Gly	Pro	Leu	Cys	Lys
				245					250					255	
Ala	Asp	Ser	Leu	Tyr	Val	Ser	Ala	Ala	Asp	Ile	Cys	Gly	Leu	Phe	Thr
			260					265					270		
Asn	Ser	Ser	Gly	Thr	Gln	Gln	Trp	Arg	Gly	Leu	Pro	Arg	Tyr	Phe	Lys
		275					280					285			
Ile	Arg	Leu	Arg	Lys	Arg	Ser	Val	Lys	Asn	Pro	Tyr	Pro	Ile	Ser	Phe
	290					295					300				
Leu	Leu	Ser	Asp	Leu	Ile	Asn	Arg	Arg	Thr	Gln	Arg	Val	Asp	Gly	Gln
305					310					315					320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
 325 330 335

Gly Thr Glu Gln Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
 340 345 350

Arg Gln Gly Gln Leu Gln Thr Lys Met Val
 355 360

<210> 122

<211> 362

<212> PRT

<213> BK virus

<400> 122

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
 35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Asn Asp Leu Arg
 50 55 60

Gly Tyr Ser Leu Arg Leu Thr Ala Glu Thr Ala Phe Asp Ser Asp Ser
 65 70 75 80

Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
 100 105 110

Ala Val Thr Val Lys Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
 115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu Asn Gly Gly Gly Lys Pro
 130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
 165 170 175

Thr Val Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
 180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
 195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
 210 215 220

210 215 220
 Tyr Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
 225 230 235 240

 Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
 245 250 255

 Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
 260 265 270

 Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Pro Arg Tyr Phe Lys
 275 280 285

 Ile Arg Met Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
 290 295 300

 Phe Ile Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
 305 310 315 320

 Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
 325 330 335

 Gly Thr Glu Gln Leu Pro Gly Met Pro Asp Leu Ile Arg Tyr Ile Asp
 340 345 350

 Arg Gln Gly Gln Leu Gln Thr Lys Met Val
 355 360

<210> 123

<211> 362

<212> PRT

<213> BK virus

<220>

<221> misc_feature

<222> (186)..(186)

<223> Xaa can be any naturally occurring amino acid

<400> 123

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

 Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20 25 30

 Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
 35 40 45

 Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Asn Asp Leu Arg
 50 55 60

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

Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
100 105 110

Ala Val Thr Val Lys Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
115 120 125

Leu His Ala Gly Ser Gln Lys Val His Glu Asn Gly Gly Gly Lys Pro
130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
165 170 175

Thr Val Thr Pro Lys Asn Pro Thr Ala Xaa Ser Gln Val Met Asn Thr
180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
210 215 220

Tyr Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Pro Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Gln Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Arg Gln Gly Gln Leu Gln Thr Lys Met Val
355 360

<210> 124

<211> 362

<212> PRT

<213> BK virus

<400> 124

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
 20          25          30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
 35          40          45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Asn Asp Leu Arg
 50          55          60

Gly Tyr Ser Leu Arg Leu Thr Ala Glu Thr Ala Phe Asp Ser Asp Ser
 65          70          75          80

Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
 85          90          95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
100          105          110

Ala Val Thr Val Lys Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn
115          120          125

Leu His Ala Gly Ser Gln Lys Val His Glu Asn Gly Gly Gly Lys Pro
130          135          140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
165          170          175

Thr Val Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
180          185          190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
195          200          205

Trp Ile Pro Asp Pro Ser Lys Asn Glu Asn Thr Arg Tyr Phe Gly Thr
210          215          220

Tyr Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225          230          235          240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245          250          255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260          265          270

Asn Ser Ser Gly Thr Gln Gln Thr Asn Gly Leu Pro Asn Thr Phe Lys

```

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Pro Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Gln Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Arg Gln Gly Gln Leu Gln Thr Lys Met Val
355 360

<210> 125

<211> 362

<212> PRT

<213> BK virus

<400> 125

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

Lys Pro Lys Glu Pro Val Gln Val Pro Lys Leu Leu Ile Lys Gly Gly
20 25 30

Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr Glu Val
35 40 45

Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Asn Asp Leu Arg
50 55 60

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

Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile Pro Leu
85 90 95

Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met Trp Glu
100 105 110

Ala Val Thr Val Lys Thr Glu Val Ile Gly Ile Thr Ser Met Leu Asn

115

120

125

Leu His Ala Gly Ser Gln Lys Val His Asp Asn Gly Gly Gly Lys Pro
130 135 140

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

Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro Glu Gly
165 170 175

Thr Val Thr Pro Lys Asn Pro Thr Ala Gln Ser Gln Val Met Asn Thr
180 185 190

Asp His Lys Ala Tyr Leu Asp Lys Asn Asn Ala Tyr Pro Val Glu Cys
195 200 205

Trp Ile Pro Asp Pro Ser Arg Asn Glu Asn Thr Arg Tyr Phe Gly Thr
210 215 220

Tyr Thr Gly Gly Glu Asn Val Pro Pro Val Leu His Val Thr Asn Thr
225 230 235 240

Ala Thr Thr Val Leu Leu Asp Glu Gln Gly Val Gly Pro Leu Cys Lys
245 250 255

Ala Asp Ser Leu Tyr Val Ser Ala Ala Asp Ile Cys Gly Leu Phe Thr
260 265 270

Asn Ser Ser Gly Thr Gln Gln Trp Arg Gly Leu Pro Arg Tyr Phe Lys
275 280 285

Ile Arg Leu Arg Lys Arg Ser Val Lys Asn Pro Tyr Pro Ile Ser Phe
290 295 300

Leu Leu Ser Asp Leu Ile Asn Arg Arg Thr Gln Arg Val Asp Gly Gln
305 310 315 320

Pro Met Tyr Gly Met Glu Ser Gln Val Glu Glu Val Arg Val Phe Asp
325 330 335

Gly Thr Glu Lys Leu Pro Gly Asp Pro Asp Met Ile Arg Tyr Ile Asp
340 345 350

Arg Gln Gly Gln Leu Gln Thr Lys Met Val
355 360

<210> 126

<211> 144

<212> PRT

<213> BK virus

<400> 126

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

Glu Val Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Asn Asp
20 25 30

Leu Arg Gly Tyr Ser Leu Arg Leu Thr Ala Glu Thr Ala Phe Glu Ser
35 40 45

Asp Ser Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile
50 55 60

Pro Leu Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met
65 70 75 80

Trp Glu Ala Val Thr Val Lys Thr Glu Val Ile Gly Ile Thr Ser Met
85 90 95

Leu Asn Leu His Ala Gly Ser Gln Lys Val His Glu Asn Gly Gly Gly
100 105 110

Lys Pro Ile Gln Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asp
115 120 125

Pro Leu Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro
130 135 140

<210> 127

<211> 144

<212> PRT

<213> BK virus

<400> 127

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

Glu Val Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn
20 25 30

Leu Arg Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser
35 40 45

Asp Ser Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile
50 55 60

Pro Leu Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met
65 70 75 80

Trp Glu Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met
85 90 95

Leu Asn Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly
100 105 110

Lys Pro Ile Gln Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asp
115 120 125

Pro Leu Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro
130 135 140

<210> 128

<211> 144

<212> PRT

<213> BK virus

<400> 128

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

<210> 129

<211> 144

<212> PRT

<213> BK virus

<400> 129

Gly	Gly	Val	Glu	Val	Leu	Glu	Val	Lys	Thr	Gly	Val	Asp	Ala	Ile	Thr		
1				5					10					15			
Glu	Val	Glu	Cys	Phe	Leu	Asn	Pro	Glu	Met	Gly	Asp	Pro	Asp	Asn	Asp		
			20					25					30				
Leu	Arg	Gly	Tyr	Ser	Leu	Arg	Leu	Thr	Ala	Glu	Thr	Ala	Phe	Glu	Ser		
		35					40					45					
Asp	Ser	Pro	Asp	Arg	Lys	Met	Leu	Pro	Cys	Tyr	Ser	Thr	Ala	Arg	Ile		
	50					55					60						
Pro	Leu	Pro	Asn	Leu	Asn	Glu	Asp	Leu	Thr	Cys	Gly	Asn	Leu	Leu	Met		
65					70					75					80		
Trp	Glu	Ala	Val	Thr	Val	Lys	Thr	Glu	Val	Ile	Gly	Ile	Thr	Ser	Met		
				85					90					95			
Leu	Asn	Leu	His	Ala	Gly	Ser	Gln	Lys	Val	His	Glu	Asn	Gly	Gly	Gly		

100

105

110

Lys Pro Ile Gln Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asp
 115 120 125

Pro Leu Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Ser Tyr Pro
 130 135 140

<210> 130

<211> 144

<212> PRT

<213> BK virus

<400> 130

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

Glu Val Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Asn Asp
 20 25 30

Leu Arg Gly Tyr Ser Leu Arg Leu Thr Ala Glu Thr Ala Phe Glu Ser
 35 40 45

Asp Ser Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile
 50 55 60

Pro Leu Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met
 65 70 75 80

Trp Glu Ala Val Thr Val Lys Thr Glu Val Ile Gly Ile Thr Ser Met
 85 90 95

Leu Asn Leu His Ala Gly Ser Gln Lys Val His Glu Asn Gly Gly Gly
 100 105 110

Lys Pro Ile Gln Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asp
 115 120 125

Pro Leu Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro
 130 135 140

<210> 131

<211> 144

<212> PRT

<213> BK virus

<400> 131

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

Glu Val Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Asn Asp
 20 25 30

Leu Arg Gly Tyr Ser Leu Arg Leu Thr Ala Glu Thr Ala Phe Glu Ser
 35 40 45

Asp Ser Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile
50 55 60

Pro Leu Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met
65 70 75 80

Trp Glu Ala Val Thr Val Lys Thr Glu Val Ile Gly Ile Thr Ser Met
85 90 95

Leu Asn Leu His Ala Gly Ser Gln Lys Val His Glu Asn Gly Gly Gly
100 105 110

Lys Pro Ile Gln Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asp
115 120 125

Pro Leu Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro
130 135 140

<210> 132

<211> 144

<212> PRT

<213> BK virus

<400> 132

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

Glu Val Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn
20 25 30

Leu Arg Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser
35 40 45

Asp Ser Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile
50 55 60

Pro Leu Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met
65 70 75 80

Trp Glu Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met
85 90 95

Leu Asn Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly
100 105 110

Lys Pro Ile Gln Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asp
115 120 125

Pro Leu Glu Met Gln Gly Val Leu Leu Asn Tyr Arg Thr Lys Tyr Pro
130 135 140

<210> 133

<211> 144

<212> PRT

<213> BK virus

<400> 133

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

Glu	Val	Glu	Cys	Phe	Leu	Asn	Pro	Glu	Met	Gly	Asp	Pro	Asp	Ser	Asp
			20					25					30		

Leu	Arg	Gly	Tyr	Arg	Leu	Arg	Leu	Thr	Ala	Glu	Thr	Ala	Phe	Glu	Ser
		35					40					45			

Asp	Ser	Pro	Asp	Arg	Lys	Met	Leu	Pro	Cys	Tyr	Ser	Thr	Ala	Arg	Ile
	50					55					60				

Pro	Leu	Pro	Asn	Leu	Asn	Glu	Asp	Leu	Thr	Cys	Gly	Asn	Leu	Leu	Met
65					70					75					80

Trp	Glu	Ala	Val	Thr	Val	Lys	Thr	Glu	Val	Ile	Gly	Ile	Thr	Ser	Met
				85					90					95	

Leu	Asn	Leu	His	Ala	Gly	Ser	Gln	Lys	Val	His	Glu	Asn	Gly	Gly	Gly
			100					105					110		

Lys	Pro	Ile	Gln	Gly	Ser	Asn	Phe	His	Phe	Phe	Ala	Val	Gly	Gly	Asp
		115					120					125			

Pro	Leu	Glu	Met	Gln	Gly	Val	Leu	Met	Asn	Tyr	Arg	Thr	Lys	Tyr	Pro
	130					135					140				

<210> 134

<211> 144

<212> PRT

<213> BK virus

<400> 134

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

Glu	Val	Glu	Cys	Phe	Leu	Asn	Pro	Glu	Met	Gly	Asp	Pro	Asp	Asn	Asp
			20					25					30		

Leu	Trp	Gly	Tyr	Ser	Leu	Arg	Leu	Thr	Ala	Glu	Thr	Ala	Phe	Glu	Ser
		35					40					45			

Asp	Ser	Pro	Asp	Arg	Lys	Met	Leu	Pro	Cys	Tyr	Ser	Thr	Ala	Arg	Ile
	50					55					60				

Pro	Leu	Pro	Asn	Leu	Asn	Glu	Asp	Leu	Thr	Cys	Gly	Asn	Leu	Leu	Met
65					70					75					80

Trp	Glu	Ala	Val	Thr	Val	Lys	Thr	Glu	Val	Ile	Gly	Ile	Thr	Ser	Met
				85					90					95	

Leu Asn Leu His Ala Gly Ser Gln Lys Val His Glu Asn Gly Gly Gly
 100 105 110

Lys Pro Ile Gln Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asp
 115 120 125

Pro Leu Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro
 130 135 140

<210> 135

<211> 144

<212> PRT

<213> BK virus

<400> 135

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

Glu Val Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Asn Asp
 20 25 30

Leu Arg Gly Tyr Ser Leu Arg Leu Thr Ala Glu Thr Ala Phe Glu Ser
 35 40 45

Asp Ser Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile
 50 55 60

Pro Leu Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met
 65 70 75 80

Trp Glu Ala Val Thr Val Lys Thr Glu Val Ile Gly Ile Thr Ser Met
 85 90 95

Leu Asn Leu His Ala Gly Ser Gln Lys Val His Glu Asn Gly Gly Gly
 100 105 110

Lys Pro Ile Gln Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asp
 115 120 125

Pro Leu Glu Met Gln Gly Val Leu Leu Asn Tyr Arg Thr Lys Tyr Pro
 130 135 140

<210> 136

<211> 144

<212> PRT

<213> BK virus

<400> 136

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

Glu Val Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn
 20 25 30

Leu Arg Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser
35 40 45

Asp Ser Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile
50 55 60

Pro Leu Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met
65 70 75 80

Trp Glu Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met
85 90 95

Leu Asn Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly
100 105 110

Lys Pro Ile Gln Gly Ser Asn Leu His Phe Phe Ala Val Gly Gly Asp
115 120 125

Pro Leu Glu Met Gln Gly Val Leu Leu Asn Tyr Arg Thr Lys Tyr Pro
130 135 140

<210> 137

<211> 144

<212> PRT

<213> BK virus

<400> 137

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

Glu Val Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn
20 25 30

Leu Arg Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser
35 40 45

Asp Ser Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile
50 55 60

Pro Leu Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met
65 70 75 80

Trp Glu Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met
85 90 95

Leu Asn Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly
100 105 110

Lys Pro Ile Gln Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asp
115 120 125

Pro Leu Glu Met Gln Gly Val Leu Leu Asn Tyr Arg Thr Lys Tyr Pro
130 135 140

<210> 138

<211> 144

<212> PRT

<213> BK virus

<400> 138

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

Glu	Val	Glu	Cys	Phe	Leu	Asn	Pro	Glu	Met	Gly	Asp	Pro	Asp	Glu	Asn
			20					25					30		

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

Asp	Ser	Pro	Glu	Arg	Lys	Met	Leu	Pro	Cys	Tyr	Ser	Thr	Ala	Arg	Ile
	50					55					60				

Pro	Leu	Pro	Asn	Leu	Asn	Glu	Asp	Leu	Thr	Cys	Gly	Asn	Leu	Leu	Met
65					70					75					80

Trp	Glu	Ala	Val	Thr	Val	Gln	Thr	Glu	Val	Ile	Gly	Ile	Thr	Ser	Met
				85					90					95	

Leu	Asn	Leu	His	Ala	Gly	Ser	Gln	Lys	Val	His	Glu	His	Gly	Gly	Gly
			100					105					110		

Lys	Pro	Ile	Gln	Gly	Ser	Asn	Phe	His	Phe	Phe	Ala	Val	Gly	Gly	Asp
		115					120					125			

Pro	Leu	Glu	Met	Gln	Gly	Val	Leu	Leu	Asn	Tyr	Arg	Thr	Lys	Tyr	Pro
	130					135					140				

<210> 139

<211> 144

<212> PRT

<213> BK virus

<400> 139

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

Glu	Val	Glu	Cys	Phe	Leu	Asn	Pro	Glu	Met	Gly	Asp	Pro	Asp	Asn	Asp
			20					25					30		

Leu	Arg	Gly	Tyr	Ser	Leu	Arg	Leu	Thr	Ala	Glu	Thr	Ala	Phe	Glu	Ser
		35					40					45			

Asp	Ser	Pro	Asp	Arg	Lys	Met	Leu	Pro	Cys	Tyr	Ser	Thr	Ala	Arg	Ile
	50					55					60				

Pro	Leu	Pro	Asn	Leu	Asn	Glu	Asp	Leu	Thr	Cys	Gly	Asn	Leu	Leu	Met
65					70					75					80

Trp	Glu	Ala	Val	Thr	Val	Lys	Thr	Glu	Val	Ile	Gly	Ile	Thr	Ser	Met
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

				85				90					95			
Leu	Asn	Leu	His	Ala	Gly	Ser	Gln	Lys	Val	His	Glu	Asn	Gly	Gly	Gly	
			100					105					110			
Lys	Pro	Ile	Gln	Gly	Ser	Asn	Phe	His	Phe	Phe	Ala	Val	Gly	Gly	Asp	
		115					120					125				
Pro	Leu	Glu	Met	Gln	Gly	Val	Leu	Met	Asn	Tyr	Arg	Thr	Arg	Tyr	Pro	
	130					135					140					

<210> 140
<211> 144
<212> PRT
<213> BK virus

<400> 140
Gly Gly Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr
1 5 10 15

Glu Val Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Asp Asn
20 25 30

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

Asp Ser Pro Asp Lys Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile
50 55 60

Pro Leu Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met
65 70 75 80

Trp Glu Ala Val Thr Val Lys Thr Glu Val Ile Gly Ile Thr Ser Met
85 90 95

Leu Asn Leu His Ala Gly Ser Gln Lys Val His Glu Asn Gly Gly Gly
100 105 110

Lys Pro Val Gln Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asp
115 120 125

Pro Leu Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Arg Tyr Pro
130 135 140

<210> 141
<211> 144
<212> PRT
<213> BK virus

<400> 141
Gly Gly Val Glu Val Leu Glu Val Lys Thr Gly Val Asp Ala Ile Thr
1 5 10 15

Gly Val Gly Cys Phe Tyr Asp Phe Gly Met Gly Asp Phe Asp Gly Asp

Glu Val Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn
20 25 30

Leu Arg Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser
35 40 45

Asp Ser Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile
50 55 60

Pro Leu Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met
65 70 75 80

Trp Glu Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met
85 90 95

Leu Asn Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly
100 105 110

Lys Pro Ile Gln Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asp
115 120 125

Pro Leu Glu Met Gln Gly Val Leu Leu Asn Tyr Arg Thr Lys Tyr Pro
130 135 140

<210> 142

<211> 144

<212> PRT

<213> BK virus

<400> 142

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

Glu Val Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn
20 25 30

Leu Arg Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser
35 40 45

Asp Ser Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile
50 55 60

Pro Leu Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met
65 70 75 80

Trp Glu Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met
85 90 95

Leu Asn Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly
100 105 110

Lys Pro Ile Gln Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asp
115 120 125

Pro Leu Glu Met Gln Gly Val Leu Leu Asn Tyr Arg Thr Ser Tyr Pro
130 135 140

<210> 143

<211> 144

<212> PRT

<213> BK virus

<400> 143

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

Glu	Val	Glu	Cys	Phe	Leu	Asn	Pro	Glu	Met	Gly	Asp	Pro	Asp	Asn	Asp
			20					25					30		

Leu	Arg	Gly	Tyr	Ser	Leu	Arg	Leu	Thr	Ala	Glu	Thr	Ala	Phe	Asp	Ser
		35					40					45			

Asp	Ser	Pro	Asp	Arg	Lys	Met	Leu	Pro	Cys	Tyr	Ser	Thr	Ala	Arg	Ile
	50					55					60				

Pro	Leu	Pro	Asn	Leu	Asn	Glu	Asp	Leu	Thr	Cys	Gly	Asn	Leu	Leu	Met
65					70					75					80

Trp	Glu	Ala	Val	Thr	Val	Lys	Thr	Glu	Val	Ile	Gly	Ile	Thr	Ser	Met
				85					90					95	

Leu	Asn	Leu	His	Ala	Gly	Ser	Gln	Lys	Val	His	Glu	Asn	Gly	Gly	Gly
			100					105					110		

Lys	Pro	Ile	Gln	Gly	Ser	Asn	Phe	His	Phe	Phe	Ala	Val	Gly	Gly	Asp
		115					120					125			

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<212> PRT

<213> BK virus

<400> 144

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Glu	Val	Glu	Cys	Phe	Leu	Asn	Pro	Glu	Met	Gly	Asp	Pro	Asp	Glu	Asn
			20					25					30		

Leu	Arg	Gly	Phe	Ser	Leu	Lys	Leu	Ser	Ala	Glu	Asn	Asp	Phe	Ser	Ser
		35					40					45			

Asp	Ser	Pro	Glu	Arg	Lys	Met	Leu	Pro	Cys	Tyr	Ser	Thr	Ala	Arg	Ile
	50					55					60				

Pro	Leu	Pro	Asn	Leu	Asn	Glu	Asp	Leu	Thr	Cys	Gly	Asn	Leu	Leu	Met
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

65					70						75					80
Trp	Glu	Ala	Val	Thr	Val	Gln	Thr	Glu	Val	Ile	Gly	Ile	Thr	Ser	Met	
				85					90					95		
Leu	Asn	Leu	His	Ala	Gly	Ser	Gln	Lys	Val	His	Glu	His	Gly	Gly	Gly	
			100					105					110			
Lys	Pro	Ile	Gln	Gly	Ser	Asn	Phe	His	Phe	Phe	Ala	Val	Gly	Gly	Asp	
		115					120					125				
Pro	Leu	Glu	Met	Gln	Gly	Val	Leu	Met	Asn	Tyr	Arg	Thr	Arg	Tyr	Pro	
	130					135					140					

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<212> PRT

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<400> 145

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

<210> 146

<211> 144

<212> PRT

<213> BK virus

<400> 146

Gly	Gly	Val	Glu	Val	Leu	Glu	Val	Lys	Thr	Gly	Leu	Asp	Ala	Ile	Thr	
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Glu Val Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn
20 25 30

Leu Arg Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser
35 40 45

Asp Ser Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile
50 55 60

Pro Leu Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met
65 70 75 80

Trp Glu Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met
85 90 95

Leu Asn Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly
100 105 110

Lys Pro Ile Gln Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asp
115 120 125

Pro Leu Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro
130 135 140

<210> 147

<211> 144

<212> PRT

<213> BK virus

<400> 147

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

Glu Val Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn
20 25 30

Leu Arg Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser
35 40 45

Asp Ser Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile
50 55 60

Pro Leu Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met
65 70 75 80

Trp Glu Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met
85 90 95

Leu Asn Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly
100 105 110

Lys Pro Ile Gln Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asp
115 120 125

Pro Leu Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Asn Tyr Pro
 130 135 140

<210> 148

<211> 144

<212> PRT

<213> BK virus

<400> 148

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 1 5 10 15

Glu Val Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn
 20 25 30

Leu Arg Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser
 35 40 45

Asp Ser Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile
 50 55 60

Pro Leu Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met
 65 70 75 80

Trp Glu Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met
 85 90 95

Leu Asn Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly
 100 105 110

Lys Pro Ile Gln Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asp
 115 120 125

Pro Leu Glu Met Gln Gly Val Leu Leu Asn Tyr Arg Thr Asn Tyr Pro
 130 135 140

<210> 149

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<212> PRT

<213> BK virus

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Glu Val Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Ser Asp
 20 25 30

Leu Arg Gly Tyr Ser Leu Arg Leu Thr Ala Glu Thr Ala Phe Glu Ser
 35 40 45

Asp Ser Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile
 50 55 60

Pro Leu Pro Asn Leu Asn Glu Asn Leu Thr Cys Gly Asn Leu Leu Met

P10 Leu P10 Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met
65 70 75 80

Trp Glu Ala Val Thr Val Lys Thr Glu Val Ile Gly Ile Thr Ser Met
85 90 95

Leu Asn Leu His Ala Gly Ser Gln Lys Val His Glu Asn Gly Gly Gly
100 105 110

Lys Pro Ile Gln Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asp
115 120 125

Pro Leu Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro
130 135 140

<210> 150

<211> 144

<212> PRT

<213> BK virus

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Glu Val Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Asn
20 25 30

Leu Arg Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser
35 40 45

Asp Ser Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile
50 55 60

Pro Leu Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met
65 70 75 80

Trp Glu Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met
85 90 95

Leu Asn Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly
100 105 110

Lys Pro Ile Gln Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asp
115 120 125

Pro Leu Glu Met Gln Gly Val Leu Leu Asn Tyr Arg Thr Lys Tyr Pro
130 135 140

<210> 151

<211> 144

<212> PRT

<213> BK virus

<400> 151

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Glu Val Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Asn Asp
20 25 30

Leu Arg Gly Tyr Ser Leu Arg Leu Thr Ala Glu Thr Ala Phe Asp Ser
35 40 45

Asp Ser Pro Asn Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile
50 55 60

Pro Leu Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met
65 70 75 80

Trp Glu Ala Val Thr Val Lys Thr Glu Val Ile Gly Ile Thr Ser Met
85 90 95

Leu Asn Leu His Ala Gly Ser Gln Lys Val His Glu Asn Gly Gly Gly

100

105

110

Lys Pro Ile Gln Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asp
115 120 125

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<210> 152

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<212> PRT

<213> BK virus

<400> 152

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Leu Arg Gly Phe Ser Leu Arg Leu Thr Ala Glu Asn Ala Phe Glu Ser
35 40 45

Asp Ser Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile
50 55 60

Pro Leu Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met
65 70 75 80

Trp Glu Ala Val Thr Val Lys Thr Glu Val Ile Gly Ile Thr Ser Met
85 90 95

Leu Asn Leu His Ala Gly Ser Gln Lys Val His Glu Asn Gly Gly Gly
100 105 110

Lys Pro Ile Gln Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asn

Pro Leu Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Ser Tyr Pro
 115 120 125

Pro Leu Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Ser Tyr Pro
 130 135 140

<210> 153

<211> 144

<212> PRT

<213> BK virus

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 20 25 30

Leu Arg Gly Phe Ser Leu Arg Leu Ser Val Ala Asn Asp Phe Ser Ser
 35 40 45

Asp Ser Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile
 50 55 60

Pro Leu Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met
 65 70 75 80

Trp Glu Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met
 85 90 95

Leu Asn Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly
 100 105 110

Lys Pro Ile Gln Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asp
 115 120 125

Pro Leu Glu Met Gln Gly Val Leu Met Asn Tyr Lys Thr Lys Tyr Pro
 130 135 140

<210> 154

<211> 144

<212> PRT

<213> BK virus

<400> 154

Gly Gly Val Glu Val Leu Glu Val Lys Asn Gly Val Asp Ser Ile Thr
 1 5 10 15

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 20 25 30

Leu Arg Gly Tyr Ser Leu Lys Ser Ile Ser Lys Asn Asp Phe Glu Ser
 35 40 45

Asp Ser Pro Asp Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile
 50 55 60

Pro Leu Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met
65 70 75 80

Trp Glu Ala Val Thr Val Lys Thr Glu Val Ile Gly Ile Thr Ser Met
85 90 95

Leu Asn Phe His Ala Gly Ser Gln Lys Ala His Glu Asn Gly Gly Gly
100 105 110

Lys Pro Ile Gln Gly Ser Ser Phe His Phe Phe Ala Val Gly Gly Asp
115 120 125

Pro Leu Glu Met Gln Gly Val Leu Met Asn Tyr Arg Thr Lys Tyr Pro
130 135 140

<210> 155

<211> 144

<212> PRT

<213> BK virus

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1 5 10 15

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20 25 30

Leu Arg Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser
35 40 45

Asp Ser Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile
50 55 60

Pro Leu Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met
65 70 75 80

Trp Glu Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Ser Ser Met
85 90 95

Leu Asn Leu His Ala Gly Ser Gln Lys Glu His Glu His Gly Gly Gly
100 105 110

Lys Pro Ile Gln Gly Ser His Phe His Phe Phe Ala Val Gly Gly Asp
115 120 125

Pro Leu Glu Met Gln Gly Val Leu Leu Asn Tyr Arg Thr Lys Tyr Pro
130 135 140

<210> 156

<211> 144

<212> PRT

<213> BK virus

<400> 156

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

Glu Val Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Glu Glu Lys

20

25

30

Leu Asn Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Phe Ser Ser
 35 40 45

Asp Ser Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile
 50 55 60

Pro Leu Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met
 65 70 75 80

Trp Glu Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met
 85 90 95

Leu Asn Leu His Ala Gly Ser Gln Lys Glu His Glu His Gly Gly Gly
 100 105 110

Lys Pro Ile Gln Gly Ser His Phe His Phe Phe Ala Val Gly Gly Asp
 115 120 125

Pro Leu Glu Met Gln Gly Val Leu Leu Asn Tyr Arg Thr Lys Tyr Pro
 130 135 140

<210> 157

<211> 144

<212> PRT

<213> BK virus

<400> 157

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 1 5 10 15

Glu Val Glu Cys Phe Leu Asn Pro Glu Met Gly Asp Pro Asp Glu Ser
 20 25 30

Phe Arg Gly Phe Ser Leu Lys Leu Ser Ala Glu Asn Asp Ile Ser Ser
 35 40 45

Asp Asn Pro Glu Arg Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile
 50 55 60

Pro Leu Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met
 65 70 75 80

Trp Glu Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Ser Ser Met
 85 90 95

Leu Asn Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly
 100 105 110

Lys Pro Ile Gln Gly Ser Asn Phe His Phe Phe Ala Val Gly Gly Asp
115 120 125

Pro Leu Lys Met Gln Gly Val Leu Leu Asn Tyr Arg Thr Ser Tyr Pro
130 135 140

<210> 158

<211> 144

<212> PRT

<213> BK virus

<400> 158

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20 25 30

Phe Arg Gly Phe Ser Leu Lys Gln Ser Ser Glu Lys Asp Ile Ser Asn
35 40 45

Asp Ser Pro Lys Lys Lys Met Leu Pro Cys Tyr Ser Thr Ala Arg Ile
50 55 60

Pro Leu Pro Asn Leu Asn Glu Asp Leu Thr Cys Gly Asn Leu Leu Met
65 70 75 80

Trp Glu Ala Val Thr Val Gln Thr Glu Val Ile Gly Ile Thr Ser Met
85 90 95

Leu Asn Leu His Ala Gly Ser Gln Lys Val His Glu His Gly Gly Gly
100 105 110

Lys Pro Ile Gln Gly Ser His Val His Phe Phe Ala Val Gly Gly Asp
115 120 125

Pro Leu Lys Met Gln Gly Val Val Met Asn Tyr Lys Thr Lys Tyr Pro
130 135 140

REFERENCES CITED IN THE DESCRIPTION

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P A T E N T K R A V

1. Isoleret BKV-serotype I (BKV-I)-kapsidpolypeptid eller nukleinsyre, som koder for BKV-I-kapsidpolypeptidet; og isoleret BKV-serotype IV (BKV-IV)-kapsidpolypeptid eller nukleinsyre, som koder for BKV-IV-kapsidpolypeptidet, til anvendelse i en fremgangsmåde til fremkaldelse af et immunrespons mod en BK-polyomavirus (BKV) hos et individ, hvilken fremgangsmåde omfatter administration til et individ med behov for forbedret immunitet over for BKV af:

en terapeutisk effektiv mængde af mindst én af det isolerede BKV-serotype I (BKV-I)-kapsidpolypeptid eller en nukleinsyre, som koder for det mindst ene BKV-I-kapsidpolypeptid; og en terapeutisk effektiv mængde af mindst én af det isolerede BKV-serotype IV (BKV-IV)-kapsidpolypeptid eller en nukleinsyre, som koder for det mindst ene BKV-IV-kapsidpolypeptid,

for derved at fremkalde et immunrespons mod BKV'en,

hvor det mindst ene BKV-I-kapsidpolypeptid og det mindst ene BKV-IV-kapsidpolypeptid administreres samtidigt eller sekventielt.

2. Kapsidpolypeptider eller nukleinsyrer til anvendelsen ifølge krav 1, hvor administration af det mindst ene isolerede BKV-I-kapsidpolypeptid omfatter administration af en viruslignende partikel, som omfatter det mindst ene BKV-I-kapsidpolypeptid, og/eller hvor administration af det mindst ene isolerede BKV-IV-kapsidpolypeptid omfatter administration af en viruslignende partikel, som omfatter det mindst ene BKV-IV-kapsidpolypeptid.

3. Kapsidpolypeptider eller nukleinsyrer til anvendelsen ifølge krav 1 eller 2, hvor det mindst ene isolerede BKV-I-kapsidpolypeptid omfatter BKV-I-VP1, BKV-I-VP2, BKV-I-VP3 eller en kombination af to eller flere deraf, og/eller hvor det mindst ene isolerede BKV-IV-kapsidpolypeptid omfatter BKV-IV-VP1, BKV-IV-VP2, BKV-IV-VP3 eller en kombination af to eller flere deraf, og/eller

hvor det mindst ene isolerede BKV-IV-kapsidpolypeptid omfatter aminosyresekvensen ifølge en hvilken som helst af SEQ ID NO: 4-6, 16 og 110-125, og det mindst ene isolerede BKV-I-kapsidpolypeptid omfatter aminosyresekvensen ifølge en hvilken som helst af SEQ ID NO: 1-3, 13-15 og 52-103.

4. Kapsidpolypeptider eller nukleinsyrer til anvendelsen ifølge krav 3, hvor BKV-I-VP1-polypeptidet omfatter et eller flere af et BKV-Ia-VP1-polypeptid, et BKV-Ib1-VP1-polypeptid, et BKV-Ib2-VP1-polypeptid og et BKV-Ic-VP1-polypeptid, og/eller hvor BKV-IV-VP1-polypeptidet omfatter et eller flere af et BKV-IVb1-VP1-polypeptid og et BKV-IVc2-VP1-polypeptid.

5. Kapsidpolypeptider eller nukleinsyrer til anvendelsen ifølge et hvilket som helst af kravene 1 til 4, hvor fremgangsmåden endvidere omfatter administration til individet af en terapeutisk effektiv mængde af:

mindst ét isoleret BKV-serotype II (BKV-II)-kapsidpolypeptid eller en nukleinsyre, som koder for det mindst ene BKV-II-kapsidpolypeptid; og/eller

mindst ét isoleret BKV-serotype III (BKV-III)-kapsidpolypeptid eller en nukleinsyre, som koder for det mindst ene BKV-III-kapsidpolypeptid.

6. Kapsidpolypeptider eller nukleinsyrer til anvendelsen ifølge krav 5, hvor fremgangsmåden endvidere omfatter administration til individet af en terapeutisk effektiv
5 mængde af:

mindst ét JC-polyomavirus (JCV)-kapsidpolypeptid eller en nukleinsyre, som koder for det mindst ene JCV-kapsidpolypeptid; og/eller en adjuvans.

7. Kapsidpolypeptider eller nukleinsyrer til anvendelsen ifølge et hvilket som helst af
10 kravene 1 til 6, hvor individet ikke har BKV-I-neutraliserende antistoffer og/eller BKV-IV-neutraliserende antistoffer.

8. Isoleret BKV-serotype IV (BKV-IV)-kapsidpolypeptid eller nukleinsyre, som koder for BKV-IV-kapsidpolypeptidet, til anvendelse i en fremgangsmåde til fremkaldelse af et immunrespons mod en BK-polyomavirus (BKV) hos et individ, hvilken fremgangsmåde
15 omfatter administration til et individ med behov for forbedret immunitet over for BKV af en terapeutisk effektiv mængde af mindst én af det isolerede BKV-IV-kapsidpolypeptid eller en nukleinsyre, som koder for det mindst ene BKV-IV-kapsidpolypeptid, for derved at fremkalde et immunrespons mod BKV'en.

9. Isoleret BK-polyomavirus-serotype IV (BKV-IV)-kapsidpolypeptid eller nukleinsyre,
20 som koder for BKV-IV-kapsidpolypeptidet, til anvendelse i en fremgangsmåde til behandling eller hæmning af BK-polyomavirus-associeret nefropati eller BK-polyomavirus-associeret hæmorrhagisk cystitis hos et individ, hvilken fremgangsmåde omfatter administration til et individ med behov for behandling for eller hæmning af BK-polyomavirus-associeret nefropati eller BK-polyomavirus-associeret hæmorrhagisk cystitis af en terapeutisk
25 effektiv mængde af det mindst ene isolerede BKV-serotype IV (BKV-IV)-kapsidpolypeptid eller en nukleinsyre, som koder for det mindst ene BKV-IV-kapsidpolypeptid, for derved at behandle eller hæmme den BK-polyomavirus-associerede nefropati eller den BK-polyomavirus-associerede hæmorrhagiske cystitis.

10. Kapsidpolypeptid eller nukleinsyre til anvendelsen ifølge krav 8 eller 9, som endvidere omfatter administration til individet af en terapeutisk effektiv mængde af:

mindst ét isoleret BKV-serotype I (BKV-I)-kapsidpolypeptid eller en nukleinsyre, som koder for det mindst ene BKV-I-kapsidpolypeptid;

mindst ét isoleret BKV-serotype II (BKV-II)-kapsidpolypeptid eller en nukleinsyre, som koder for det mindst ene BKV-II-kapsidpolypeptid;

35 mindst ét isoleret BKV-serotype III (BKV-III)-kapsidpolypeptid eller en nukleinsyre, som koder for det mindst ene BKV-III-kapsidpolypeptid;

mindst ét isoleret JC-polyomavirus-kapsidpolypeptid eller en nukleinsyre, som koder for det mindst ene JC-polyomavirus-kapsidpolypeptid;

eller en adjuvans; eller

40 en kombination af to eller flere deraf.

11. Kapsidpolypeptid eller nukleinsyre til anvendelsen ifølge krav 9 eller 10, hvor individet er kandidat til en organtransplantation, og den terapeutisk effektive mængde af det mindst ene BKV-IV-kapsidpolypeptid eller nukleinsyre, som koder for det mindst ene BKV-IV-kapsidpolypeptid, administreres til individet i tilstrækkelig tid før organtransplantationen til at frembringe et immunrespons hos individet, og/eller hvor individet er et immunkompromitteret individ eller et individ, der er blevet behandlet med eller er kandidat til behandling med et immunosuppressivum, eller et individ, der har fået eller er kandidat til en organtransplantation eller knoglemarvstransplantation.

12. Multivalent BK-polyomavirus (BKV)-immunogen sammensætning, som omfatter:
 10 en viruslignende partikel, som omfatter mindst ét BKV-serotype IV-kapsidpolypeptid;
 en viruslignende partikel, som omfatter mindst ét BKV-serotype I-kapsidpolypeptid; og
 en farmaceutisk acceptabel bærer.

13. Sammensætning ifølge krav 12, hvor det mindst ene isolerede BKV-IV-kapsidpolypeptid omfatter aminosyresekvensen ifølge en hvilken som helst af SEQ ID NO: 4-6, 16 og 110-125, og det mindst ene isolerede BKV-I-kapsidpolypeptid omfatter aminosyresekvensen ifølge en hvilken som helst af SEQ ID NO: 1-3, 13-15 og 52-103.

14. Immunogen sammensætning ifølge krav 12 eller 13, som endvidere omfatter:
 20 en viruslignende partikel, som omfatter mindst ét BKV-serotype II-kapsidpolypeptid; og/eller
 en viruslignende partikel, som omfatter mindst ét BKV-serotype III-kapsidpolypeptid.

15. Immunogen sammensætning ifølge krav 14, som endvidere omfatter:
 25 en viruslignende partikel, som omfatter mindst ét JC-polyomavirus (JCV)-kapsidpolypeptid; og/eller
 en adjuvans.

16. Immunogen sammensætning ifølge et hvilket som helst af kravene 12 til 15, hvor kapsidpolypeptidet omfatter VP1, VP2, VP3 eller en kombination af to eller flere deraf.

17. Immunogen sammensætning ifølge et hvilket som helst af kravene 12 til 16, hvor det mindst ene BKV-serotype IV-kapsidpolypeptid omfatter et eller flere af et BKV-IVb1-VP1-polypeptid og et BKV-IVc2-VP1-polypeptid, og/eller hvor det mindst ene BKV-serotype I-kapsidpolypeptid omfatter et eller flere af et BKV-Ia-VP1-polypeptid, et BKV-Ib1-VP1-polypeptid, et BKV-Ib2-VP1-polypeptid og et BKV-Ic-VP1-polypeptid.

18. Fremgangsmåde til monitorering af udvikling af et immunrespons på BKV hos et individ, som har fået administreret en immunogen sammensætning, der omfatter mindst ét isoleret BKV-kapsidpolypeptid eller en nukleinsyre, som koder for et BKV-kapsidpolypeptid, hvilken fremgangsmåde omfatter påvisning af tilstedeværelse af BK-polyomavirus-serotypespecifikke neutraliserende antistoffer i en prøve, der er opnået fra

individet, hvor de serotypespecifikke neutraliserende antistoffer er BKV-I-specifikke, BKV-II-specifikke, BKV-III-specifikke eller BKV-IV-specifikke.

- 19.** Viruslignende partikel, som omfatter mindst ét BKV-serotype IV-kapsidpolypeptid, og viruslignende partikel, som omfatter mindst ét BKV-serotype I-kapsidpolypeptid, til anvendelse i en fremgangsmåde til fremkaldelse af et immunrespons
5 mod en BK-polyomavirus (BKV) hos et individ, hvilken fremgangsmåde omfatter administration af partiklerne, samtidigt eller sekventielt, til et individ med behov for forbedret immunitet over for BKV.

DRAWINGS

FIG. 1

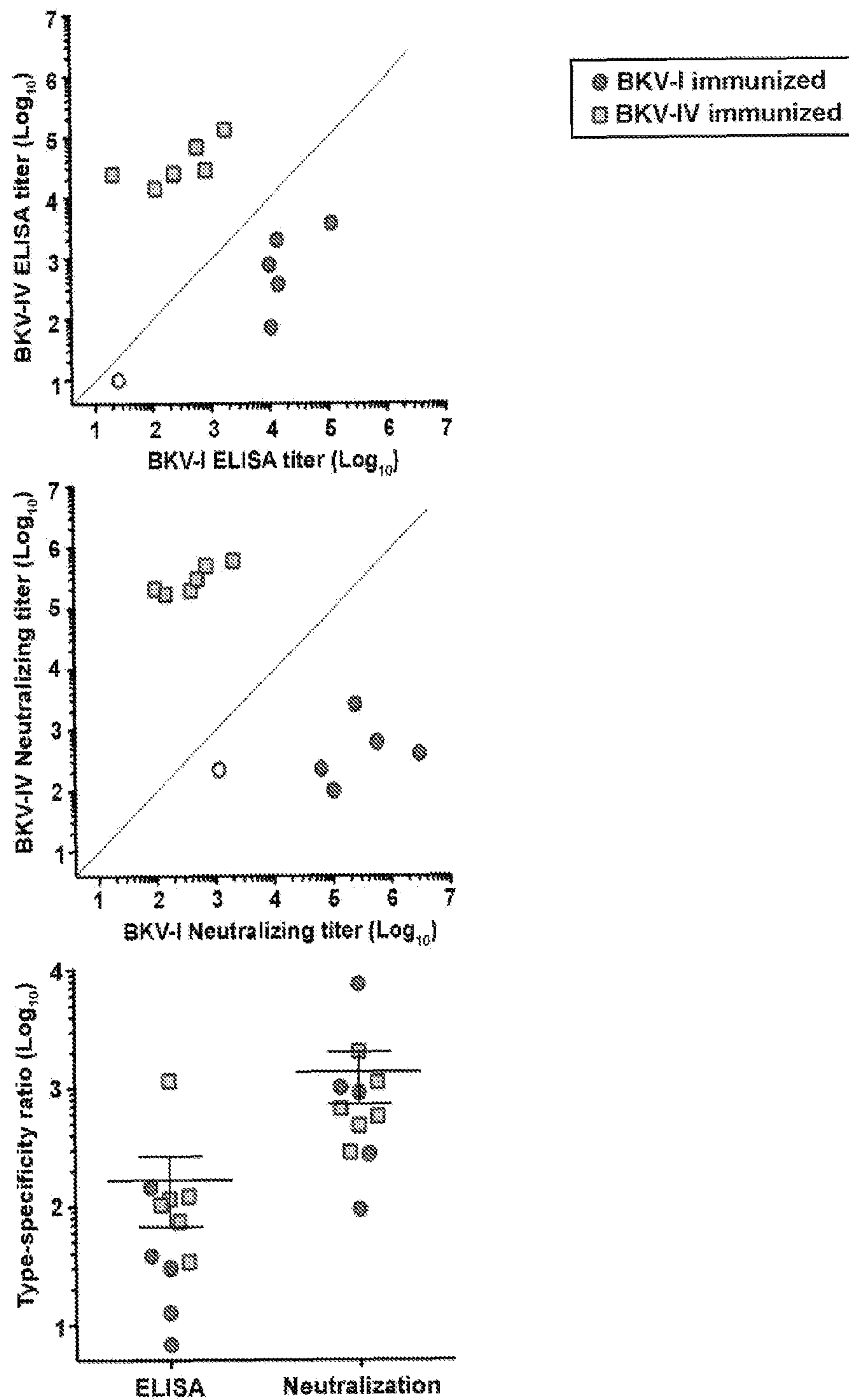


FIG. 2

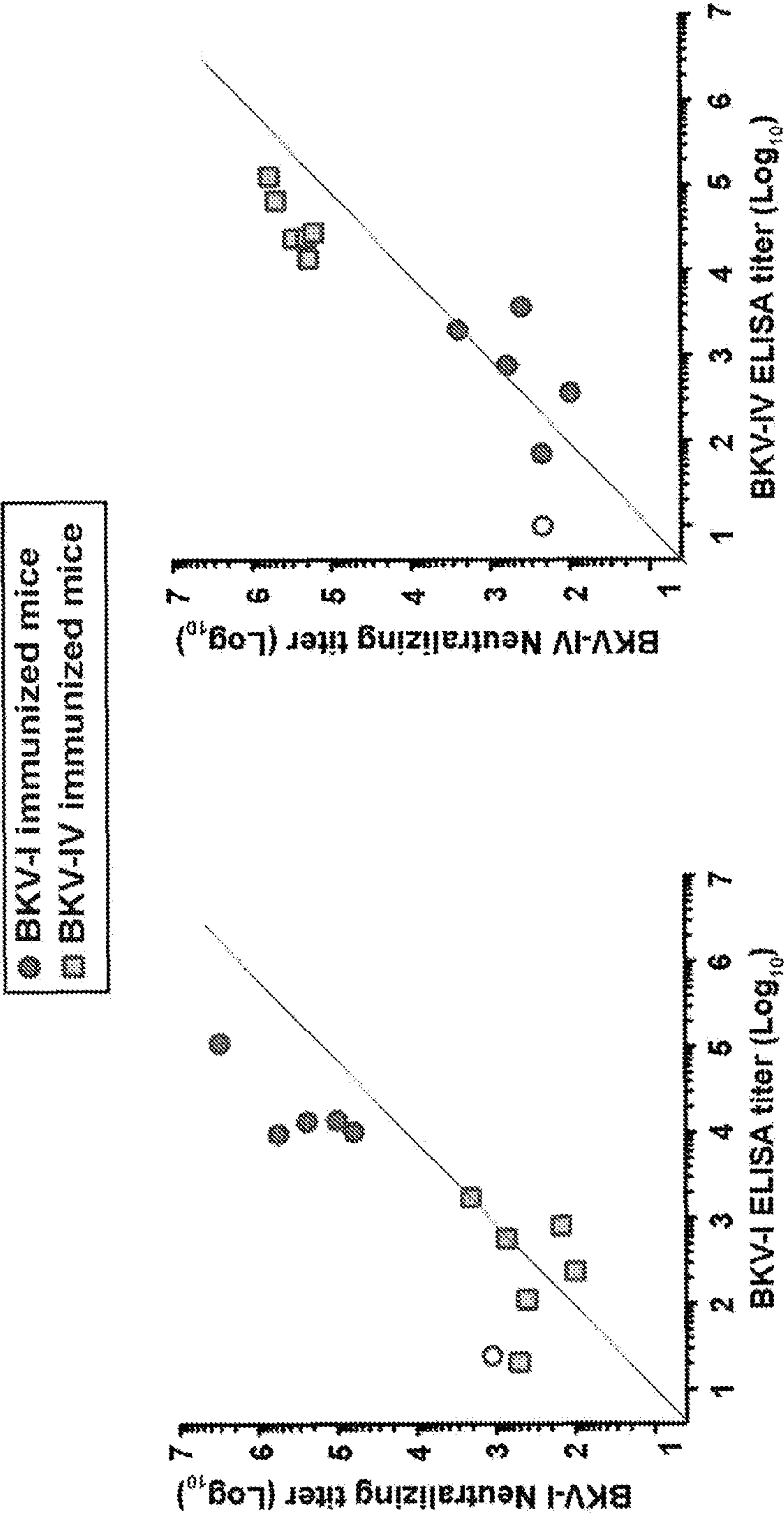


FIG. 3

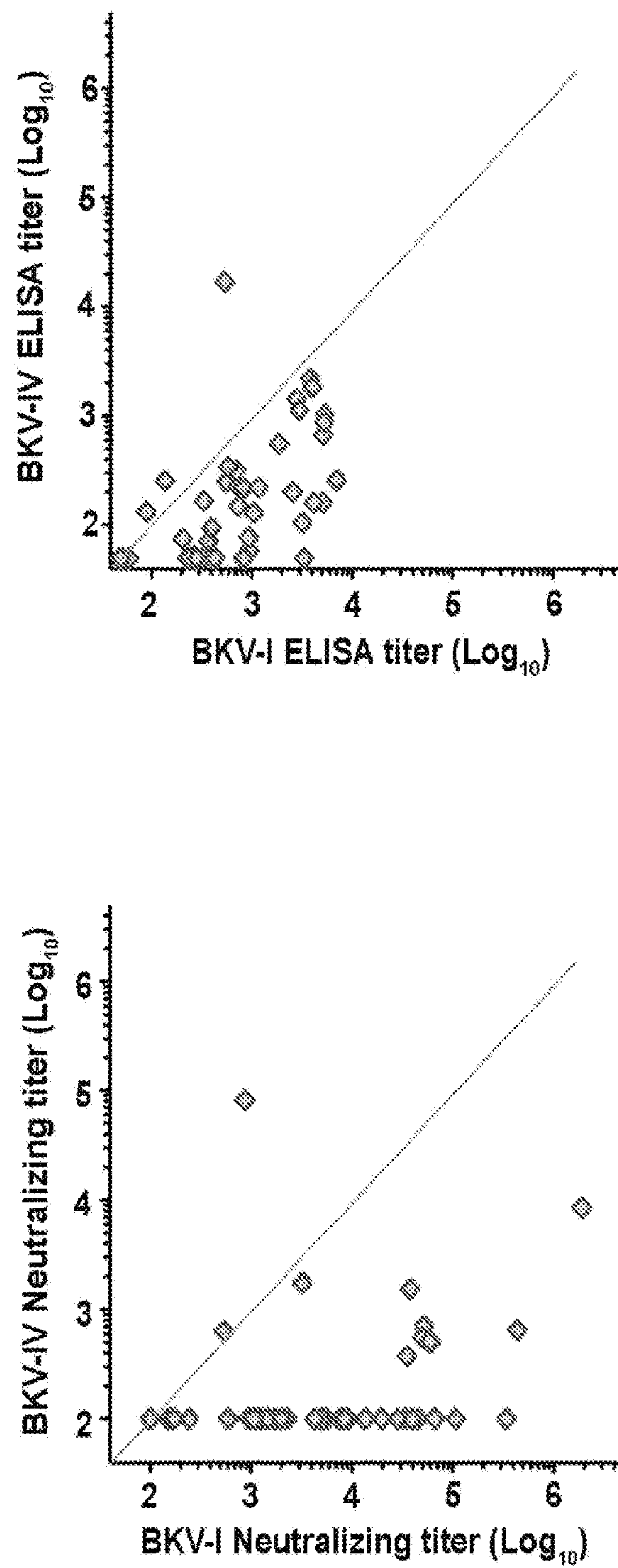


FIG. 4

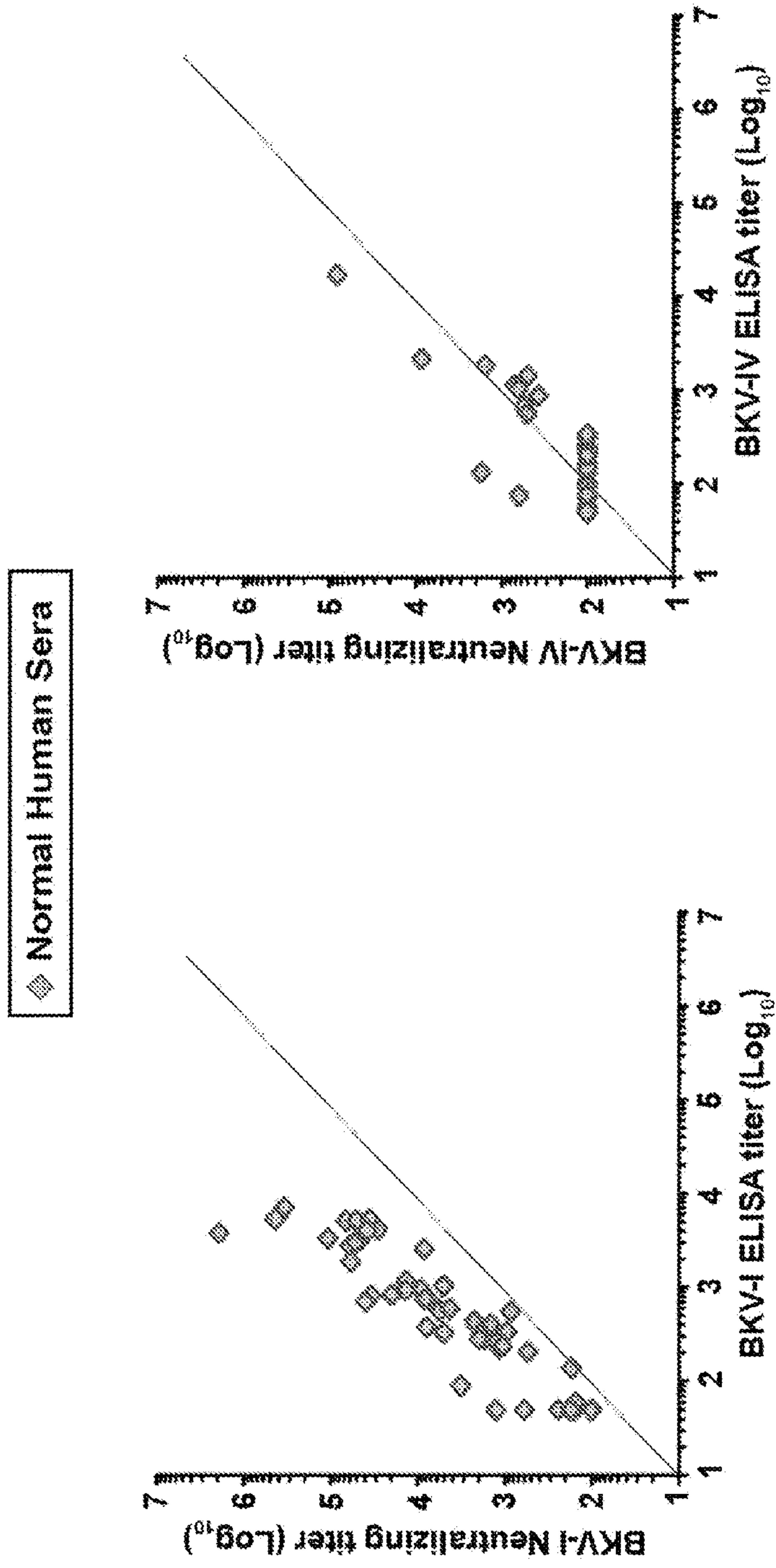


FIG. 5

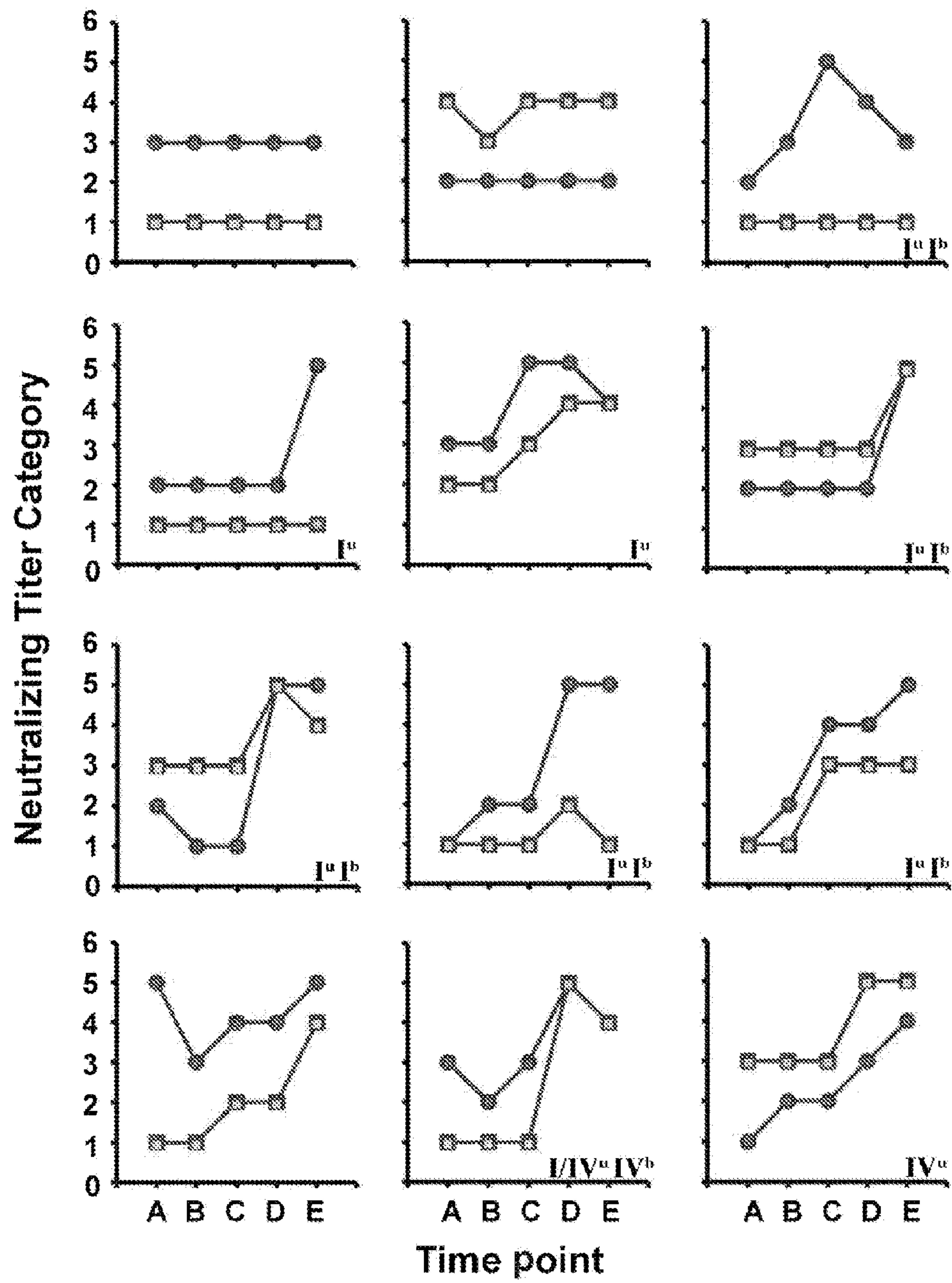


FIG. 6 (Page 1 of 6)

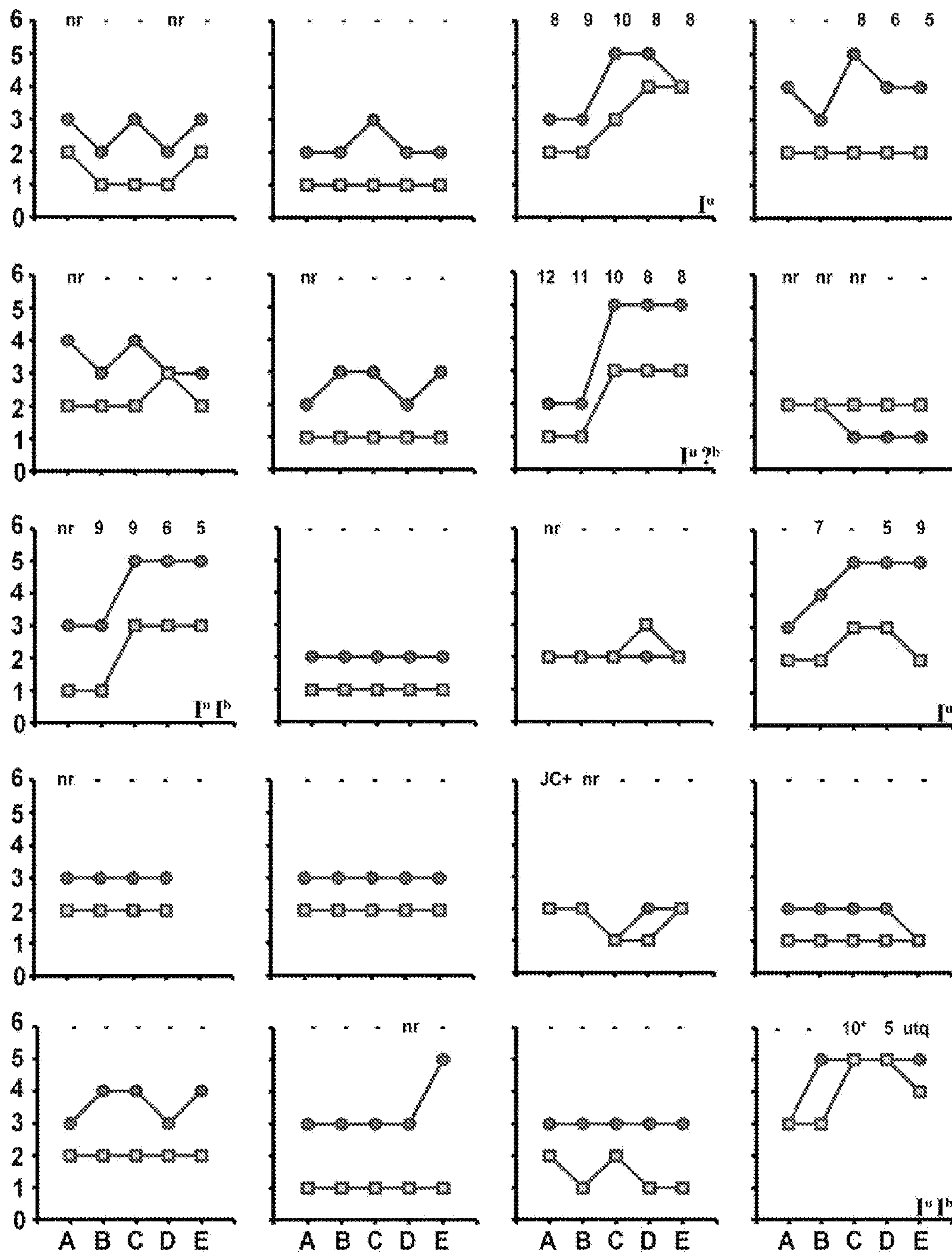


FIG. 6 (Page 2 of 6)

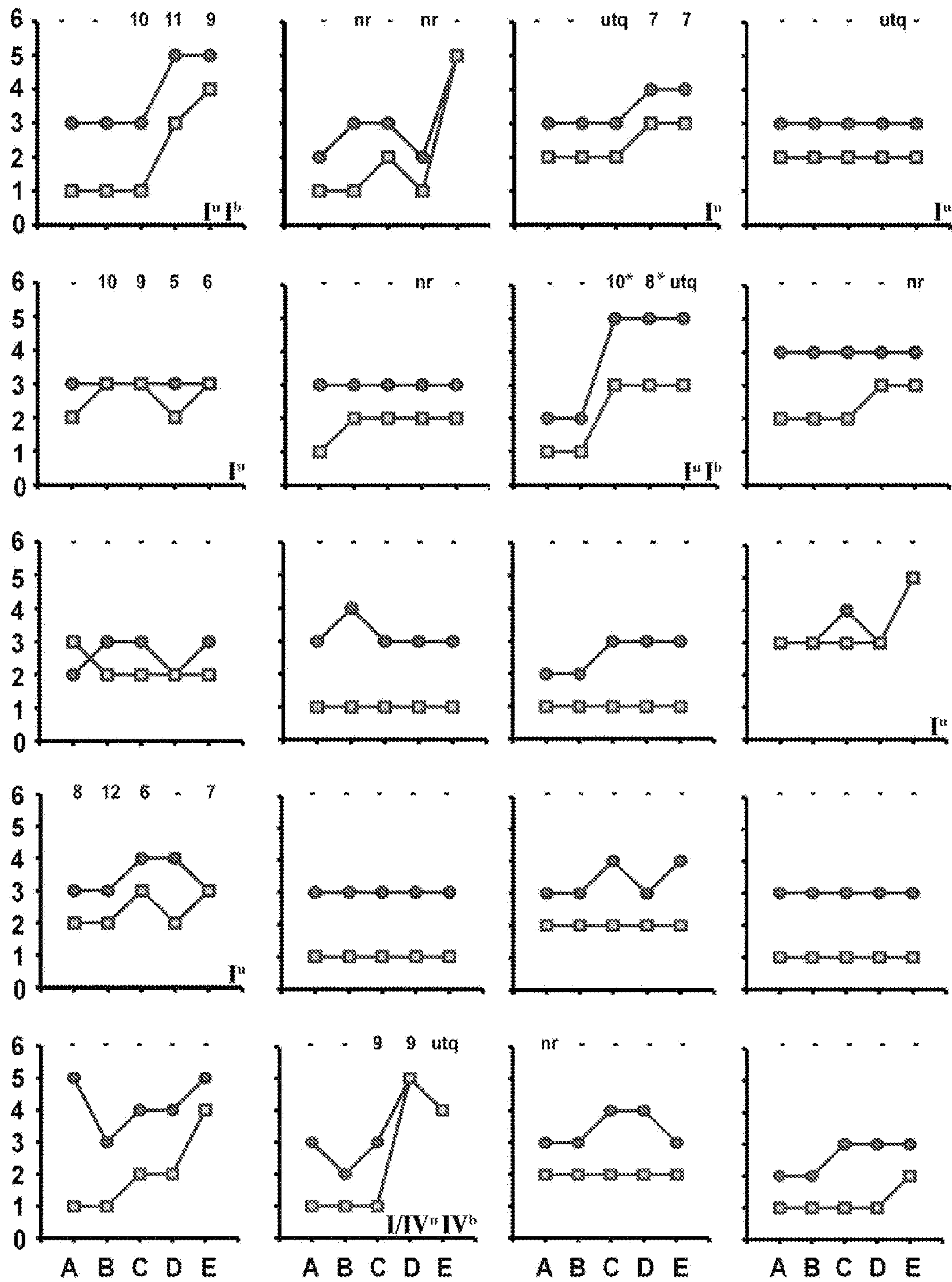


FIG. 6 (Page 3 of 6)

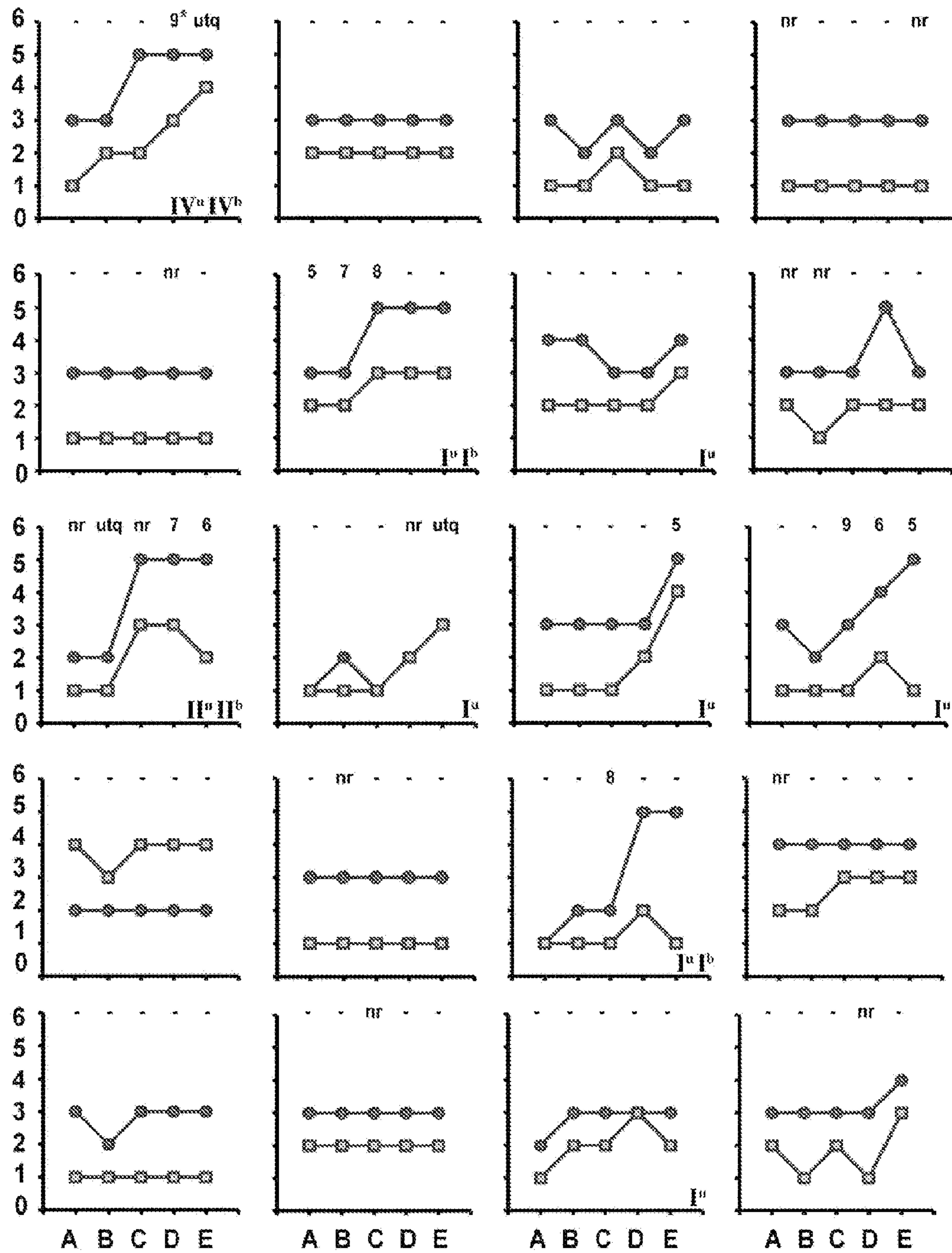


FIG. 6 (Page 4 of 6)

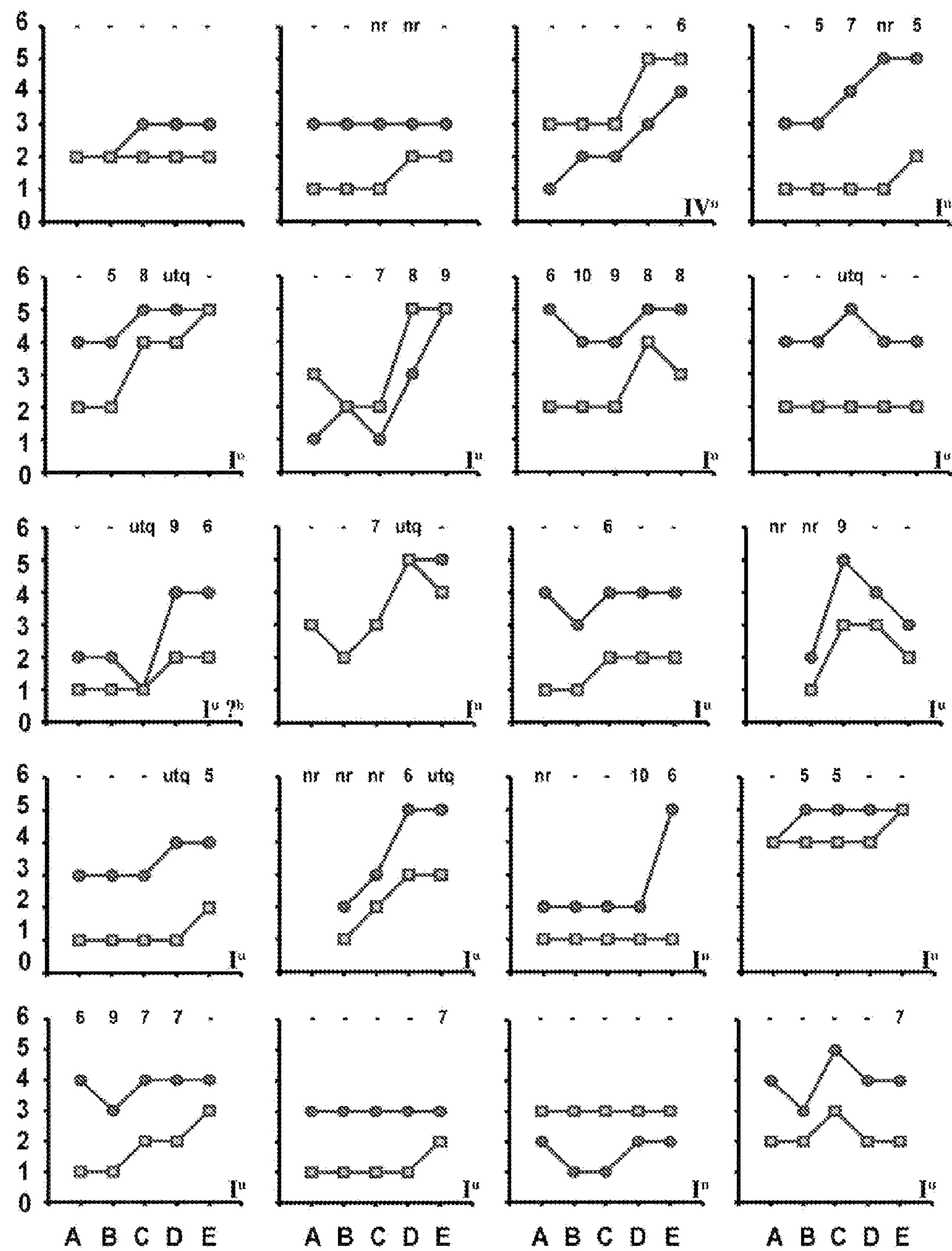


FIG. 6 (Page 5 of 6)

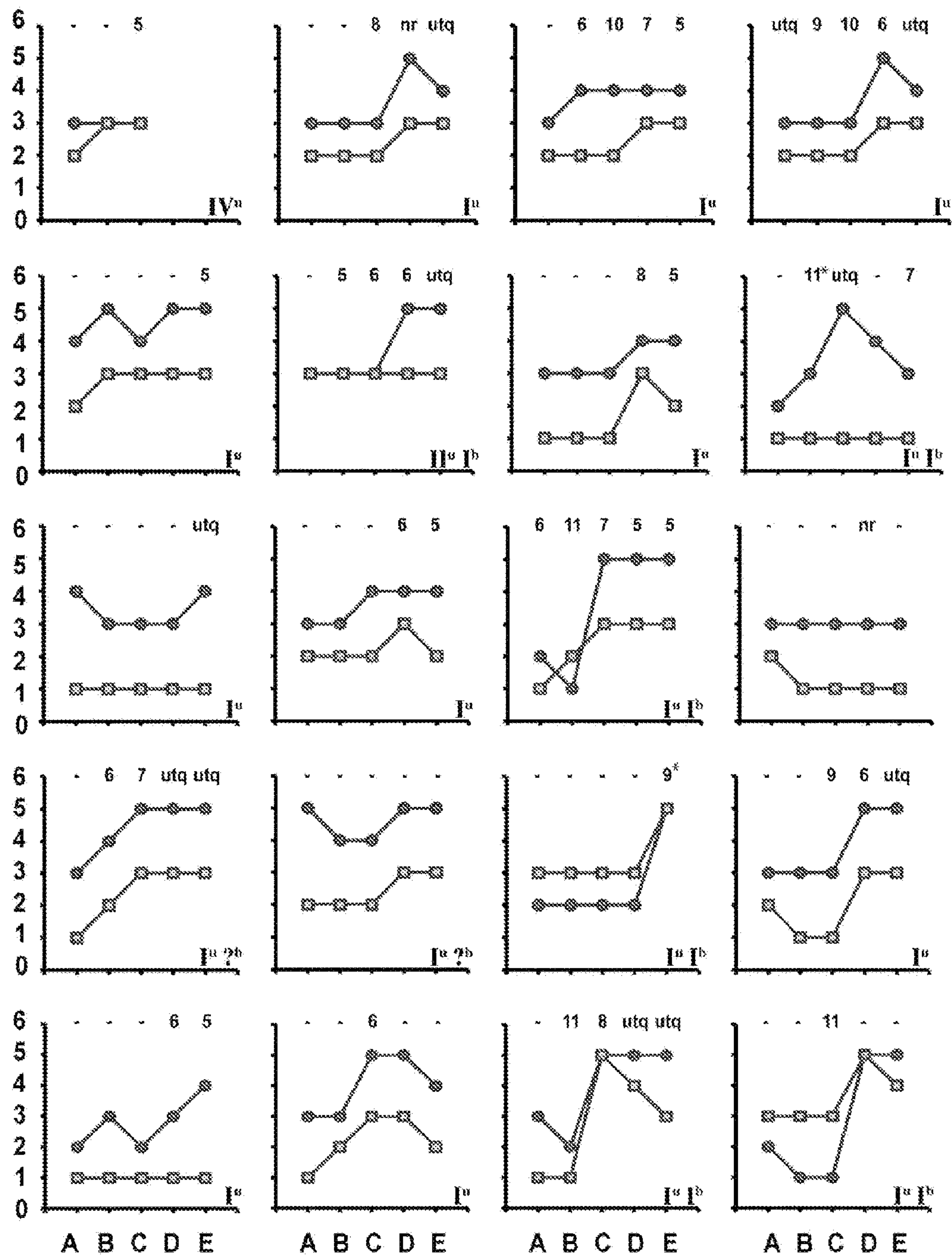


FIG. 6 (Page 6 of 6)

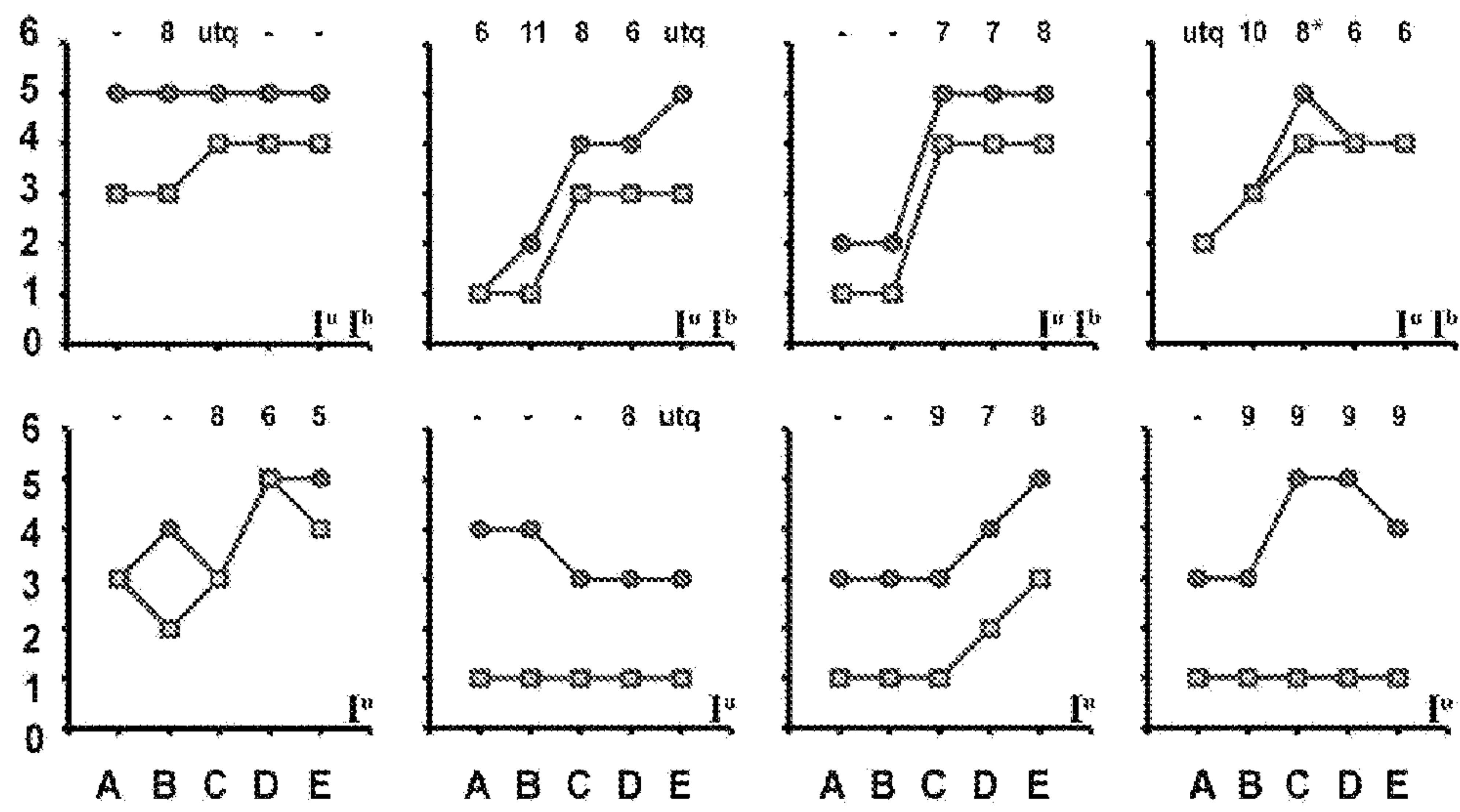


FIG. 7

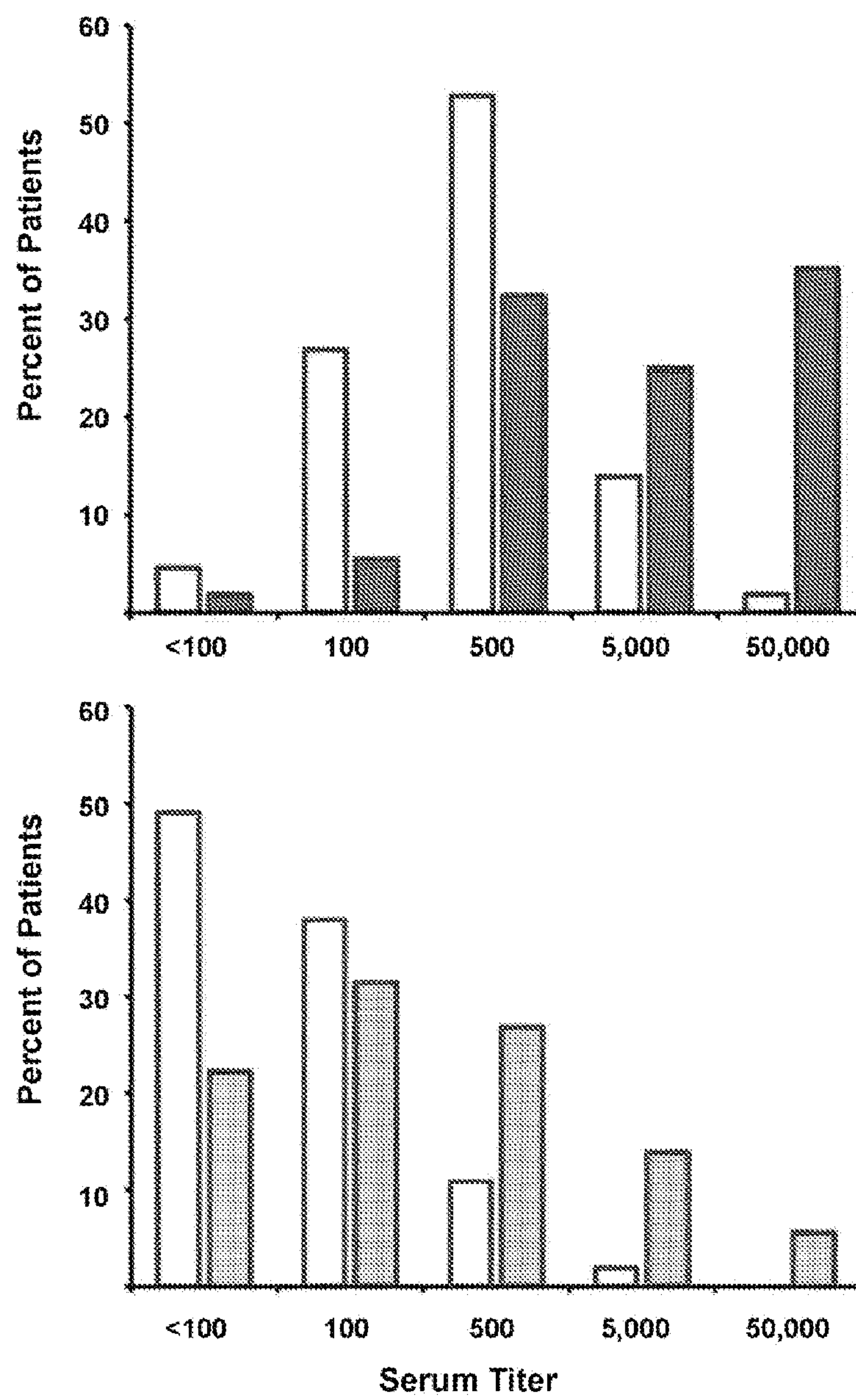


FIG. 8 (Page 1 of 4)

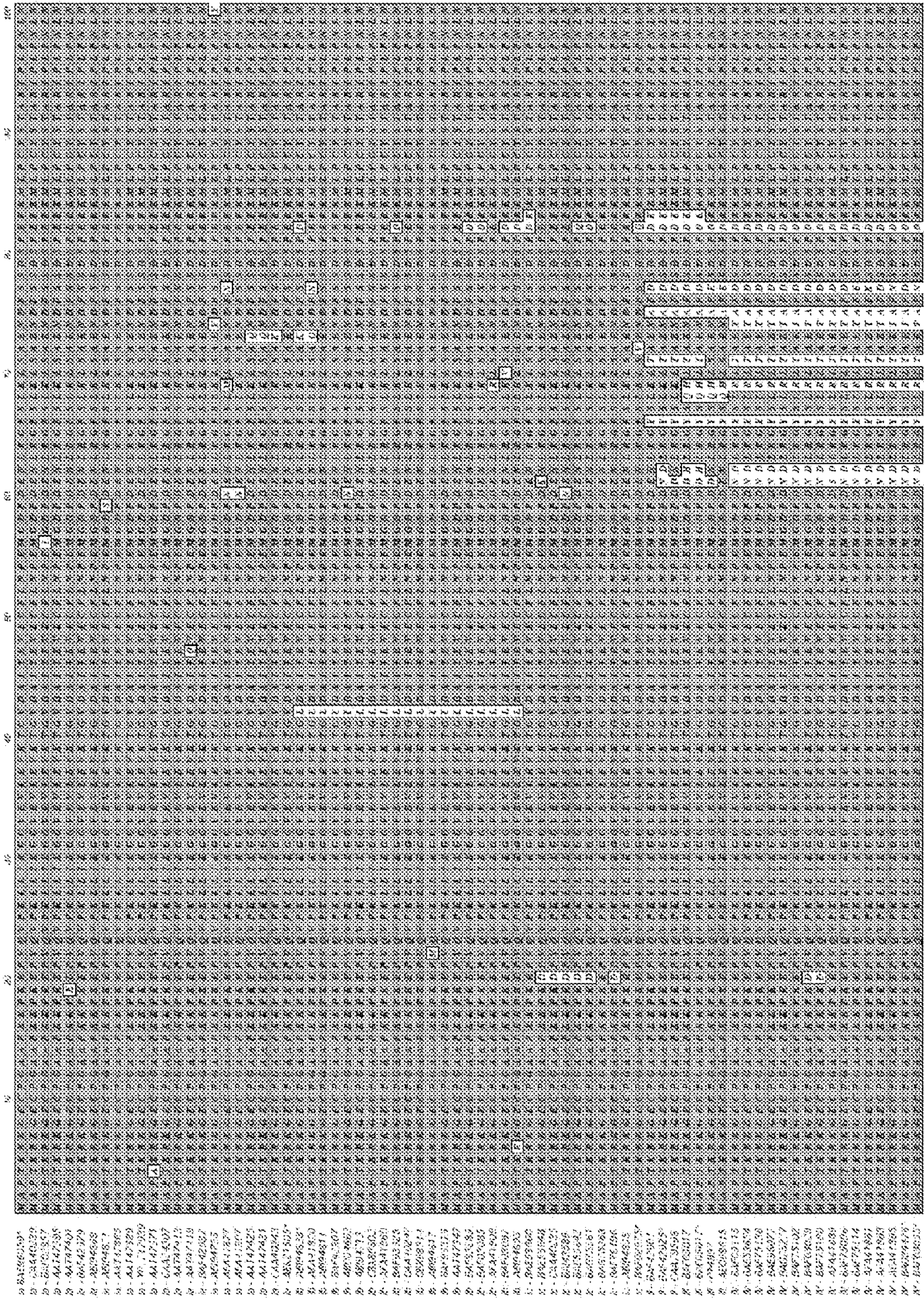


FIG. 8 (Page 2 of 4)

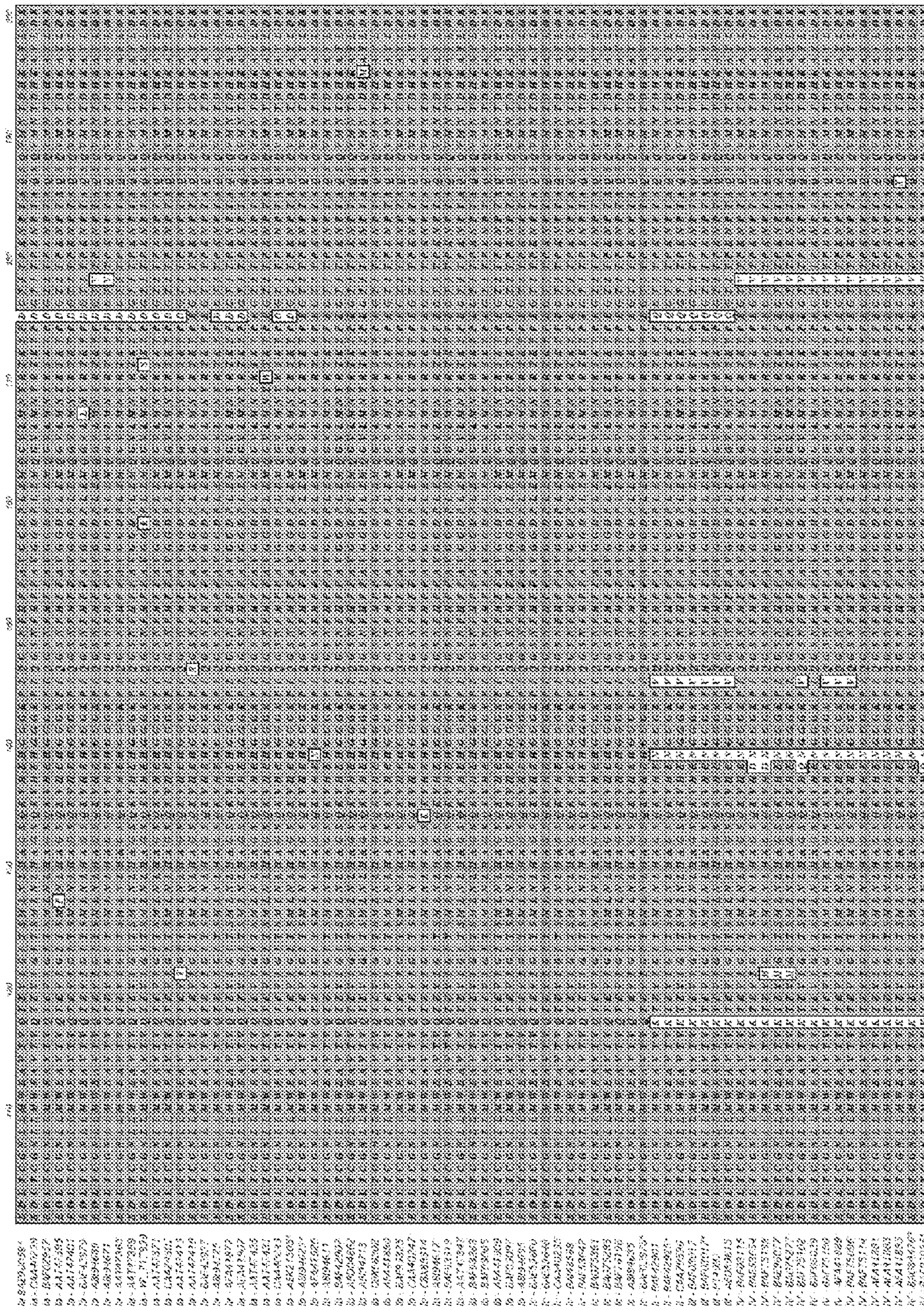


FIG. 8 (Page 3 of 4)

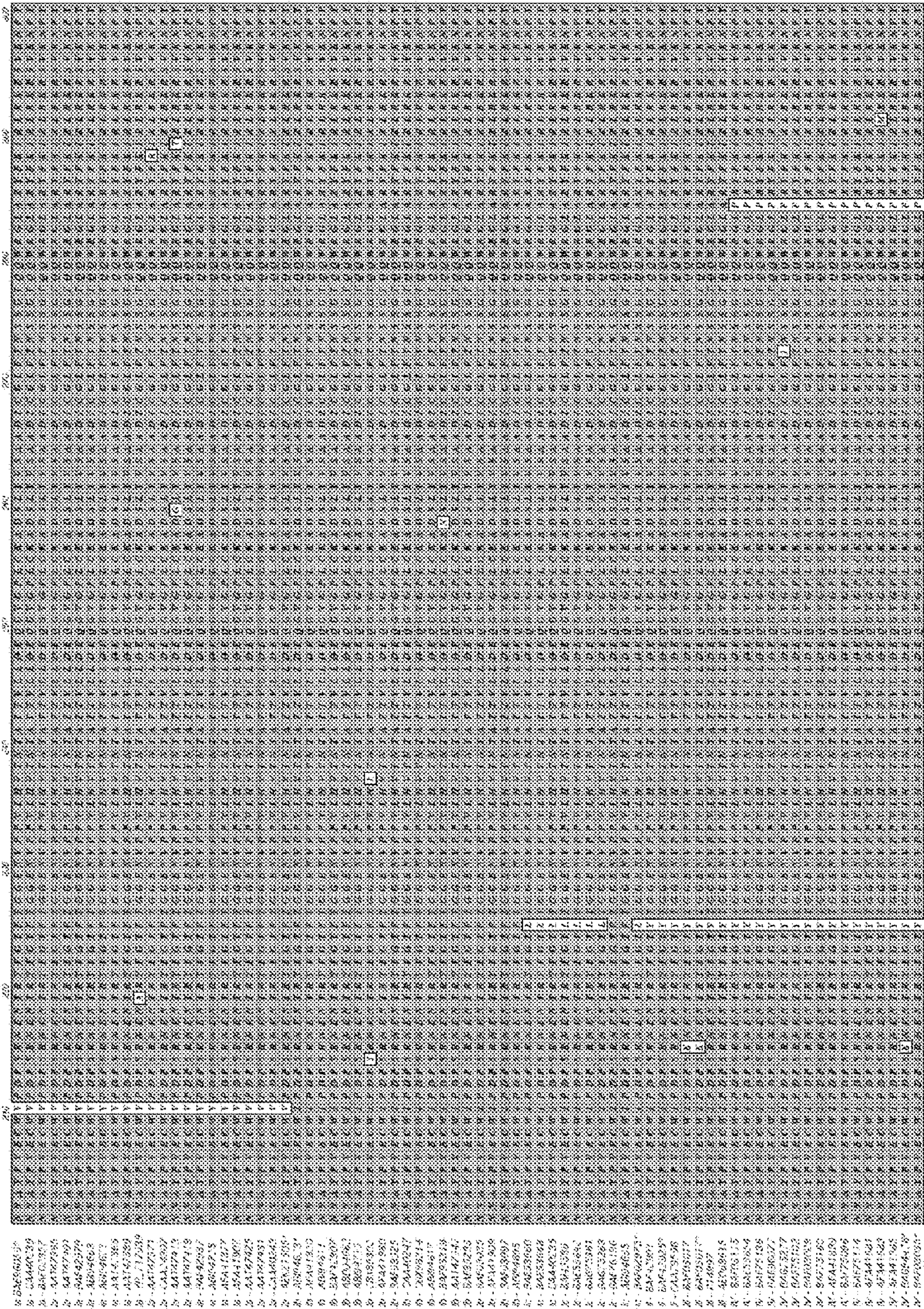


FIG. 9

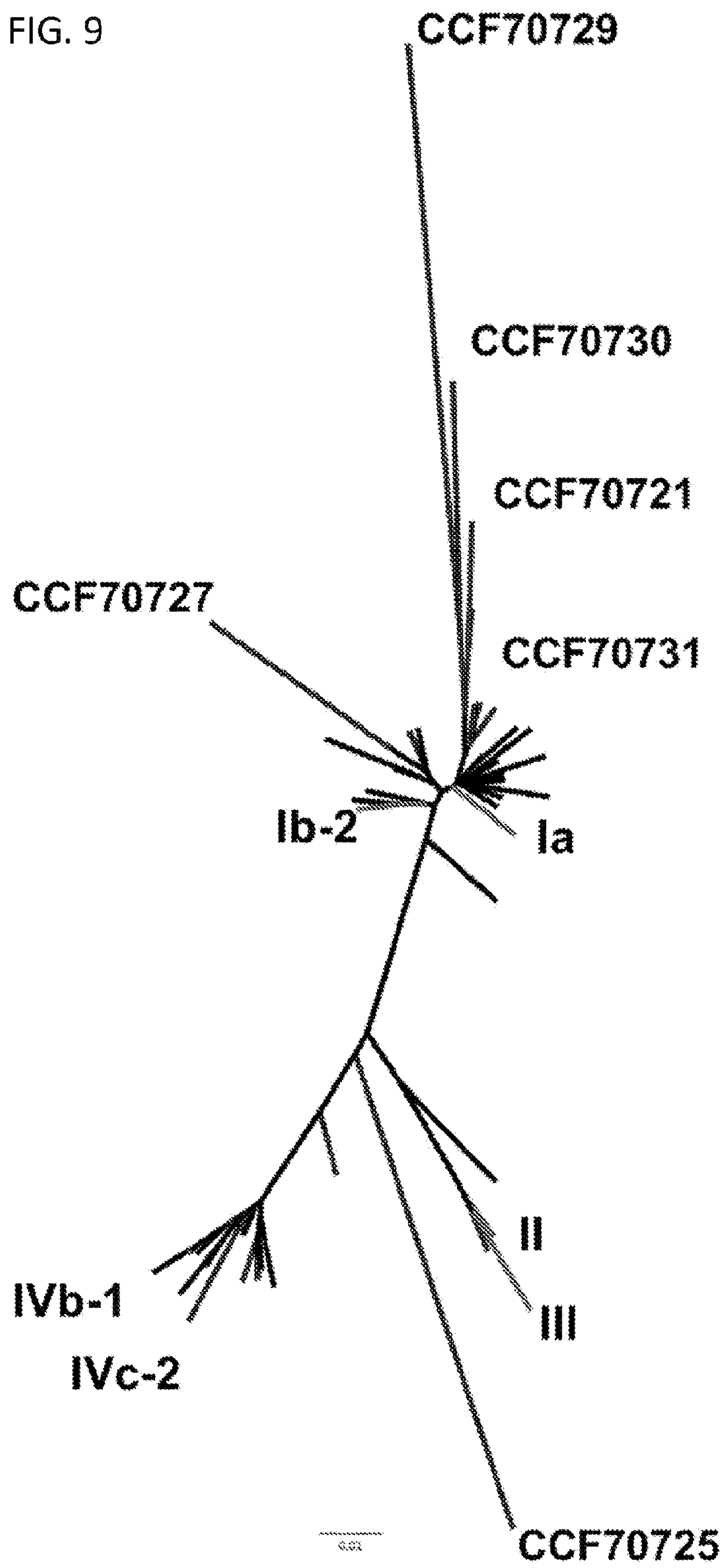


FIG. 10 (Page 1 of 2)

1a - BAE96059*
1b - AEN21505*
1c2 - AB194629*
1c - BAF029751*
1l - BAF42925*
1m - BAF03017*
1n1 - BAF03035*
1n2 - BAF03017*
CCF70703
CCF70704
CCF70705
CCF70706
CCF70707
CCF70708
CCF70709
CCF70710
CCF70711
CCF70712
CCF70713
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