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(54) **Title**: MARKERS FOR RENAL DISEASE

(57) **Abstract**: This invention provides reagents and methods for diagnosing renal disease. Differential levels of inosine metabolite, and proteins: apolipoprotein C-I, apolipoprotein C-II, fibrinogen alpha chain, or fibrinogen A-alpha chain, kininogen, Inter-Alpha Inhibitor H4 (ITIH4), keratin Type I cytoskeletol 10 cystatin A, cystatin B and other polypeptides and fragments thereof provide biomarkers of renal disease and are described herein.

MARKERS FOR RENAL DISEASE

Cross Reference to Related Applications

This application claims benefit of U.S. Provisional Application Nos. 61/351,183, filed June 3, 2010 and 61/411,280 filed November 8, 2010, which is incorporated herein by reference in its entirety.

Background of the Invention

Renal disease is associated with increased water consumption, frequent urination, diminished appetite, weight loss and muscle atrophy. Generally, by the time clinical symptoms of renal disease develop, irreparable kidney damage has occurred. Early detection permits earlier treatment and in turn slows disease progression. Current treatment includes dialysis and a diet low in phosphorous and protein. Unfortunately, no cure for chronic renal disease exists and kidney failure will eventually occur. Therefore, early detection is crucial for improved life span and quality of life.

In mammals, renal disease progression is divided into five levels. Current methods for detecting canine renal disease include kidney ultrasound, biopsy, or measurement of urine protein/creatinine levels. Biopsy is invasive and creatinine measurement is not accurate until stage three of renal failure, which is after significant tissue damage has occurred. Methods for detecting canine renal disease at earlier stages are needed in the art as such methods would inhibit disease progression.

Summary of the Invention

This invention provides reagents and methods for identifying patients with renal disease. The reagents and methods of this invention are directed to detecting levels of specific metabolites, full-length proteins and protein fragments, particularly inosine

nucleoside and the following proteins: apolipoprotein C-I, apolipoprotein C-II, fibrinogen alpha chain, or fibrinogen A-alpha chain, kininogen, keratin Type I cytoskeletol 10, cystatin A, cystatin B, Inter-Alpha Inhibitor H4 (ITIH4) and/or one or more of SEQ ID NOs:1-59 in renal patient samples. The relative levels of full-length protein and protein fragment provide biomarkers for diagnosing kidney/renal disease. Reagents and methods of this invention are additionally directed to assessing inosine concentrations as a biomarker for kidney/renal disease. Specific embodiments of the reagents and methods of the described invention are adapted for detecting protein biomarkers specific to renal disease. In one embodiment, antibodies specific for SEQ ID NOS: 3, 7, 13, or 20 are used to bind proteins and protein fragments produced in patients with renal disease; a non-limiting example of such proteins identified herein include apolipoprotein C-I, apolipoprotein C-II, fibrinogen alpha chain, or fibrinogen A-alpha chain. In a further embodiment, antibodies are specific for CysB1, Cys A, Kininogen, Inter-Alpha Inhibitor H4 (ITIH4), or keratin type I cytoskeletal 10. In a particular embodiment, methods for assessing the differential levels of inosine provide a biomarker for renal disease. Inosine levels may be assessed, for example, by LC/MS or inosine-specific antibodies. In additional embodiments, the reagents and methods provided herein detect altered protein levels in blood, serum, plasma, or urine. A plurality of altered protein and protein fragments are disclosed herein that occur in renal disease, including but not limited to amino acid sequences set forth in greater detail (*see* Table 1). Certain embodiments of the invention also provide one or a plurality of polypeptide sequences disclosed herein that exhibit altered levels in renal patient samples. In additional embodiments, the invention provides diagnostic methods using antibodies specific to one or a plurality of polypeptides consisting of SEQ ID NOS: 1-59 for identifying renal disease.

An embodiment of the invention provides antibodies that specifically bind to one or a plurality of polypeptides consisting of SEQ ID NOS: 1-59. In a preferred embodiment, the

invention provides an antibody that specifically binds to a polypeptide consisting of SEQ ID NOS: 3, 7, 13, or 20. An antibody specific for the above SEQ ID NOS: binds full-length proteins, truncated proteins, or protein fragments comprising the respective SEQ ID. The invention further provides an antibody that specifically binds canine apolipoprotein C-I, apolipoprotein C-II, fibrinogen alpha chain, or fibrinogen A-alpha chain. The invention further provides an antibody that specifically binds canine CysB1, Cys A, Kininogen, Inter-Alpha Inhibitor H4 (ITIH4), or keratin type I cytoskeletal 10. The antibody can be a monoclonal antibody, polyclonal antibody, antigen-binding antibody fragment, or a single chain antibody.

Another embodiment of the invention provides a method of diagnosing renal disease in a subject. The method comprises obtaining a biological sample from the subject; contacting the biological sample with an antibody specific for one or a plurality of SEQ ID NOS: 1-59 under conditions that allow polypeptide/antibody complexes to form; and detecting the levels of polypeptide/antibody complexes relative to levels present in control samples. In a preferred embodiment, a diagnostic antibody is specific for one or a plurality of SEQ ID NOS: 3, 7, 13, or 20, wherein the antibodies respectively specifically bind apolipoprotein C-I, apolipoprotein C-II, fibrinogen alpha chain, or fibrinogen A-alpha chain. The invention further provides an antibody that specifically binds canine Cystatin B, Cystatin A, Kininogen, Inter-Alpha Inhibitor H4 (ITIH4), or keratin type I cytoskeletal 10.

Yet another embodiment of the invention provides a method of detecting renal failure by identifying one or a plurality of polypeptides specific to SEQ ID NOS: 1-59 in a sample. The method comprises contacting antibodies that specifically bind to a polypeptide consisting of SEQ ID NOS: 1-59 with the sample under conditions that allow polypeptide/antibody complexes to form; and detecting the polypeptide/antibody complexes, wherein the differential levels of polypeptide/antibody complexes formed with patient sample versus

control sample is an indication of renal disease. In an alternative embodiment, the method comprises contacting antibodies that specifically bind SEQ ID NOS: 3, 7, 13, or 20, wherein the antibodies respectively specifically bind apolipoprotein C-I, apolipoprotein C-II, fibrinogen alpha chain, or fibrinogen A-alpha chain. In yet another embodiment the antibodies specifically bind full-length proteins, truncated proteins, or protein fragments containing the respective SEQ ID.

The detection of the levels of polypeptide/antibody complexes present in the sample at differential levels to those of control samples (*i.e.*, non-diseased) is an indication renal disease. In one embodiment of the invention the levels of polypeptide/antibody complexes in a patient sample at greater levels than controls is an indication of disease. In an alternative embodiment, the levels of polypeptide/antibody complexes in a patient at levels less than control is an indication of disease, particularly for inosine-specific antibodies. The antibodies can be monoclonal antibodies, polyclonal antibodies, antigen-binding antibody fragments, or single chain antibodies. The antibodies can specifically full-length proteins, truncated proteins, or protein fragments containing the respective SEQ ID NOS. In certain embodiments the inventive methods use metabolomics (i.e., LC/MS), and the biomarkers identified thereby, provide a significant improvement over current methods of detection. Instead of analyzing a solid tissue sample, cellular products or proteins are identified in patient biofluid or serum samples. This type of testing could reduce patient discomfort, permit repeated measurement, and allow more timely assessments.

One embodiment of the invention provides for one or a plurality of purified polypeptide comprising SEQ ID NOS: 1-59, wherein the polypeptide consists of less than about 40, 30, 20, or 10 contiguous naturally occurring amino acids; SEQ ID NOS: 1-3, wherein the polypeptide consists of less than about 30 contiguous naturally occurring apolipoprotein C-I amino acids; SEQ ID NOS: 4-7, wherein the polypeptide consists of less

than about 40 contiguous naturally occurring fibrinogen A-alpha chain amino acids; SEQ ID NOS: 8-13, wherein the polypeptide consists of less than about 40 contiguous naturally occurring apolipoprotein C-II amino acids; or SEQ ID NOS: 14-20, wherein the polypeptide consists of less than about 20 contiguous naturally occurring fibrinogen alpha chain amino acids; SEQ ID NOS: 21-24, wherein the polypeptide consists of less than about 20 contiguous naturally occurring Kininogen chain amino acids; SEQ ID NOS: 25-28, wherein the polypeptide consists of less than about 30 contiguous naturally occurring Inter-Alpha Inhibitor H4 (ITIH4) chain amino acids; SEQ ID NOS: 29-31, wherein the polypeptide consists of less than about 20 contiguous naturally occurring CysA chain amino acids; SEQ ID NOS: 32-38, wherein the polypeptide consists of less than about 20 contiguous naturally occurring CysB1 chain amino acids; SEQ ID NOS: 39-59, wherein the polypeptide consists of less than about 30 contiguous naturally occurring keratin Type I cytoskeletol 10 chain amino acids. The invention also provides isolated polynucleotides that encode the purified polypeptide of the invention.

Therefore, the invention provides compositions and methods for the detecting, diagnosing, or prognosing renal disease.

Specific embodiments of this invention will become evident from the following more detailed description of certain preferred embodiments and the claims.

Brief Description of the Drawings

These and other objects and features of this invention will be better understood from the following detailed description taken in conjunction with the drawings wherein:

Figure 1 is a graph representing LC/MS measurement of inosine levels between high creatinine and control (low creatinine) dogs.

Figure 2 is a graph representing inosine, NGAL, and creatinine levels over time in an induced canine model of renal disease. Units of measurement include: Inosine in µg/deciliter; Creatinine in mg/centiliter; and NGAL in ng/ml.

Figure 3 is a series of graphs representing relative concentrations of apolipoprotein C1 (Figure 3A), kininogen (Figure 3B), and Inter-Alpha Inhibitor H4 (ITIH4) (Figure 3C) levels over time in an induced model of canine model of renal disease.

Detailed Description of the Preferred Embodiments

This invention is more particularly described below and the Examples set forth herein are intended as illustrative only, as numerous modifications and variations therein will be apparent to those skilled in the art. As used in the description herein and throughout the claims that follow, the meaning of "a", "an", and "the" includes plural reference unless the context clearly dictates otherwise. The terms used in the specification generally have their ordinary meanings in the art, within the context of the invention, and in the specific context where each term is used. Some terms have been more specifically defined below to provide additional guidance to the practitioner regarding the description of the invention.

In other embodiments, the invention provides methods for detecting the polypeptides provided in Table 1, wherein the relative levels of the disclosed polypeptides identifies patients with renal disease. In the application and practice of these inventive methods, any method known in the art for detecting polypeptides can be used. In certain embodiments, these methods are practiced by identifying expression levels of full-length protein and polypeptide fragments of apolipoprotein C-I, apolipoprotein C-II, fibrinogen alpha chain, or fibrinogen A-alpha chain, CysB1, Cys A, Kininogen, Inter-Alpha Inhibitor H4 (ITIH4), or keratin type I cytoskeletal 10 in patient samples, wherein differential expression of the proteins as compared to a control are an indication of renal disease. In alternative

embodiments, immunohistochemical (IHC) methods are used to detect renal disease in kidney biopsies.

In a particular embodiment, the invention provides methods for detecting inosine levels and other protein/metabolite levels in patient samples relative to controls. Relative levels can be measured by LC/MS (liquid chromatography/mass spectrometry). Alternatively, inosine and/or protein levels can be assessed with specific antibodies. For anti-inosine antibodies, *see*, Inouye, H. *et al.*, Biochim Biophys Acta 1971, 240:594-603; Bonavida, B. et al., Immunochemistry 1972, 9:443-49; Inouye, H. *et al.*, J Biol Chem 1973, 23:8125-29. Reduced levels of inosine are indicative of kidney/renal disease.

As used herein, a "patient" or "subject" to be treated by the disclosed methods can mean either a human or non-human animal but in certain particular embodiments is a human feline, or canine.

The term “patient sample” as used herein includes but is not limited to a blood, serum, plasma, or urine sample obtained from a patient.

The term “control sample” as used herein can mean a sample obtained from a non-diseased individual or population, more particularly an individual or population that does not suffer from renal disease.

The term “polypeptides” can refer to one or more of one type of polypeptide (a set of polypeptides). “Polypeptides” can also refer to mixtures of two or more different types of polypeptides (*i.e.*, a mixture of polypeptides that includes but is not limited to full-length protein, truncated protein, or protein fragments). The terms “polypeptides” or “polypeptide” can each also mean “one or more polypeptides.”

The term “full-length” as used herein refers to a protein comprising its natural amino acid sequence as expressed *in vivo*, or variants thereof. The term “truncated” refers to a protein that is lacks amino acids from the N- or C- terminal ends of the protein. The term

"peptide fragment" refers to a partial amino acid sequence from a larger protein. In particular embodiments, a peptide fragment is 10, 20, 30, 40, or 50 amino acids in length.

As disclosed herein, the polypeptides identified and provided by this invention comprise one or a plurality of proteins that have altered expression (*e.g.*, either increased or decreased) in patients with renal disease. In certain embodiments, aberrant levels of the polypeptides set forth herein are associated with renal dysfunction; in particular, increased apolipoprotein C-I, increased apolipoprotein C-II, decreased fibrinogen A-alpha chain, or decreased fibrinogen alpha chain polypeptide fragments as detected inter alia by antibodies specific to the polypeptides of the invention. In certain embodiments aberrant levels of additional polypeptides and proteins are included and in particular inosine metabolite and the following protiens: apolipoprotein C-I, apolipoprotein C-II, fibrinogen alpha chain, or fibrinogen A-alpha chain, kininogen, and Inter-Alpha Inhibitor H4 (ITIH4). In some embodiments, the proteins are found in blood, serum, plasma, or urine. The relative levels of specific polypeptides can indicate progression of renal failure and disease severity.

In either embodiment, altered protein expression is relative to control (e.g., non-renal diseased) sample comprising the invention show differential expression levels as compared to control samples. This invention provides antibodies specific to the polypeptides of Table 1 and methods of use thereof for identifying renal disease, in patient samples and to provide prognosis and diagnosis thereby. It is an advantage of this invention that altered expression of the polypeptides provided herein can be readily detected using methods well known to the skilled worker.

In particular embodiments, the invention provides reagents and methods for identifying renal disease in a mammal, and more particularly, in dogs, cats and humans. In certain embodiments, the invention provides methods for providing a diagnosis and prognosis for a renal patient. As disclosed herein, identifying the polypeptides of this invention in

patient samples can be an independent predictor of kidney disease or an identifier of disease stage (*e.g.*, stages 1-5). This invention advantageously permits diagnosis and identification of kidney disease stage prior to stage three and is not limited by patient age or body mass. Accordingly, additional embodiments of the invention are directed to using said renal patient prognosis determined using the polypeptides of the invention to select appropriate renal therapies.

For the purposes of this invention, the term "immunological reagents" is intended to encompass antisera and antibodies, particularly monoclonal antibodies, as well as fragments thereof (including F(ab), $F(ab)_2$, F(ab)′ and F_v fragments). Also included in the definition of immunological reagent are chimeric antibodies, humanized antibodies, and recombinantly-produced antibodies and fragments thereof. Immunological methods used in conjunction with the reagents of the invention include direct and indirect (*for example*, sandwich-type) labeling techniques, immunoaffinity columns, immunomagnetic beads, fluorescence activated cell sorting (FACS), enzyme-linked immunosorbent assays (ELISA), radioimmune assay (RIA), as well as peroxidase labeled secondary antibodies that detect the primary antibody.

The immunological reagents of the invention are preferably detectably-labeled, most preferably using fluorescent labels that have excitation and emission wavelengths adapted for detection using commercially-available instruments such as and most preferably fluorescence activated cell sorters. Examples of fluorescent labels useful in the practice of the invention include phycoerythrin (PE), fluorescein isothiocyanate (FITC), rhodamine (RH), Texas Red (TX), Cy3, Hoechst 33258, and 4',6-diamidino-2-phenylindole (DAPI). Such labels can be conjugated to immunological reagents, such as antibodies and most preferably monoclonal antibodies using standard techniques (Maino *et al.*, 1995, *Cytometry* 20: 127-133).

Antibodies of the invention are antibody molecules that specifically bind to polypeptides of the invention as provided in Table 1, variant polypeptides of the invention, or

fragments thereof. An antibody of the invention can be specific for polypeptide fragments of apolipoprotein C-I, apolipoprotein C-II, fibrinogen alpha chain, or fibrinogen A-alpha chain, for example, an antibody specific for one or a plurality of SEQ ID NOS: 3, 7, 13, or 20. An antibody of the invention preferably recognizes multiple protein products. For example an antibody specific to SEQ ID NO: 3 recognizes multiple peptide fragment of apolipoprotein C-I, including SEQ ID NOS: 1 – 2, as well as full-length protein. One of skill in the art can easily determine if an antibody is specific for a polypeptide of Table 1 using assays described herein. An antibody of the invention can be a polyclonal antibody, a monoclonal antibody, a single chain antibody (scFv), or an antigen binding fragment of an antibody. Antigen-binding fragments of antibodies are a portion of an intact antibody comprising the antigen binding site or variable region of an intact antibody, wherein the portion is free of the constant heavy chain domains of the Fc region of the intact antibody. Examples of antigen binding antibody fragments include Fab, Fab', Fab'-SH, $F(ab')_2$ and F_v fragments.

An antibody of the invention can be any antibody class, including for example, IgG, IgM, IgA, IgD and IgE. An antibody or fragment thereof binds to an epitope of a polypeptide of the invention. An antibody can be made *in vivo* in suitable laboratory animals or *in vitro* using recombinant DNA techniques. Means for preparing and characterizing antibodies are well know in the art. *See, e.g.,* Dean, *Methods Mol. Biol.* 80:23-37 (1998); Dean, *Methods Mol. Biol.* 32:361-79 (1994); Baileg, *Methods Mol. Biol.* 32:381-88 (1994); Gullick, *Methods Mol. Biol.* 32:389-99 (1994); Drenckhahn *et al. Methods Cell. Biol.* 37:7-56 (1993); Morrison, *Ann. Rev. Immunol.* 10:239-65 (1992); Wright *et al. Crit. Rev. Immunol.* 12:125-68 (1992). For example, polyclonal antibodies can be produced by administering a polypeptide of the invention to an animal, such as a human or other primate, mouse, rat, rabbit, guinea pig, goat, pig, dog, cow, sheep, donkey, or horse. Serum from the immunized animal is collected and the antibodies are purified from the plasma by, for example, precipitation with

ammonium sulfate, followed by chromatography, such as affinity chromatography. Techniques for producing and processing polyclonal antibodies are known in the art.

"Specifically binds," "specifically bind," or "specific for" means that a first antigen, *e.g.,* a polypeptide of Table 1, recognizes and binds to an antibody of the invention with greater affinity than to other, non-specific molecules. "Specifically binds," "specifically bind" or "specific for" also means a first antibody, *e.g.*, an antibody raised against SEQ ID NOS:1-59, recognizes and binds to SEQ ID NOS:1-59, with greater affinity than to other non-specific molecules. A non-specific molecule is an antigen that shares no common epitope with the first antigen. Specific binding can be tested using, for example, an enzyme-linked immunosorbant assay (ELISA), a radioimmunoassay (RIA), or a western blot assay using methodology well known in the art.

The phrase "competes for binding" as used herein refers to an antibody that has a binding affinity for a particular polypeptide sequence or antigen such that when present, it will bind preferentially and specifically to the peptide sequence/antigen over other non-specific molecules. Again, a non-specific molecule is an antigen that shares no common epitope with the first antigen.

Antibodies of the invention include antibodies and antigen binding fragments thereof that (a) compete with a reference antibody for binding to SEQ ID NOS: 1-59 or antigen binding fragments thereof; (b) binds to the same epitope of SEQ ID NOS: 1-59 or antigen binding fragments thereof as a reference antibody; (c) binds to SEQ ID NOS: 1-59 or antigen binding fragments thereof with substantially the same K_d as a reference antibody; and/or (d) binds to SEQ ID NOS: 1-59 or fragments thereof with substantially the same off rate as a reference antibody, wherein the reference antibody is an antibody or antigen-binding fragment thereof that specifically binds to a polypeptide of SEQ ID NOS: 1-59 or antigen binding fragments thereof with a binding affinity K_a of 10^7 l/mol or more.

The affinity of a molecule X for its partner Y can be represented by a dissociation constant (Kd). The equilibrium dissocation constant (Kd) is calculated at the ration of k_{off}/k_{on}. *See* Chen, Y. *et al.*, 1999, J. Mol. Biol. 293: 865-881. A variety of methods are known in the art for measuring affinity constants, which can be used for purposes of the present invention. In a particular embodiment, the reference antibody is an antibody or antigen-binding fragment thereof that has a binding affinity to a polypeptide of SEQ ID NOS: 1-59 with a particular K_{on} rate/association rate or K_{off} rate. In one embodiment, the antibodies of the invention specifically bind with a K_{on} of 6×10^5 $M^{-1}s^{-1}$ or better; antibodies specifically bind with a K_{off} rate of 5×10^{-6} s^{-1} or better; or antibodies specifically binds with a binding affinity of 500pM, 400pM, 300pM, 200 pM, 100pM, 50pM, 40pM, 30 pM, 20 pM or better.

Additionally, monoclonal antibodies directed against epitopes present on a polypeptide of the invention can also be readily produced. For example, normal B cells from a mammal, such as a mouse, which was immunized with a polypeptide of the invention can be fused with, for example, HAT-sensitive mouse myeloma cells to produce hybridomas. Hybridomas producing polypeptide-specific antibodies can be identified using RIA or ELISA and isolated by cloning in semi-solid agar or by limiting dilution. Clones producing specific antibodies are isolated by another round of screening. Monoclonal antibodies can be screened for specificity using standard techniques, for example, by binding a polypeptide of the invention to a microtiter plate and measuring binding of the monoclonal antibody by an ELISA assay. Techniques for producing and processing monoclonal antibodies are known in the art. *See e.g.,* Kohler & Milstein, Nature, 256:495 (1975). Particular isotypes of a monoclonal antibody can be prepared directly, by selecting from the initial fusion, or prepared secondarily, from a parental hybridoma secreting a monoclonal antibody of a different isotype by using a sib selection technique to isolate class-switch variants. *See*

Steplewski *et al., P.N.A.S. U.S.A.* 82:8653 1985; Spria *et al., J. Immunolog. Meth.* 74:307, 1984. Monoclonal antibodies of the invention can also be recombinant monoclonal antibodies. *See, e.g.,* U.S. Patent No. 4,474,893; U.S. Patent No. 4,816,567. Antibodies of the invention can also be chemically constructed. *See, e.g.,* U.S. Patent No. 4,676,980.

Antibodies of the invention can be chimeric (*see, e.g.,* U.S. Patent No. 5,482,856), humanized (*see, e.g.,* Jones *et al., Nature* 321:522 (1986); Reichmann *et al., Nature* 332:323 (1988); Presta, *Curr. Op. Struct. Biol.* 2:593 (1992)), caninized, canine, or human antibodies. Human antibodies can be made by, for example, direct immortilization, phage display, transgenic mice, or a Trimera methodology, *see e.g.,* Reisener *et al., Trends Biotechnol.* 16:242-246 (1998).

Antibodies that specifically bind SEQ ID NOS: 1-59 are particularly useful for detecting the presence of polypeptide fragments specific for renal disease present in a sample, such as a serum, blood, plasma, cell, tissue, or urine sample from an animal. An immunoassay for can utilize one antibody or several antibodies. An immunoassay can use, for example, a monoclonal antibody specific for one epitope, a combination of monoclonal antibodies specific for epitopes of one polypeptide, monoclonal antibodies specific for epitopes of different polypeptides, polyclonal antibodies specific for the same antigen, polyclonal antibodies specific for different antigens, or a combination of monoclonal and polyclonal antibodies. Immunoassay protocols can be based upon, for example, competition, direct reaction, or sandwich type assays using, for example, labeled antibody. Antibodies of the invention can be labeled with any type of label known in the art, including, for example, fluorescent, chemiluminescent, radioactive, enzyme, colloidal metal, radioisotope and bioluminescent labels.

Antibodies of the invention or antigen-binding fragments thereof can be bound to a support and used to detect the presence of proteins differential produced in renal disease.

Supports include, for example, glass, polystyrene, polypropylene, polyethylene, dextran, nylon, amylases, natural and modified celluloses, polyacrylamides, agaroses and magletite.

Antibodies of the invention can further be used to isolate polypeptides by immunoaffinity columns. The antibodies can be affixed to a solid support by, for example, absorption or by covalent linkage so that the antibodies retain their immunoselective activity. Optionally, spacer groups can be included so that the antigen binding site of the antibody remains accessible. The immobilized antibodies can then be used to bind the polypeptides of Table 1 from a biological sample, including but not limited to saliva, serum, blood, and urine.

Antibodies of the invention can also be used in immunolocalization studies to analyze the presence and distribution of a polypeptide of the invention during various cellular events or physiological conditions. Antibodies can also be used to identify molecules involved in passive immunization and to identify molecules involved in the biosynthesis of non-protein antigens. Identification of such molecules can be useful in vaccine development. Antibodies of the invention, including, for example, monoclonal antibodies and single chain antibodies, can be used to monitor the course of amelioration of a kidney disease. By measuring the increase or decrease of antibodies specific for the polypeptides of Table 1 in a test sample from an animal, it can be determined whether a particular therapeutic regiment aimed at ameliorating the disorder is effective. Antibodies can be detected and/or quantified using for example, direct binding assays such as RIA, ELISA, or Western blot assays.

The methods of the invention can be used to detect polypeptide fragments of Table 1 or full-length proteins containing an amino acid sequence provided in Table 1, wherein antibodies or antigen-binding antibody fragments are specific for SEQ ID NOS : 1-59. A biological sample can include, for example, sera, blood, cells, plasma, saliva, or urine from a mammal such as a dog, cat or human. The test sample can be untreated, precipitated, fractionated, separated, diluted, concentrated, or purified.

In one embodiment methods of the invention comprise contacting a test sample with one or a plurality of antibodies specific to SEQ ID NOS : 1-59 under conditions that allow polypeptide/antibody complexes, *i.e.,* immunocomplexes, to form. That is, antibodies of the invention specifically bind to one or a plurality of polypetides of SEQ ID NOS : 1 – 59 located in the sample. One of skill in the art is familiar with assays and conditions that are used to detect antibody/polypeptide complex binding. The formation of a complex between polypeptides and antibodies in the sample is detected. The formation of antibody/polypeptide complexes is an indication that polypeptides are present in the patient sample.

Antibodies of the invention can be used in a method of the diagnosis renal disease by obtaining a test sample from, *e.g.*, a human, cat or dog suspected of suffering from renal disease. The test sample is contacted with antibodies of the invention under conditions enabling the formation of antibody-antigen complexes (*i.e.,* immunocomplexes). One of skill in the art is aware of conditions that enable and are appropriate for formation of antigen/antibody complexes. The amount of antibody-antigen complexes can be determined by methodology known in the art.

Methods of the invention comprise diagnosing renal disease in a patient by identifying the differential expression of the polypeptides of Table 1 in a patient sample as compared to control. These methods include the diagnosis or identification of disease stage (*e.g.*, stages 1 – 5). The present invention further include methods for prognosing patient health, monitoring disease progression, and/or assessing/monitoring treatment efficacy by identifying levels of specific polypeptides of the invention in a patient sample. In one aspect, the inventive methods can be performed at multiple time points to evaluate disease progression or treatment efficacy. In a particular embodiment, the methods may be performed at diagnosis and then at specific time points post-treatment wherein a specific therapy should result in a reduction or amelioration of disease progression.

In an alternative embodiment, the methods of the invention are used to assess the efficacy of a composition or treatment regime (whether a composition or diet) for the amelioration of renal disease progression. Similarly, the methods of the invention can be used for assessing a composition or treatment regimens activity on patient levels of the polypeptides of Table 1.

Differential levels of antibody-complexes present in patient samples versus control samples provides an indicator for renal disease. In one embodiment of the invention an antibody is specific for one or plurality of the polypeptides provided in Table 1. An antibody of the invention can be contacted with a test sample. Antibodies specific to the polypeptides present in a test sample will form antigen-antibody complexes under suitable conditions. The amount of antibody-antigen complexes can be determined by methods known in the art.

In one embodiment of the invention, renal disease can be detected in a subject. A biological sample is obtained from the subject. One or more antibodies specific to the polypeptides comprising SEQ ID NOS:1-59 or other polypeptides of the invention are contacted with the biological sample under conditions that allow polypeptide/antibody complexes to form. The polypeptide/antibody complexes are detected. The detection of the polypeptide/antibody complexes at differential levels as compared to controls is an indication that the mammal has renal disease.

In one embodiment of the invention, the polypeptide/antibody complex is detected when an indicator reagent, such as an enzyme conjugate, which is bound to the antibody, catalyzes a detectable reaction. Optionally, an indicator reagent comprising a signal generating compound can be applied to the polypeptide/antibody complex under conditions that allow formation of a polypeptide/antibody/indicator complex. The polypeptide/antibody/indicator complex is detected. Optionally, the polypeptide or antibody

can be labeled with an indicator reagent prior to the formation of a polypeptide/antibody complex. The method can optionally comprise a positive or negative control.

In one embodiment of the invention, one or more antibodies of the invention are attached to a solid phase or substrate. A test sample potentially comprising a protein comprising a polypeptide of the invention is added to the substrate. One or more antibodies that specifically bind polypeptides of the invention are added. The antibodies can be the same antibodies used on the solid phase or can be from a different source or species and can be linked to an indicator reagent, such as an enzyme conjugate. Wash steps can be performed prior to each addition. A chromophore or enzyme substrate is added and color is allowed to develop. The color reaction is stopped and the color can be quantified using, for example, a spectrophotometer.

In another embodiment of the invention, one or more antibodies of the invention are attached to a solid phase or substrate. A test sample potentially containing a protein comprising a polypeptide of the invention is added to the substrate. Second anti-species antibodies that specifically bind polypeptides of the invention are added. These second antibodies are from a different species than the solid phase antibodies. Third anti-species antibodies are added that specifically bind the second antibodies and that do not specifically bind the solid phase antibodies are added. The third antibodies can comprise and indicator reagent such as an enzyme conjugate. Wash steps can be performed prior to each addition. A chromophore or enzyme substrate is added and color is allowed to develop. The color reaction is stopped and the color can be quantified using, for example, a spectrophotometer.

In one embodiment, one or more capture antibodies can specifically bind to one or more epitopes of a polypeptide of the invention. The capture antibody or antibodies would be used to immobilize one or a plurality of polypeptide of SEQ ID NOS : 1 – 59 to, for example a solid support. One or more detection antibodies can specifically bind to the same one or

more epitopes or different one or more epitopes of the polypeptides of the invention. The detection antibody can be used to detect or visualize the immobilization of the polypeptide of the invention to a solid support. This embodiment is advantageous because it is more specific and more sensitive than assays using only one antibody for both capture and detection functions.

Assays of the invention include, but are not limited to those based on competition, direct reaction or sandwich-type assays, including, but not limited to enzyme linked immunosorbent assay (ELISA), western blot, IFA, radioimmunoassay (RIA), hemagglutination (HA), fluorescence polarization immunoassay (FPIA), and microtiter plate assays (any assay done in one or more wells of a microtiter plate). One assay of the invention comprises a reversible flow chromatographic binding assay, for example a SNAP® assay. *See e.g.,* U.S. Pat. No. 5,726,010.

Assays can use solid phases or substrates or can be performed by immunoprecipitation or any other methods that do not utilize solid phases. Where a solid phase or substrate is used, one or more polypeptides of the invention are directly or indirectly attached to a solid support or a substrate such as a microtiter well, magnetic bead, non-magnetic bead, column, matrix, membrane, fibrous mat composed of synthetic or natural fibers (*e.g.*, glass or cellulose-based materials or thermoplastic polymers, such as, polyethylene, polypropylene, or polyester), sintered structure composed of particulate materials (*e.g.*, glass or various thermoplastic polymers), or cast membrane film composed of nitrocellulose, nylon, polysulfone or the like (generally synthetic in nature). In one embodiment of the invention a substrate is sintered, fine particles of polyethylene, commonly known as porous polyethylene, for example, 10-15 micron porous polyethylene from Chromex Corporation (Albuquerque, NM). All of these substrate materials can be used in suitable shapes, such as films, sheets, or plates, or they may be coated onto or bonded or

laminated to appropriate inert carriers, such as paper, glass, plastic films, or fabrics. Suitable methods for immobilizing antibodies on solid phases include ionic, hydrophobic, covalent interactions and the like.

In one type of assay format, one or more antibodies can be coated on a solid phase or substrate. A test sample suspected of containing polypeptides of Table 1 or fragments thereof is incubated with an indicator reagent comprising a signal generating compound conjugated to an antibodies or antibody fragments specific for said polypeptides for a time and under conditions sufficient to form antigen/antibody complexes of either antibodies of the solid phase to the test sample polypeptides or the indicator reagent compound conjugated to an antibody specific for the polypeptides. The binding of the indicator reagent conjugated to anti-polypeptide antibodies to the solid phase can be quantitatively measured. A measurable alteration in the signal compared to the signal generated from a control sample indicates the presence of polypeptides of the present invention (SEQ ID NOS : 1 – 59). This type of assay can quantitate the amount of polypeptide in a test sample.

In another type of assay format, one or more antibodies of the invention are coated onto a support or substrate. An antibody of the invention is conjugated to an indicator reagent and added to a test sample. This mixture is applied to the support or substrate. If polypeptides of the invention are present in the test sample, they will bind the one or more antibodies conjugated to an indicator reagent and to the one or more antibodies immobilized on the support. The polypeptide/antibody/indicator complex can then be detected. This type of assay can quantitate the amount of polypeptide in a test sample.

In another type of assay format, one or more antibodies of the invention are coated onto a support or substrate. The test sample is applied to the support or substrate and incubated. Unbound components from the sample are washed away by washing the solid support with a wash solution. If the polypeptides of Table 1 are present in the test sample,

they will bind to the antibody coated on the solid phase. This polypeptide/antibody complex can be detected using a second species-specific antibody that is conjugated to an indicator reagent. The polypeptide/antibody/anti-species antibody indicator complex can then be detected. This type of assay can quantitate the amount of polypeptides in a test sample.

The formation of a polypeptide/antibody complex or a polypeptide/antibody/indicator complex can be detected by, for example, radiometric, colorimetric, fluorometric, size-separation, or precipitation methods. Optionally, detection of a polypeptide/antibody complex is by the addition of a secondary antibody that is coupled to an indicator reagent comprising a signal generating compound. Indicator reagents comprising signal generating compounds (labels) associated with a polypeptide/antibody complex can be detected using the methods described above and include chromogenic agents, catalysts such as enzyme conjugates fluorescent compounds such as fluorescein and rhodamine, chemiluminescent compounds such as dioxetanes, acridiniums, phenanthridiniums, ruthenium, and luminol, radioactive elements, direct visual labels, as well as cofactors, inhibitors, magnetic particles, and the like. Examples of enzyme conjugates include alkaline phosphatase, horseradish peroxidase, beta-galactosidase, and the like. The selection of a particular label is not critical, but it will be capable of producing a signal either by itself or in conjunction with one or more additional substances.

Formation of the complex at differential levels as compared to control is indicative of the presence of renal disease. Therefore, the methods of the invention can be used to diagnose kidney disease in an animal.

The phrase "determining the amounts" as used herein refers to measuring or identifying the levels of one or a plurality polypeptides in a patient sample. In a particular embodiment, the identification of a specific epitope in polypeptides of multiple lengths including full-length protein, truncated protein, and protein fragments is provided. This can

be accomplished by methodology well known in the art for the detection of polypeptides including using antibodies including, for example enzyme-linked immunosorbant assay (ELISA), a radioimmunoassay (RIA), or a western blot assay, or immunohistochemistry. Alternatively polypeptides of the present invention, SEQ ID NOS: 1-59, can be determined by mass spectrometry or similar methods known by one of skill in the art. Determining the amount of polypeptide present in a patient sample is accomplished by such *in vitro* analysis and experimental manipulation. The amount of polypeptide present cannot be assessed by mere inspection.

In an alternative embodiment, elevated or reduced levels of one or a plurality of polypeptide transcripts of Table 1 present in a patient sample are detected by a process of hybridizing a nucleic acid probe that selectively hybridizes to the polypeptides of the invention. Conditions are utilized that permit high stringency hybridization between the nucleic acid probe, which is used as a detection means, and the polypeptide transcripts of the invention, wherein a level of nucleic acid complex formation and detection is indicative of the level of transcript in a sample. The enhanced or reduced level of polypeptide is indicative of renal disease. Methods for producing nucleic acid probes specific to the polypeptide transcripts are well known in the art.

The methods of the invention can also indicate the amount or quantity of polypeptides of Table 1 or full-length proteins comprising a polypeptide sequence of Table 1 in a test sample. In a particular embodiment, the amount or quantity of certain polypeptides provides an indicator of disease stage (*i.e.*, stages 1 – 5), disease progression, and/or a prognostic indicator. With many indicator reagents, such as enzyme conjugates, the amount of polypeptide present is proportional to the signal generated. Depending upon the type of test sample, it can be diluted with a suitable buffer reagent, concentrated, or contacted with a solid phase without any manipulation. For example, it usually is preferred to test serum or

plasma samples that previously have been diluted, or concentrated specimens such as urine, in order to determine the presence and/or amount of polypeptide present.

Polypeptides and assays of the invention can be combined with other polypeptides or assays to detect the presence of renal disease. For example, polypeptides and assays of the invention can be combined with reagents that creatinine or general protein levels.

The invention also provides kits for performing the methods disclosed herein. In certain embodiments, the kits of this invention comprise one or a plurality of antibodies specific for one or plurality of the polypeptides provided in Table 1, wherein in particular embodiments said antibody are monoclonal antibodies, polyclonal antibodies, antigen-binding antibody fragments, or single chain antibodies. Optionally included in specific embodiments of the kits of the invention can be instructions for use, as well as secondary antibodies useful *inter alia* in sandwich assays understood by those in the art. Distinguishingly labeled embodiments of the antibody components of said kits, as well as reagents and methods for labeling said antibodies, are also advantageously-provided components of the kits of the invention.

In further embodiments, kits of the invention comprise one or plurality of antibodies that each specifically bind to differential protein expression of one or a plurality of the polypeptides identified in Table 1. In certain embodiments, said antibodies are provided on a solid support, including without limitation chips, microarrays, beads and the like. Optionally included in specific embodiments of the kits of the invention can be instructions for use, as well as secondary antibodies useful *inter alia* in sandwich assays understood by those in the art. Distinguishingly labeled embodiments of the antibody components of said kits, as well as reagents and methods for labeling said antibodies, are also advantageously-provided components of the kits of the invention.

The kits of the present invention (*e.g.*, articles of manufacture) are for detecting the polypeptides of Table 1, or protein fragment thereof in a patient sample. A kit comprises one or more antibodies of the invention and means for determining binding of the antibodies to full-length proteins or protein fragments containing the amino acid sequences provided in Table 1 present in the sample. A kit or article of manufacture can also comprise one or more antibodies or antibody fragments of the invention and means for determining binding of the antibodies or antibody fragments to polypeptides in the sample. A kit can comprise a device containing one or more polypeptides or antibodies of the invention and instructions for use of the one or more polypeptides or antibodies for, *e.g.*, the identification of renal disease in a mammal. The kit can also comprise packaging material comprising a label that indicates that the one or more polypeptides or antibodies of the kit can be used for the identification of kidney dysfunction. Other components such as buffers, controls, and the like, known to those of ordinary skill in art, can be included in such test kits. The polypeptides, antibodies, assays, and kits of the invention are useful, for example, in the diagnosis of individual cases of renal disease in a patient.

The kits of the invention are useful for diagnosing, prognosing, or monitoring the treatment of renal disease, particularly canine renal disease.

One embodiment provides a purified polypeptide comprising SEQ ID NOS:1-59, wherein the polypeptide consists of less than about 50, 40, 35, 30, 25, 20, 15, 10 (or any range between about 31 and about 175) contiguous naturally occurring amino acids. In one embodiment of the invention a purified polypeptide consists of more than about 10, 15, 20, 25, 30, 35, 40, 50, 60, contiguous naturally occurring amino acids.

The fact that polypeptides SEQ ID NOS:1-59 are smaller than the full length proteins is important because smaller polypeptides can have greater specificity and/or sensitivity than full length polypeptides assays. These smaller polypeptides can be less expensive to

manufacture, and may be obtained at greater purity than the full length polypeptide. Additionally, the smaller fragments and the levels of smaller fragements present in a sample are indicative of disease state. The differential expression of fragmented proteins is a marker for renal disease.

Variant polypeptides are at least about 80%, or about 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, or 99% identical to the polypeptide sequences shown in SEQ ID NOS:1-59 and are also polypeptides of the invention. For example, a variant polypeptide of SEQ ID NOS:1-59 can be about at least 97%, 94%, 90%, 87%, 84%, or 81% identical to SEQ ID NOS:1-59. Variant polypeptides have one or more conservative amino acid variations or other minor modifications and retain biological activity, *i.e.,* are biologically functional equivalents. A biologically active equivalent has substantially equivalent function when compared to the corresponding wild-type polypeptide. In one embodiment of the invention a polypeptide has about 1, 2, 3, 4, 5, 10, 20 or less conservative amino acid substitutions.

Percent sequence identity has an art recognized meaning and there are a number of methods to measure identity between two polypeptide or polynucleotide sequences. *See, e.g.,* Lesk, Ed., *Computational Molecular Biology*, Oxford University Press, New York, (1988); Smith, Ed., *Biocomputing: Informatics And Genome Projects*, Academic Press, New York, (1993); Griffin & Griffin, Eds., *Computer Analysis Of Sequence Data, Part I*, Humana Press, New Jersey, (1994); von Heinje, *Sequence Analysis In Molecular Biology*, Academic Press, (1987); and Gribskov & Devereux, Eds., *Sequence Analysis Primer*, M Stockton Press, New York, (1991). Methods for aligning polynucleotides or polypeptides are codified in computer programs, including the GCG program package (Devereux *et al.*, *Nuc. Acids Res.* 12:387 (1984)), BLASTP, BLASTN, FASTA (Atschul *et al.*, *J. Molec. Biol.* 215:403 (1990)), and Bestfit program (Wisconsin Sequence Analysis Package, Version 8 for Unix, Genetics

Computer Group, University Research Park, 575 Science Drive, Madison, WI 53711) which uses the local homology algorithm of Smith and Waterman (*Adv. App. Math.*, 2:482-489 (1981)). For example, the computer program ALIGN which employs the FASTA algorithm can be used, with an affine gap search with a gap open penalty of -12 and a gap extension penalty of -2.

When using any of the sequence alignment programs to determine whether a particular sequence is, for instance, about 95% identical to a reference sequence, the parameters are set such that the percentage of identity is calculated over the full length of the reference polynucleotide and that gaps in identity of up to 5% of the total number of nucleotides in the reference polynucleotide are allowed.

Variant polypeptides can generally be identified by modifying one of the polypeptide sequences of the invention, and evaluating the properties of the modified polypeptide to determine if it is a biological equivalent. A variant is a biological equivalent if it reacts substantially the same as a polypeptide of the invention in an assay such as an immunohistochemical assay, an enzyme-linked immunosorbent Assay (ELISA), a radioimmunoassay (RIA), immunoenzyme assay or a western blot assay, *e.g.* has 90-110% of the activity of the original polypeptide. In one embodiment, the assay is a competition assay wherein the biologically equivalent polypeptide is capable of reducing binding of the polypeptide of the invention to a corresponding reactive antigen or antibody by about 80, 95, 99, or 100%. An antibody that specifically binds a corresponding wild-type polypeptide also specifically binds the variant polypeptide.

A conservative substitution is one in which an amino acid is substituted for another amino acid that has similar properties, such that one skilled in the art of peptide chemistry would expect the secondary structure and hydropathic nature of the polypeptide to be substantially unchanged. In general, the following groups of amino acids represent

conservative changes: (1) ala, pro, gly, glu, asp, gln, asn, ser, thr; (2) cys, ser, tyr, thr; (3) val, ile, leu, met, ala, phe; (4) lys, arg, his; and (5) phe, tyr, trp, his.

A polypeptide of the invention can further comprise a signal (or leader) sequence that co-translationally or post-translationally directs transfer of the protein. The polypeptide can also comprise a linker or other sequence for ease of synthesis, purification or identification of the polypeptide (*e.g.,* poly-His), or to enhance binding of the polypeptide to a solid support. For example, a polypeptide can be conjugated to an immunoglobulin Fc region or bovine serum albumin.

A polypeptide can be covalently or non-covalently linked to an amino acid sequence to which the polypeptide is not normally associated with in nature, *i.e.,* a heterologous amino acid sequence. A heterologous amino acid sequence can be from a different organism, a synthetic sequence, or a sequence not usually located at the carboxy or amino terminus of a polypeptide of the invention. Additionally, a polypeptide can be covalently or non-covalently linked to compounds or molecules other than amino acids, such as indicator reagents. A polypeptide can be covalently or non-covalently linked to an amino acid spacer, an amino acid linker, a signal sequence, a stop transfer sequence, a transmembrane domain, a protein purification ligand, or a combination thereof. A polypeptide can also be linked to a moiety (i.e., a functional group that can be a polypeptide or other compound) that enhances an immune response (e.g., cytokines such as IL-2), a moiety that facilitates purification (e.g., affinity tags such as a six-histidine tag, trpE, glutathione, maltose binding protein), or a moiety that facilitates polypeptide stability (e.g., polyethylene glycol; amino terminus protecting groups such as acetyl, propyl, succinyl, benzyl, benzyloxycarbonyl or t-butyloxycarbonyl; carboxyl terminus protecting groups such as amide, methylamide, and ethylamide). In one embodiment of the invention a protein purification ligand can be one or more C amino acid residues at, for example, the amino terminus or carboxy terminus or both

termini of a polypeptide of the invention. An amino acid spacer is a sequence of amino acids that are not associated with a polypeptide of the invention in nature. An amino acid spacer can comprise about 1, 5, 10, 20, 100, or 1,000 amino acids.

If desired, a polypeptide of the invention can be part of a fusion protein, which contains other amino acid sequences, such as amino acid linkers, amino acid spacers, signal sequences, TMR stop transfer sequences, transmembrane domains, as well as ligands useful in protein purification, such as glutathione-S-transferase, histidine tag, and *Staphylococcal* protein A. More than one polypeptide of the invention can be present in a fusion protein of the invention. A polypeptide of the invention can be operably linked to proteins of a different organism or to form fusion proteins. A fusion protein of the invention can comprise one or more of polypeptides of the invention, fragments thereof, or combinations thereof. A fusion protein does not occur in nature. The term "operably linked" means that the polypeptide of the invention and the other polypeptides are fused in-frame to each other either to the N-terminus or C-terminus of the polypeptide of the invention.

Polypeptides of the invention can be in a multimeric form. That is, a polypeptide can comprise one or more copies of a polypeptide of the invention or a combination thereof. A multimeric polypeptide can be a multiple antigen peptide (MAP). *See e.g.,* Tam, J. Immunol. Methods, 196:17-32 (1996).

Polypeptides of the invention can comprise an antigen that is recognized by an antibody specific for the polypeptides of SEQ ID NOS: 1-59. The antigen can comprise one or more epitopes (*i.e.*, antigenic determinants). An epitope can be a linear epitope, sequential epitope or a conformational epitope. Epitopes within a polypeptide of the invention can be identified by several methods. *See, e.g.,* U.S. Patent No. 4,554,101; Jameson & Wolf, *CABIOS* 4:181-186 (1988). For example, a polypeptide of the invention can be isolated and screened. A series of short peptides, which together span an entire polypeptide sequence, can

be prepared by proteolytic cleavage. By starting with, for example, 30-mer polypeptide fragments (or smaller fragments), each fragment can be tested for the presence of epitopes recognized in an ELISA. For example, in an ELISA assay, a polypeptide of the invention, such as a 30-mer polypeptide fragment, is attached to a solid support, such as the wells of a plastic multi-well plate. A population of antibodies are labeled, added to the solid support and allowed to bind to the unlabeled antigen, under conditions where non-specific absorption is blocked, and any unbound antibody and other proteins are washed away. Antibody binding is detected by, for example, a reaction that converts a colorless substrate into a colored reaction product. Progressively smaller and overlapping fragments can then be tested from an identified 30-mer to map the epitope of interest.

A polypeptide of the invention can be produced recombinantly. A polynucleotide encoding a polypeptide of the invention can be introduced into a recombinant expression vector, which can be expressed in a suitable expression host cell system using techniques well known in the art. A variety of bacterial, yeast, plant, mammalian, and insect expression systems are available in the art and any such expression system can be used. Optionally, a polynucleotide encoding a polypeptide can be translated in a cell-free translation system. A polypeptide can also be chemically synthesized or obtained from patient samples or cells.

An immunogenic polypeptide of the invention can comprise an amino acid sequence shown in SEQ ID NOS:1-59 or fragments thereof. An immunogenic polypeptide can elicit antibodies or other immune responses (*e.g.*, T-cell responses of the immune system) that recognize epitopes of a polypeptide having SEQ ID NOS:1-59. An immunogenic polypeptide of the invention can also be a fragment of a polypeptide that has an amino acid sequence shown in SEQ ID NOS:1-6. An immunogenic polypeptide fragment of the invention can be about 10, 15, 20, 25, 30, 40, 50 or more amino acids in length. An

immunogenic polypeptide fragment of the invention can be about 50, 40, 30, 20, 15, 10 or less amino acids in length.

The invention illustratively described herein suitably can be practiced in the absence of any element or elements, limitation or limitations that are not specifically disclosed herein. Thus, for example, in each instance herein any of the terms "comprising", "consisting essentially of", and "consisting of" may be replaced with either of the other two terms, while retaining their ordinary meanings. The terms and expressions which have been employed are used as terms of description and not of limitation, and there is no intention that in the use of such terms and expressions of excluding any equivalents of the features shown and described or portions thereof, but it is recognized that various modifications are possible within the scope of the invention claimed. Thus, it should be understood that although the present invention has been specifically disclosed by embodiments, optional features, modification and variation of the concepts herein disclosed may be resorted to by those skilled in the art, and that such modifications and variations are considered to be within the scope of this invention as defined by the description and the appended claims.

Embodiments of the methods of this invention comprising the above-mentioned features are intended to fall within the scope of this invention.

Examples

The Examples that follow are illustrative of specific embodiments of the invention, and various uses thereof. They set forth for explanatory purposes only, and are not to be taken as limiting the invention.

Example 1

Identification and Purification of Blood Samples

Patient blood samples were collected from dogs. The dogs were members of a single family maintained at Texas A & M University since 1997. More specifically, this family is a colony of heterozygous (carrier) females with X-linked hereditary neuropathy (XLHN). XLHN is caused by a mutation in the gene *COL4A5*which in the female dogs causes a mosaic expression of type IV collagen peptides and onset of glomerular proteinuria between 3 and 6 months of age. Nabity *et al.*, J Vet Intern Med 2007; 21:425-430. Control versus experimental (diseased) was selected wherein controls were healthy dogs and the experimental or diseased group were dogs exhibiting elevated creatinine levels.

The following procedure was utilized for the preparation of patient samples for experimental analysis. Utilizing a 0.5 mL protein LoBind eppendorf tube, 110uL of serum was precipitated by addition of 200uL N,N-dimethylacetamide, which was followed by vortexing for 10 seconds, and incubating the sample at room temperature for 30 minutes. Resulting precipitate was pelleted by centrifugation at 13000 rpm for 30 minutes at 10°C. Supernatant was decanted into a borosilicate culture tube containing 5.0 mL of 0.1% formic acid in water and mixed to homogeneity.

The diluted extract was then further fractionated using a Caliper Life Science Rapid trace automated solid phase extraction apparatus as follows: 1mL (30mg) Waters OASIS® HLB solid phase extraction cartridges were conditioned at 0.5 mL/sec first with 1.0 mL 0.1% formic acid in water followed by 1.0 mL 0.1% formic acid in acetonitrile and finally with 2.0 mL 0.1% formic acid in water. Samples were loaded at a flow rate of 0.015 mL/sec then washed with 1.25 mL of 0.1% formic acid in water at a flow rate of 0.015 mL/sec. 1.25 mL fractions were then collected into borosilicate glass tubes containing 5µL of 20mg/mL N-nonyl-β-glucopyranoside in water. Fractions were eluted consecutively and collected separately using first 0.1% formic acid in 35% acetonitrile/water and next 0.1% formic acid in 65% acetonitrile/water at a flow rate of 0.015 mL/sec. The canula and solvent transfer

lines were purged and cleaned between runs with 3.0 mL of 0.1% formic acid in acetonitrile then 3.0 mL of 0.1% formic acid in water at a flow rate of 0.5 mL/sec.

Fractions were split in half and evaporated to dried state at room temperature using a Savant Speed Vac Concentrator Model SVC-100H. The dried samples were then separated into two batches and stored at -80° C. For analysis, the samples were reconstituted in 60 µL 0.1% formic acid in either 5% (35% fraction) or 35% (65% fraction) acetonitrile and analyzed by liquid chromatography/mass spectrometry (LC/MS).

Example 2

Identification of Polypeptides in Diseased Dogs by Liquid Chromatography/Mass Spectrometry

Experimental and control samples were subjected to liquid chromatography/mass spectrometry (LC/MS) for the identification of differentially produced polypeptides by mass. The identified polypeptide masses were then annotated to determine the corresponding protein name by performing a peptide ID search of existing databases. A unique databases for peptide annnotation was created from NCBI, Swissprot , Uniprot.

The resulting data provided the polypeptides provided in Table 1. SEQ ID NOS: 1-59 are the polypeptides that were differentially produced in dogs with renal disease. Therefore, these polypeptides provide unique biomarkers for the detection renal disease in dogs.

Table 1: Polypeptides differentially produced in dogs with renal disease.

Accession	No. Peptides	No. AAs	MW [kDa]	Description		Expression Levels
P56595	3	88	9.7	Apolipoprotein C-I OS=Canis familiaris GN=APOC1 PE=2 SV=1 - [APOC1_CANFA]		Increased
	Sequence	**m/z [Da]**	**MH+ [Da]**	**RT [min]**		
	AGEISSTFERIPDKLKEFGNTLEDKA (SEQ. ID NO: 1)	965.83238	2895.48259	27.98		
	EISSTFERIPDKLKEFGNTLEDKA (SEQ. ID NO: 2)	923.14789	2767.42910	27.41		
	DKLKEFGNTLEDKA (SEQ. ID NO: 3)	536.61725	1607.83719	20.36		
Q28243	4	443	45.9	Fibrinogen A-alpha-chain (Fragment) OS=Canis familiaris PE=4 SV=1 - [Q28243_CANFA]		Decreased
	Sequence	**m/z [Da]**	**MH+ [Da]**	**RT [min]**		
	IMGSDSDIFTNIGTPEFPSSGKTSSHSKQFVTSSTT (SEQ. ID NO: 4)	945.45618	3778.80288	26.50		
	THIMGSDSDIFTNIGTPEFPSSGKTSSH (SEQ. ID NO: 5)	738.34826	2950.37119	26.38		
	THIMGSDSDIFTNIGTPEFPSSGKTSSHS (SEQ. ID NO: 6)	1013.13733	3037.39743	26.25		
	IMGSDSDIFTNIGTPEFPSSGKTSSHS (SEQ. ID NO: 7)	933.76956	2799.29412	27.29		
P12278	6	101	11.2	Apolipoprotein C-II OS=Canis familiaris GN=APOC2 PE=2 SV=1 - [APOC2_CANFA]		Increased
	Sequence	**m/z [Da]**	**MH+ [Da]**	**RT [min]**		
	AHESQQDETTSSALLTQMQESLYSYWGTARSAAEDL (SEQ. ID NO: 8)	1335.61365	4004.82639	35.25		
	AHESQQDETTSSALLTQMQESL (SEQ. ID NO: 9)	1217.55859	2434.10991	28.22		

Accession	No. Peptides	No. AAs	MW [kDa]	Description		Expression Levels
	AHESQQDETTSSALLTQMQESLYSYWGTA (SEQ. ID NO: 10)	1088.15869	3262.46152	33.89		
	AHESQQDETTSSALLTQMQESL (SEQ. ID NO: 11)	812.04224	2434.11216	28.24		
	AHESQQDETTSSALLTQMQESLYSYWGTA (SEQ. ID NO: 12)	1631.73376	3262.46025	33.91		
	AHESQQDETTSSALL (SEQ. ID NO: 13)	808.87756	1616.74785	20.77		
P68213	7	28	3.0	Fibrinogen alpha chain (Fragment) OS=Canis familiaris GN=FGA PE=1 SV=1 - [FIBA_CANFA]		Decreased
	Sequence	**m/z [Da]**	**MH+ [Da]**	**RT [min]**		
	NSKEGEFIAEGGGV (SEQ. ID NO: 14)	697.33575	1393.66423	21.26		
	SKEGEFIAEGGGV (SEQ. ID NO: 15)	640.31421	1279.62114	21.32		
	TNSKEGEFIAEGGGV (SEQ. ID NO: 16)	747.85939	1494.71151	21.25		
	KEGEFIAEGGGV (SEQ. ID NO: 17)	596.79858	1192.58989	21.20		
	EGEFIAEGGGV (SEQ. ID NO: 18)	1064.49362	1064.49362	22.99		
	GEFIAEGGGV (SEQ. ID NO: 19)	935.44861	935.44861	22.73		
	FIAEGGGV (SEQ. ID NO: 20)	749.38739	749.38739	20.88		
XP_535836	4	653	73.1	Kininogen		Decreased
	Sequence	**Charge**	**m/z [Da]**	**MH+ [Da]**	**RT [min]**	
	HGGQRELDFDLEHQ (SEQ. ID NO: 21)	3	560.93286	1680.78403	20.94	
	DEEWDSGKEQGPTHGHG (SEQ. ID NO: 22)	3	622.59778	1865.77878	15.61	
	ELDFDLEHQ (SEQ. ID NO: 23)	2	573.26135	1145.51543	24.10	
	DCDYKESTQAATGEC (SEQ. ID NO: 24)	3	540.87445	1620.60880	26.40	
XP_848765 & XP_843672	4	958	105.0	Inter-Alpha Inhibitor H4 (ITIH4)		Differentially expressed
	Sequence	**Charge**	**m/z [Da]**	**MH+ [Da]**	**RT [min]**	
	GSEIVVVGKLRDQSPDVLSAKV (SEQ. ID NO: 25)	3	766.10455	2296.29911	24.87	

Accession	No. Peptides	No. AAs	MW [kDa]	Description		Expression Levels
	PRDWKPLLVPASPENVD (SEQ. ID NO: 26)	3	645.01086	1933.01804	18.72	
	ETLFSMMPGLNMTMDKTGLLL (SEQ. ID NO: 27)	2	1172.08431	2343.16135	34.46	
	AETVQ (SEQ. ID NO: 28)	1	547.27649	547.27649	20.09	
XP_545130	66.23	3	77	8.8	CysA	Differentially expressed
	Sequence	**Charge**	**m/z [Da]**	**MH+ [Da]**	**RT [min]**	
	VGDNSYIHLKIFKGLP (SEQ. ID NO: 29)	3	601.00467	1800.99945	26.31	
	LTLTGYQTDKSKDDELTG (SEQ. ID NO: 30)	3	662.33471	1984.98957	18.10	
	KPQLEEKTNETYQEFEA (SEQ. ID NO: 31)	3	695.32800	2083.96946	19.15	
XP_535601	75.32	7	77	9.0	CysB	Decreased
	Sequence	**Charge**	**m/z [Da]**	**MH+ [Da]**	**RT [min]**	
	YQTNKAKHDELAYF (SEQ. ID NO: 32)	3	576.61572	1727.83261	21.46	
	QTNKAKHDELAYF (SEQ. ID NO: 33)	3	522.26111	1564.76877	20.82	
	ENKPLALSSYQTNK (SEQ. ID NO: 34)	2	796.91620	1592.82513	27.77	
	QVVAGTPY (SEQ. ID NO: 35)	1	834.43532	834.43532	31.89	
	EERENKKYTTFK (SEQ. ID NO: 36)	2	786.90753	1572.80779	31.24	
	YFIKVQVDDDEFVHLR (SEQ. ID NO: 37)	3	675.00958	2023.01419	23.40	
	VVAGTPYFIKVQVDDD (SEQ. ID NO: 38)	3	589.30709	1765.90671	19.41	
NP_001013443	43.66	21	568	57.6	Keratin Type I Cyto-skeletal 10	Differentially expressed
	Sequence	**Charge**	**m/z [Da]**	**MH+ [Da]**	**RT [min]**	
	MQNLNDRLAS (SEQ. ID NO: 39)	2	581.28491	1161.56255	20.90	
	FGGGYGGVSFGGGSFGGGSFGG (SEQ. ID NO: 40)	3	624.60724	1871.80716	19.91	
	SFGGGYGGVSFG (SEQ. ID NO: 41)	2	546.24731	1091.48735	25.33	
	FSRGSSGGGCFGGSSGGYGGLGG (SEQ. ID NO: 42)	3	656.61829	1967.84031	28.01	
	EEQLQ (SEQ. ID NO: 43)	1	646.30862	646.30862	15.60	
	QNRKDAEAWFNEKSK (SEQ. ID NO: 44)	3	617.64661	1850.92527	19.80	
	PRDYSKYYQTIEDLKNQI (SEQ. ID NO: 45)	3	758.71680	2274.13584	26.49	
	KDAEAWFNEKSKEL (SEQ. ID NO: 46)	3	565.61548	1694.83188	19.42	
	KYENEVALRQSVEA (SEQ. ID NO: 47)	3	545.94529	1635.82131	19.39	

Accession	No. Peptides	No. AAs	MW [kDa]	Description		Expression Levels
	KSKELTTEINSNIEQM (SEQ. ID NO: 48)	3	622.31818	1864.93998	19.60	
	LQIDN (SEQ. ID NO: 49)	1	602.31784	602.31784	16.07	
	SIGGGFSSGG (SEQ. ID NO: 50)	1	825.37653	825.37653	34.30	
	FGGGGFSGGSFGGYGGGYGGDGGLL (SEQ. ID NO: 51)	3	719.64934	2156.93346	23.14	
	LENEIQTYRSLLEGEG (SEQ. ID NO: 52)	3	617.64661	1850.92527	19.80	
	GSIGGGFSSG (SEQ. ID NO: 53)	1	825.37653	825.37653	34.30	
	EDLKNQILNLTTDN (SEQ. ID NO: 54)	2	815.92169	1630.83611	26.45	
	GGGGYGGGSSGGGGSHGGSSGG (SEQ. ID NO: 55)	3	537.21368	1609.62650	19.61	
	GRYCVQLSQIQAQISS (SEQ. ID NO: 56)	2	890.94928	1780.89128	20.25	
	RVLDELTLT (SEQ. ID NO: 57)	1	1059.60266	1059.60266	33.79	
	RLASYLDKVRALEESNY (SEQ. ID NO: 58)	2	1014.02356	2027.03984	37.86	
	GGGYGGDGGLLSGNEKV (SEQ. ID NO: 59)	2	768.86627	1536.72527	22.51	

Although methods for performing LC/MS are well known in the art, the specific liquid chromatography/ mass spectrometry methods utilized for the present study are provided below:

Liquid Chromatography Parameters

Solvent A: 0.1% Formic acid in water; Solvent B: 0.1% Formic acid in acetonitrile; Column: Acquity UPLC BEH130 C18 1.7µM 2.1id x 150mm length; Guard Column: vanguard BEH 300 C_{18} 1.7uM; Injection volume: 25µL; Tray temp: 10°C; Column oven temp: 45°C; MS run time: 60 minutes; Divert valve: none

Table 2: Gradient for 35% fraction

No	Time	A%	B%	C%	D%	µL/min
1	0	100	0	0	0	300
2	5	100	0	0	0	300
3	45	50	50	0	0	300
4	46	100	0	0	0	300
5	60	100	0	0	0	300

Table 3: Gradient for 65% fraction

No	Time	A%	B%	C%	D%	µL/min
1	0	70	30	0	0	300
2	5	70	30	0	0	300
3	45	25	75	0	0	300
4	46	70	30	0	0	300
5	60	70	30	0	0	300

Mass Spectrometry Parameters and Methods

MS scan event 1: FTMS; resolution 30000; scan range 500.0-2000.0
MS scan event 2-6: ITMS + c norm Dep MS/MS 1^{st}, 2^{nd}, 3^{rd} most intense ion from scan 1 for differential expression and from list for targeted identification
Activation Type: CID
Min Signal Required: 500
Isolation Width: 1.5
Normalized Coll. Energy: 35.0
Default Charge State: 2
Activation Q: 0.250
Activation Time: 30.000
CV = 0.0V

Data Dependent Settings for differential expression: Use separate polarity settings disabled Parent Mass List: none Reject Mass List: none Neutral loss Mass List: none Product Mass List: none Neutral loss in top: 3 Product in top: 3 Most intense if no parent masses found not enabled Add/subtract mass not enabled FT master scan preview mode enabled Charge state screening enabled Monoisotopic precursor selection enabled Non-peptide monoisotopic recognition not enabled Charge state rejection enabled Unassigned charge states: rejected Charge state 1: not rejected Charge state 2: not rejected Charge state 3: not rejected Charge state 4+: not rejected
Data Dependent Settings for targeted identification: Use separate polarity settings disabled Reject Mass List: none Neutral loss Mass List: none Product Mass List: none Neutral loss in top: 3 Product in top: 3 Most intense if no parent masses found not enabled Add/subtract mass not enabled FT master scan preview mode enabled Charge state screening enabled Monoisotopic precursor selection enabled Non-peptide monoisotopic recognition not enabled Charge state rejection enabled Unassigned charge states: rejected Charge state 1: not rejected Charge state 2: not rejected Charge state 3: not rejected Charge state 4+: not rejected
Global Data Dependent Settings” Use global parent and reject mass lists not enabled for differential expression and enabled for targeted identification Exclude parent mass from data dependent selection not enabled

Exclusion mass width relative to mass Exclusion mass width relative to low (ppm): 20.00 Exclusion mass width relative to high (ppm): 20.00 Parent mass width relative to mass Parent mass width low (ppm): 10.00 Parent mass width high (ppm): 10.00 Reject mass width relative to mass Reject mass width low (ppm): 20.00 Reject mass width high (ppm): 20.00 Zoom/UltraZoom scan mass width by mass Zoom/UltraZoom scan mass low: 5.00 Zoom/UltraZoom scan mass high: 5.00 FT SIM scan mass width low: 5.00 FT SIM scan mass width high: 5.00 Neutral Loss candidates processed by decreasing intensity Neutral loss mass width by mass Neutral Loss mass width low: 0.50000 Neutral Loss mass width high: 0.50000 Product candidates processed by decreasing intensity Product mass width by mass Product mass width low: 0.50000 Product mass width high: 0.50000 MS mass range: 0.00-1000000.00 Use m/z values as masses not enabled Analog UV data dep. Not enabled Dynamic exclusion enabled Repeat Count: 2 Repeat Duration: 30.00 Exclusion List Size: 500 Exclusion Duration: 60.00 Exclusion mass width relative to mass Exclusion mass width low (ppm): 20.00 Exclusion mass width high (ppm): 20.00 Isotopic data dependence not enabled Mass Tags data dependence not enabled Custom Data Dependent Settings not enabled
MS Tune File Values Source Type: ESI Capillary Temp (°C): 250.00 Sheath gas Flow: 24.00 Aux Gas Flow: 13.00 Sweep Gas Flow: 0 Ion Trap MSn AGC Target: 10000 FTMS Injection waveforms: off FTMS AGC Target: 500000 Source voltage (kV): 4.50

Source current (μA): 100.00 Capillary Voltage (V): 68.28 Tube Lens (V): 130.00 Skimmer Offset (V): 0.00 Multipole RF Amplifier (Vp-p): 550.00 Multipole 00 offset (V): -1.60 Lens 0 Voltage (V): -2.70 Multipole 0 offset (V): -5.80 Lens 1 Voltage (V): -11.00 Gate Lens offset (V): -60.00 Multipole 1 offset (V): -10.50 Front Lens (V): -5.18 FTMS full microscans: 1 FTMS full Max Ion Time (ms): 500 Ion Trap MSn Micro Scans: 3 Ion Trap MSn Max Ion Time: 100

The mass spec data from the above analysis were analyzed for differential expression of the peptides using SIEVE 1.3 software with the following parameters:

Table 4: SIEVE Parameters

Alignment Parameters	
AlignmentBypass	False
CorrelationBinWidth	1
RT LimitsForAlignment	True
TileIncrement	150
TileMaximum	300
TileSize	300
Tile Threshold	0.6
Analysis Definition	
Experiment Target	PROTEOMICS
Experiment Type	AVSB
Frame Parameters	
AvgChargeProcessor	False
ControlGroup	c
FramelDCriteria	ORDER BY PVALUE ASC
FrameSeedFile	
KMClusters	10
MS2CorrProcessor	False
MZStart	500
MZStop	2000

MZWidth	0.01
ProcessorModules	PCA V1.0:ROC V1.0
RTStart	0
RTStop	59.98
RTWidth	1.5
UseTICNormalizedRatios	False

Table 5: Global Parent mass 35% fraction for targeted identification:

m/z	start time (min)	End time (min)
500.837	20.8	21.4
511.557	20.8	21.4
516.216	20.8	21.4
529.195	20.8	21.4
534.519	20.8	21.4
540.878	23.4	24.0
549.959	44.1	44.7
554.519	22.1	22.7
586.686	23.3	23.9
588.915	20.8	21.4
590.986	44.1	44.7
596.798	20.7	21.3
630.336	26.0	26.6
632.392	37.0	37.6
640.314	20.8	21.4
646.067	17.9	18.5
661.491	35.0	35.6
662.294	27.1	27.7
666.330	37.3	37.9
666.770	20.8	21.4
697.336	20.7	21.3
697.837	20.7	21.3
714.396	27.1	27.7
722.599	20.7	21.3
732.085	20.7	21.3
736.079	20.7	21.3
745.375	28.8	29.4
747.859	20.7	21.3
748.299	20.8	21.4
746.279	22.5	23.1
758.347	20.8	21.4
761.089	20.8	21.4
762.952	33.1	33.7
766.832	20.8	21.4
770.824	20.8	21.4
774.316	20.8	21.4
785.495	37.0	37.6
792.484	37.0	37.6
798.662	27.1	27.7
815.324	23.7	24.3
815.292	22.0	22.6
831.276	22.0	22.6
845.270	27.1	27.7
857.071	27.1	27.7
883.346	36.5	37.1
888.005	20.8	21.4
908.015	20.8	21.4
926.783	21.2	21.8
929.445	20.7	21.3
946.081	37.0	37.6
963.128	20.7	21.3
972.536	37.0	37.6
980.768	20.7	21.3
996.811	20.7	21.3
999.409	20.7	21.3
1014.449	20.8	21.4
1017.377	39.7	40.3
1017.250	39.6	40.2
1034.163	36.5	37.1
1061.032	38.0	38.6
1071.011	20.7	21.3
1073.287	38.3	38.9
1074.429	43.6	44.2
1075.546	43.0	43.6
1078.177	40.3	40.9
1083.736	22.1	22.7
1089.401	38.0	38.6
1096.026	20.7	21.3
1101.960	43.0	43.6
1104.411	37.4	38.0
1109.504	20.7	21.3
1117.566	42.9	43.5
1141.310	40.2	40.8
1140.059	40.2	40.8
1162.715	39.6	40.2
1162.285	39.6	40.2
1175.385	42.8	43.4
1175.963	20.7	21.3
1182.040	36.5	37.1
1185.065	38.6	39.2
1184.315	38.7	39.3
1184.044	36.5	37.1
1186.945	20.7	21.3
1189.456	36.5	37.1
1197.564	38.3	38.9
1201.052	38.0	38.6
1205.551	27.1	27.7
1221.832	38.1	38.7
1221.330	38.0	38.6
1221.956	38.1	38.7
1221.203	38.0	38.6
1229.059	41.7	42.3
1229.337	43.0	43.6
1234.050	43.3	43.9
1234.184	43.2	43.8
1237.197	38.1	38.7
1239.714	38.3	38.9

1239.903	40.3	40.9	1405.390	37.0	37.6
1239.906	22.0	22.6	1412.808	42.9	43.5
1239.336	39.3	39.9	1416.957	38.2	38.8
1241.893	22.0	22.6	1417.242	38.2	38.8
1245.780	42.9	43.5	1416.813	38.2	38.8
1244.893	41.7	42.3	1415.521	38.3	38.9
1244.821	38.2	38.8	1416.365	38.2	38.8
1252.485	42.9	43.5	1423.711	43.0	43.6
1253.180	38.0	38.6	1432.054	43.1	43.7
1262.757	41.7	42.3	1434.534	38.3	38.9
1269.226	43.0	43.6	1444.691	20.7	21.3
1268.942	42.9	43.5	1461.219	39.3	39.9
1271.795	41.7	42.3	1466.392	38.3	38.9
1271.940	41.7	42.3	1480.934	43.0	43.6
1272.223	41.7	42.3	1480.763	42.9	43.5
1271.511	41.7	42.3	1483.434	41.5	42.1
1271.366	41.5	42.1	1483.261	41.5	42.1
1271.653	43.6	44.2	1483.594	43.1	43.7
1271.939	42.9	43.5	1483.096	41.5	42.1
1271.663	43.0	43.6	1488.084	41.5	42.1
1279.356	41.7	42.3	1488.253	41.5	42.1
1279.640	41.7	42.3	1492.580	41.8	42.4
1280.487	43.1	43.7	1492.738	43.1	43.7
1282.341	42.9	43.5	1494.710	20.7	21.3
1282.623	42.9	43.5	1493.188	41.4	42.0
1283.501	41.7	42.3	1501.262	43.1	43.7
1283.215	41.7	42.3	1501.243	42.8	43.4
1287.661	42.8	43.4	1504.607	41.4	42.0
1287.380	42.8	43.4	1519.408	40.2	40.8
1287.671	42.9	43.5	1519.963	42.8	43.4
1289.949	41.4	42.0	1533.454	41.4	42.0
1290.093	41.4	42.0	1550.589	42.9	43.5
1290.231	41.4	42.0	1567.262	43.0	43.6
1295.514	42.8	43.4	1566.964	43.2	43.8
1302.780	40.2	40.8	1616.809	42.8	43.4
1313.671	42.8	43.4	1625.276	38.1	38.7
1326.085	42.9	43.5	1682.802	41.4	42.0
1329.279	41.4	42.0	1708.700	35.2	35.8
1340.257	42.8	43.4	1715.693	43.0	43.6
1353.504	38.6	39.2	1719.490	42.8	43.4
1353.226	38.0	38.6	1720.363	43.1	43.7
1354.345	38.0	38.6	1720.076	41.7	42.3
1355.998	39.6	40.2	1735.925	42.9	43.5
1361.344	38.6	39.2	1735.448	42.9	43.5
1378.833	43.0	43.6	1742.423	42.8	43.4
1393.662	20.7	21.3	1742.691	39.3	39.9
1395.947	38.0	38.6	1749.090	42.8	43.4
1395.808	38.1	38.7	1755.091	42.9	43.5
1396.095	38.0	38.6	1766.811	43.0	43.6
1396.238	38.1	38.7	1769.294	42.9	43.5
1403.093	38.1	38.7	1775.798	43.0	43.6

1802.490	42.8	43.4	1144.899	5.0	60.0
1808.484	42.9	43.5	1205.104	5.0	60.0
1822.120	41.4	42.0	1526.197	5.0	60.0
1893.263	5.0	60.0	1430.872	5.0	60.0
1796.466	5.0	60.0	1907.494	5.0	60.0
1596.971	5.0	60.0	1760.841	5.0	60.0
1368.976	5.0	60.0	1977.132	5.0	60.0
1150.101	5.0	60.0	1757.527	5.0	60.0
1635.848	5.0	60.0	1581.907	5.0	60.0
1338.604	5.0	60.0	1438.189	5.0	60.0
921.201	5.0	60.0	1054.941	5.0	60.0
775.405	5.0	60.0	879.285	5.0	60.0
1618.973	5.0	60.0	659.716	5.0	60.0
1324.797	5.0	60.0	1897.745	5.0	60.0
1121.137	5.0	60.0	1660.653	5.0	60.0
911.113	5.0	60.0	1022.328	5.0	60.0
809.990	5.0	60.0	633.253	5.0	60.0
1529.751	5.0	60.0	1831.242	5.0	60.0
1384.157	5.0	60.0	1664.857	5.0	60.0
1263.883	5.0	60.0	1526.203	5.0	60.0
1211.263	5.0	60.0	1408.880	5.0	60.0
1162.853	5.0	60.0	1308.318	5.0	60.0
1247.480	5.0	60.0	796.762	5.0	60.0
1366.192	5.0	60.0	733.101	5.0	60.0
1510.899	5.0	60.0	1991.952	5.0	60.0
1950.616	5.0	60.0	1770.739	5.0	60.0
1540.172	5.0	60.0	1593.766	5.0	60.0
1170.773	5.0	60.0	1448.969	5.0	60.0
1090.293	5.0	60.0	1328.306	5.0	60.0
1185.014	5.0	60.0	1226.206	5.0	60.0
1362.615	5.0	60.0	1138.692	5.0	60.0
1542.070	5.0	60.0	1062.846	5.0	60.0
1445.754	5.0	60.0	996.481	5.0	60.0
1360.769	5.0	60.0	937.924	5.0	60.0
1285.227	5.0	60.0	885.873	5.0	60.0
1217.636	5.0	60.0	839.301	5.0	60.0
1156.805	5.0	60.0	797.909	5.0	60.0
1101.767	5.0	60.0	759.464	5.0	60.0
1051.732	5.0	60.0	724.988	5.0	60.0
1006.048	5.0	60.0	693.511	5.0	60.0
964.172	5.0	60.0	664.657	5.0	60.0
14138.386	5.0	60.0	638.111	5.0	60.0
1768.180	5.0	60.0	1427.610	5.0	60.0
1286.224	5.0	60.0	1223.810	5.0	60.0
1088.498	5.0	60.0	1070.959	5.0	60.0
943.499	5.0	60.0	856.969	5.0	60.0
884.593	5.0	60.0	779.154	5.0	60.0
786.924	5.0	60.0	782.314	5.0	60.0
745.080	5.0	60.0	626.056	5.0	60.0
954.251	5.0	60.0	1042.755	5.0	60.0
1040.909	5.0	60.0	1037.510	5.0	60.0

692.009	5.0	60.0
519.259	5.0	60.0
1291.643	5.0	60.0
861.431	5.0	60.0
646.325	5.0	60.0
1480.558	5.0	60.0
905.177	5.0	60.0
857.589	5.0	60.0
1394.901	5.0	60.0
761.313	5.0	60.0
1104.010	5.0	60.0
631.727	5.0	60.0
883.410	5.0	60.0
1768.860	5.0	60.0
708.148	5.0	60.0
590.291	5.0	60.0
785.635	5.0	60.0
845.991	5.0	60.0
916.407	5.0	60.0
999.625	5.0	60.0
1221.540	5.0	60.0
1831.806	5.0	60.0
1615.749	5.0	60.0
1243.116	5.0	60.0
1077.502	5.0	60.0
950.855	5.0	60.0
850.871	5.0	60.0
1177.032	5.0	60.0
969.498	5.0	60.0
1098.630	5.0	60.0
1862.260	5.0	60.0
1676.135	5.0	60.0
1289.567	5.0	60.0
1117.759	5.0	60.0
882.653	5.0	60.0
1480.757	5.0	60.0
1253.103	5.0	60.0
1018.335	5.0	60.0
905.299	5.0	60.0
1472.097	5.0	60.0
1104.325	5.0	60.0
1766.315	5.0	60.0
883.661	5.0	60.0
679.972	5.0	60.0
589.443	5.0	60.0
1809.590	5.0	60.0
1357.444	5.0	60.0
1086.157	5.0	60.0
958.492	5.0	60.0
857.704	5.0	60.0
1286.224	5.0	60.0
1768.180	5.0	60.0
1571.827	5.0	60.0
1414.745	5.0	60.0
1179.883	5.0	60.0

Table 6

MZ	Start Time	End Time
747.8585	20.963	21.963
748.3594	20.963	21.963
1494.711	20.973	21.973
1393.662	20.925	21.925
997.1431	20.963	21.963
1091.809	43.558	44.558
758.9495	23.687	24.687
963.4607	20.963	21.963
996.8089	20.963	21.963
529.4085	20.079	21.079
963.1265	20.963	21.963
1495.694	21.586	22.586
939.1018	37.446	38.446
785.4966	37.446	38.446
1279.621	20.973	21.973
938.6002	37.446	38.446
632.3923	37.449	38.449
692.862	27.718	28.718
1245.308	37.446	38.446
713.5975	24.835	25.835
766.8335	20.973	21.973
1118.573	18.91	19.91
1356.332	40.142	41.142
713.2632	24.862	25.862
632.8939	37.449	38.449
767.3351	20.973	21.973
1245.354	45.921	46.921
1092.202	37.164	38.164
1091.703	37.446	38.446
576.0089	45.797	46.797
774.3157	20.963	21.963
1398.409	37.446	38.446
1082.377	29.745	30.745
1082.521	29.72	30.72
747.7883	28.871	29.871
747.5877	28.871	29.871
1017.626	40.143	41.143
856.5498	27.091	28.091
1082.234	29.745	30.745
923.815	27.718	28.718
514.3178	45.805	46.805
670.3671	22.036	23.036
1185.613	29.438	30.438

534.9825	45.819	46.819
520.341	45.691	46.691
747.9889	28.871	29.871
886.6	30.939	31.939
1262.604	29.769	30.769
723.3659	32.732	33.732
994.2356	45.096	46.096

Table 7: Global Parent Masses 65% fraction for targeted identification

m/z	Start time (min)	End time (min)
1222.77185	18.898	19.498
1222.62903	18.898	19.498
1222.91467	18.898	19.498
1222.48633	18.898	19.498
1222.34363	18.898	19.498
535.41309	44.458	45.058
549.31537	35.307	35.907
1240.9231	18.895	19.495
1241.21008	18.895	19.495
522.59802	47.752	48.352
500.20343	24.938	25.538
557.44525	34.845	35.445
700.55261	44.458	45.058
502.29593	31.133	31.733
576.00928	20.109	20.709
1229.77344	19.099	19.699
1227.05896	21.087	21.687
666.32935	12.86	13.46
555.42859	44.458	45.058
919.62494	10.837	11.437
1086.43494	18.895	19.495
500.20352	24.16	24.76
785.54749	44.458	45.058
1240.49377	18.893	19.493
656.32324	35.678	36.278
576.00928	20.962	21.562
1044.64368	33.755	34.355
565.43127	34.845	35.445
534.98254	20.109	20.709
689.45453	33.647	34.247
522.59821	46.986	47.586
552.97772	35.36	35.96
1160.28918	18.176	18.776
535.41296	40.034	40.634
514.31842	22.557	23.157
1092.1864	19.016	19.616
1226.62988	21.087	21.687
1245.21155	21.073	21.673
538.27802	31.183	31.783
595.95276	20.109	20.709
770.53705	35.665	36.265
514.13129	22.572	23.172
533.19391	45.359	45.959
503.29941	31.133	31.733
1035.65649	33.8	34.4
1228.77197	19.099	19.699
865.69196	44.492	45.092
552.64246	35.36	35.96
621.2735	35.307	35.907
639.38116	12.36	12.96
795.98547	12.411	13.011
788.02655	34.697	35.297
816.57715	46.757	47.357
1245.06909	21.073	21.673
590.78833	35.36	35.96
522.59857	46.026	46.626
1089.55884	16.803	17.403
785.59174	41.855	42.455
656.03418	44.963	45.563
1245.64099	21.073	21.673
734.5838	41.312	41.912
527.42432	44.458	45.058
816.57703	45.912	46.512
564.90961	44.767	45.367
1160.14612	18.176	18.776
787.98962	33.811	34.411
1530.9856	33.8	34.4
834.60272	45.536	46.136
1013.6778	47.807	48.407
927.50275	24.16	24.76
770.53809	41.117	41.717
672.8623	20.478	21.078
1236.03796	18.898	19.498
827.44568	17.482	18.082
1021.62933	31.226	31.826
612.2973	35.687	36.287
818.59338	40.929	41.529
763.073	44.933	45.533
884.26294	15.568	16.168
784.58783	34.201	34.801
647.50586	43.805	44.405
816.57739	42.456	43.056
816.57806	44.856	45.456
589.98645	20.109	20.709
678.38123	29.773	30.373
574.37909	36.07	36.67
590.789	33.644	34.244

550.38953	39.608	40.208	1089.43811	21.069	21.669
1234.76331	21.088	21.688	834.58734	44.106	44.706
747.63464	45.81	46.41	548.95966	20.109	20.709
684.06628	43.942	44.542	811.67133	44.9	45.5
834.60327	43.684	44.284	977.78485	43.805	44.405
1226.48657	21.087	21.687	984.71124	45.034	45.634
537.77429	31.183	31.783	816.57745	39.918	40.518
726.76282	35.307	35.907	541.35706	37.363	37.963
575.44519	44.421	45.021	1242.32043	21.087	21.687
856.57281	44.856	45.456	1296.89185	18.895	19.495
818.56958	41.989	42.589	816.57672	41.217	41.817
818.59167	37.061	37.661	834.60321	42.206	42.806
780.55658	44.856	45.456	800.58289	36.618	37.218
783.59045	45.191	45.791	1057.11133	31.226	31.826
806.57233	36.618	37.218	841.43475	46.467	47.067
547.08124	12.898	13.498	1090.30103	18.898	19.498
1255.62939	19.003	19.603	1076.55383	19.11	19.71
1101.73071	47.659	48.259	516.23901	44.751	45.351
616.12958	24.863	25.463	699.44244	34.996	35.596
942.46729	24.16	24.76	1082.91907	19.11	19.71
1065.6875	33.644	34.244	816.57849	36.279	36.879
564.9295	35.766	36.366	1073.30225	21.087	21.687
1096.42273	16.828	17.428	836.44843	35.316	35.916
816.57843	43.658	44.258	928.77789	43.805	44.405
747.63562	42.131	42.731	500.30814	33.647	34.247
606.30951	33.644	34.244	1096.2981	16.79	17.39
809.47382	43.611	44.211	1252.44897	19.099	19.699
1255.79785	12.391	12.991	800.5827	37.369	37.969
868.50171	39.152	39.752	797.4433	31.183	31.783
1234.90649	21.088	21.688	780.55627	41.566	42.166
789.95789	31.226	31.826	997.70264	47.786	48.386
576.27594	35.36	35.96	1207.7627	18.983	19.583
799.41437	15.568	16.168	847.11377	44.569	45.169
528.29279	35.166	35.766	1512.69934	18.898	19.498
842.56836	45.191	45.791	1856.21155	12.469	13.069
1081.91406	18.898	19.498	1250.02783	19.099	19.699
1865.21143	12.45	13.05	1095.60803	33.811	34.411
536.73425	10.897	11.497	658.4317	36.611	37.211
800.58289	44.856	45.456	1098.92664	19.016	19.616
1761.11316	33.8	34.4	972.04376	11.007	11.607
1234.33362	21.088	21.688	571.61591	31.37	31.97
523.28363	46.596	47.196	561.2981	31.327	31.927
692.56415	44.492	45.092	591.93182	39.863	40.463
856.57227	44.038	44.638	800.58289	39.551	40.151
682.36548	42.931	43.531	1309.29358	31.226	31.826
584.9256	45.702	46.302	817.58173	41.855	42.455
508.58325	47.575	48.175	650.42218	31.629	32.229
549.30127	31.216	31.816	591.38416	35.266	35.866
547.81464	35.36	35.96	550.34637	36.076	36.676
640.4176	34.467	35.067	507.32535	32.394	32.994
874.50842	12.645	13.245	1242.32202	19.128	19.728

1452.40747	16.828	17.428	968.62842	39.552	40.152
640.44788	36.711	37.311	863.56744	43.589	44.189
1296.60388	18.899	19.499	1439.88672	21.088	21.688
574.38922	39.095	39.695	809.54089	40.947	41.547
1127.66003	35.36	35.96	1234.05066	21.049	21.649
549.04468	10.94	11.54	1080.41943	19.099	19.699
1288.52576	20.914	21.514	1259.47473	20.829	21.429
1452.41113	21.087	21.687	1251.28943	12.43	13.03
943.24799	33.642	34.242	1874.19434	12.428	13.028
1244.78503	21.069	21.669	1098.1825	12.403	13.003
1236.81531	12.778	13.378	678.40588	35.36	35.96
656.0343	43.815	44.415	1080.2937	21.09	21.69
552.31799	33.644	34.244	1163.60168	31.331	31.931
533.19354	44.604	45.204	1081.90649	21.003	21.603
800.58374	38.715	39.315	1303.35498	20.914	21.514
800.58313	41.099	41.699	730.01355	37.502	38.102
1105.16418	19.016	19.616	540.86346	41.855	42.455
1080.5448	19.042	19.642	627.93677	39.175	39.775
1234.19116	21.088	21.688	1226.34363	21.087	21.687
834.58575	37.992	38.592	754.50586	44.569	45.169
722.05969	44.8	45.4	820.47766	35.368	35.968
1537.02759	33.8	34.4	1440.05261	21.087	21.687
542.90161	44.569	45.169	763.05652	39.17	39.77
1441.04272	18.895	19.495	965.57751	35.3	35.9
1057.70325	34.656	35.256	956.92969	18.895	19.495
575.38568	44.131	44.731	549.7619	33.862	34.462
528.40558	36.809	37.409	1039.28918	32.404	33.004
694.05194	43.783	44.383	1027.18225	38.565	39.165
591.98376	21.656	22.256	540.86285	40.956	41.556
780.55603	42.334	42.934	1220.05237	18.899	19.499
832.57202	40.929	41.529	646.42871	33.65	34.25
708.03638	44.492	45.092	1864.20129	12.391	12.991
743.07135	41.312	41.912	1279.36121	18.902	19.502
731.60846	42.622	43.222	1501.39685	18.898	19.498
1350.76477	38.534	39.134	1238.34937	20.516	21.116
548.95728	33.799	34.399	1252.34387	20.983	21.583
816.57764	35.123	35.723	1425.90979	33.836	34.436
1080.66956	21.088	21.688	1087.41003	19.128	19.728
1063.85815	20.109	20.709	1356.00232	16.785	17.385
742.09894	35.339	35.939	804.55017	40.49	41.09
527.31049	33.782	34.382	1611.92188	31.276	31.876
585.40204	33.044	33.644	650.42383	33.647	34.247
859.44659	35.307	35.907	1238.32214	17.718	18.318
1080.41858	21.09	21.69	795.48767	35.162	35.762
818.59222	34.562	35.162	868.92645	31.353	31.953
1370.99316	44.806	45.406	1664.72192	12.411	13.011
1089.53223	19.11	19.71	1260.61768	21.069	21.669
1431.85144	12.411	13.011	1159.58667	46.467	47.067
695.89008	20.593	21.193	741.53467	37.131	37.731
591.42761	41.789	42.389	1266.21619	18.902	19.502
504.75061	31.022	31.622	1275.7948	33.733	34.333

1245.63	20.983	21.583
696.51019	44.963	45.563
1089.3103	21.087	21.687
704.9386	43.649	44.249
1178.38953	35.3	35.9
811.95068	10.634	11.234
751.05286	44.8	45.4
936.49298	31.271	31.871
737.05133	44.458	45.058
939.39587	24.473	25.073
1027.66821	33.8	34.4
714.42725	39.557	40.157
780.98224	35.166	35.766
834.58661	41.639	42.239
571.37	39.418	40.018

Table 8:

MZ	Start Time	End Time
502.2947	30.953	31.953
576.0092	17.85	18.85
1035.655	33.622	34.622
1021.629	31.026	32.026
787.9893	33.601	34.601
534.9822	17.85	18.85
1530.986	33.601	34.601
666.3301	12.673	13.673
789.9586	31.016	32.016
1027.67	33.601	34.601
1309.292	31.026	32.026
595.9525	17.85	18.85
780.982	35.033	36.033

Proteome Discoverer 1.1 was used to identify the differentially expressed peptides with the work flow as follows:

Table 9:

Input Data	
1. General Settings	
Precursor Selection Use MS1 Precursor	
2. Spectrum Properties Filter	
Lower RT Limit	5
Upper RT Limit	84
Lowest Charge State	1
Highest Charge State	4
Min. Precursor Mass	100 D a
Max. Precursor Mass	9000 D a
Total Intensity Threshold	0
Minimum Peak Count	1
3. Scan Event Filters	
Mass Analyzer	Is ITMS; FTMS
MS Order	Is MS2
Activation Type	Is CID
Scan Type	Is Full
Ionization Source	Is ESI
Polarity Mode	Is +
3. Peak Filters	
S/N Threshold	0
4. Replacement for Unrecognized Properties	
Unrecognized Charge Re	1;2;3;4
Unrecognized Mass Anal	ITMS
Unrecognized MS Order	MS2
Unrecognized Activation	CID
Unrecognized Polarity	+
1. Spectrum Match Criteria	
Precursor Mass Criterion	Same Measured M
Presursor Mass Tolerance	7 ppm
Max. RT Difference [min]	1.5
Allow Mass Analyzer Mis	False
Allow MS Order Mismatch	False
1. Thresholds	
S/N Threshold	0
1. Filter Settings	
Mass Analyzer	Is ITMS; FTMS

MS Order	Is MS1; MS2
Activation Type	Is CID
Scan Type	Is Full
Ionization Source	Is ESI
Polarity Mode	Is +
1. Spectrum Properties	
Lowest Charge State	1
Highest Charge State	4
Min. Precursor Mass	100 D a
Max. Precursor Mass	9000 D a
2. Thresholds	
Total Intensity Threshold	0
Minimum Peak Count	1

Table 10:

1. Input Data	
Protein Database	Maha.fasta
Enzyme Name	No-Enzyme [No
Maximum Missed Cleavage	0
2. Decoy Database Search	
Search Against Decoy D	False
Target FDR (Strict)	0.01
Target FDR (Relaxed)	0.05
3. Tolerances	
Precursor Mass Tolerance	7 ppm
Fragment Mass Tolerance	0.8 D a
Use Average Precursor	False
Use Average Fragment	False
4. Ion Series	
Use Neutral Loss a Ions	True
Use Neutral Loss b Ions	True
Use Neutral Loss y Ions	True
Weight of a Ions	0
Weight of b Ions	1
Weight of c Ions	0
Weight of x Ions	0
Weight of y Ions	1
Weight of z Ions	0
5. Dynamic Modifications	
N-Terminal Modification	None
C-Terminal Modification	None
1. Dynamic Modification	None
2. Dynamic Modification	None

3. Dynamic Modification	None
4. Dynamic Modification	None
5. Dynamic Modification	None
6. Dynamic Modification	None
6. Static Modifications	
Peptide N-Terminus	None
Peptide C-Terminus	None

The database for peptide annotation was created from NCBI, Swissprot, and Uniprot. The resulting annotated proteins are provided above in Table 1.

Example 3

Inosine Concentrations in Dogs with Renal Disease

Dog serum was obtained from field samples submitted to IDEXX Reference Laboratories. Dogs were of various breeds and ages. 25 samples with < 1.8 mg/dL serum creatinine were assigned to a low creatinine group, and 25 samples with >1.8 mg/dL serum creatinine were assigned to a high creatinine group. Again, high creatinine is associated with renal disease, therefore inosine levels were assessed to determine whether inosine could be a biomarker for reduced kidney function.

Serum samples from a high creatinine and normal creatinine canine populations were analyzed on LC/MS and differentially produced mass features were indentified by informatics as previously described. LC/MS was run for each sample (i.e., dog) individually. SIEVE software (Thermo Scientific, Waltham, Massachusetts) was used for statistical analysis of the LC/MS data. Raw LC/MS data files were loaded into SIEVE, and peaks were identified. Statistical analysis was performed to compare peaks in low creatinine and high creatinine samples. A

differential peak corresponding to inosine was identified. Serum inosine was found to be depleted in 13 out of the 25 dogs with high serum creatinine. The ion intensity for inosine (as measured by LC/MS) is shown in Figure 1, where "Renal" represents the 13 dogs with high creatinine and inosine depletion, and "Control" represents all 25 dogs with low serum creatinine.

A protocol utilized for initial LC/MS analysis as shown in Figure 1 follows below: Plasma extraction was performed in a 0.5 mL protein LoBind eppendorf tube. 110uL of canine serum was precipitated by addition of 200uL acetonitrile. After vortexing for 10 seconds, and leaving the sample at room temperature for 30 minutes, the precipitate was pelleted by centrifugation at 13,000 rpm for 30 minutes at room temperature using a benchtop centrifuge. The supernatant was then analyzed by LC/MS. SIEVE and R were used to identify molecules present at differential levels (p-value <0.05).

LC method was performed with Solvent A: 0.1% Formic acid in water and Solvent B: 0.1% Formic acid in acetonitrile:

No	Time	A%	B%	C%	D%	µL/min
1	0	100	0	0	0	300
2	5	100	0	0	0	300
3	23	65	35	0	0	300
4	26	65	35	0	0	300
5	44	5	95	0	0	300
6	46	5	95	0	0	300
7	46.5	100	0	0	0	300
8	60	100	0	0	0	300

Column: Acquity UPLC BEH130 C18 1.7µM 2.1id x 150mm length
Guard Column: vanguard BEH 300 C_{18} 1.7uM
Injection volume: 25µL
Tray temp: 10°C
Column oven temp: 45°C
MS run time: 60 minutes
Divert valve:
To waste 0-5

To source 5-55
To waste 55-60

Mass Spectrometry method was performed according to the following parameters:

MS scan event 1: FTMS; resolution 30000; scan range 100.0-500.0
MS scan event 2: FTMS; resolution 30000; scan range 500.0-2000.0

MS Tune File Values
Source Type: ESI
Capillary Temp (°C): 250.00
Sheath gas Flow: 24.00
Aux Gas Flow: 13.00
Sweep Gas Flow: 0
Ion Trap MSn AGC Target: 10000
FTMS Injection waveforms: off
FTMS AGC Target: 500000
Source voltage (kV): 4.50
Source current (μA): 100.00
Capillary Voltage (V): 68.28
Tube Lens (V): 130.00
Skimmer Offset (V): 0.00
Multipole RF Amplifier (Vp-p): 550.00
Multipole 00 offset (V): -1.60
Lens 0 Voltage (V): -2.70
Multipole 0 offset (V): -5.80
Lens 1 Voltage (V): -11.00
Gate Lens offset (V): -60.00
Multipole 1 offset (V): -10.50
Front Lens (V): -5.18
FTMS full microscans: 1
FTMS full Max Ion Time (ms): 500
Ion Trap MSn Micro Scans: 3
Ion Trap MSn Max Ion Time: 100

To verify inosine as a biomarker for kidney disease, a complementary study was performed on dogs with X-linked hereditary neuropathy (XLHN). XLHN is caused by a mutation in the gene *COL4A5* (see Example 1 for details). These XLHN dogs provided a model of kidney disease that begins as glomerular defect and progresses to tubular failure. Serum and urine samples from four male dog puppies with XLHN (Table 11) were collected at pre-disease,

mid-stage, and end-stage disease and analyzed for inosine as described in the Renal LC/MS Assay provided below.

LC/ MS Mobile Phases Prep.

1. Mobile Phase A: to 1 liter of water add 1ml acetic acid. Mix well.
2. Mobile Phase B: to 1 liter of Acetonitrile add 1ml of acetic acid. Mix well.

Internal STD (IS solution) prep

1. Weigh 5mg deuterated creatinine and 6-Chloropurine riboside into a 20ml vial.
2. Add 5 ml of water to dilute. (1mg/ml solution).
3. Transfer 5ml of # 2 into a 2l flask and add 2l of water to the mark (2.5ug/ml solution).
4. Use # 3 as internal STD spiking solution.

STD Curve Prep

1. Weigh 10mg creatinine and 10mg inosine into a 2ml vial and add 10ml of Water to dissolve (1mg/ml solution).
2. Weigh 345mg of Bovine Serum albumin (BSA) into 5ml of phosphate buffer saline solution. Mix well. Scale up or down as needed (PBS-BSA Solution).
3. Transfer 5ul of 1mg/ml solution into 990ul of PBS-BSA solution (5ug/ml STD point1)
4. Make 11 1/1 serial dilutions of # 3 for STD points , 2, 3, 4, 5, 6, 7, 8,9,10,11 and a blank.

Sample Prep

1. Thaw serum samples.
2. Vortex samples for 10secs then centrifuge at 3000xg at room temperature for 10min.
3. Transfer 50ul of samples and STD curve points into microfuge tubes or 96well plate.
4. Add 50ul of IS solution into each sample.
5. Add 100ul of Acetonitrile.
6. Vortex to mix.
7. Sonicate for 20min in water bath.
8. Centrifuge at 3000xg for 20min at 25 degrees c.
9. Filter supernatant into amber vials/96well plates using 0.4micron nylon filters.
10. Analyze samples by LC/MS.

LC/MS METHOD

HPLC Parameters

Column 50x4.6 XBridge Amide, 3.5um column
Flow 1ml/min
Gradient

Step	total time	flow rate (ul/ml)	A%	B%
0	0.1	1000	20	80
1	5.0	1000	100	0
2.	8.00	1000	100	0

3.	8.10	1000	20	80
4.	14.00	1000	20	80
Time		14 min		
Temperature		ambient		

MS Parameters

Scan Type:	MRM
Polarity:	Positive
Scan Mode:	N/A
Ion Source:	Turbo Spray
Resolution Q1:	Unit
Resolution Q3:	Unit
Intensity Thres.:	0.00cps
Settling time:	0.000msec
MR pause:	5.000msec
MCA:	No
Step size:	0.00 amu

Inosine

Q1 Mass (amu)	Q3 Mass (amu)	Dwell (msec)	Parameters	Value
269.1	137.1	150.00	DP	30
			EP	7
			CEP	8
			CE	17
			CXP	3

CREATININE

Q1 Mass (amu)	Q3 Mass (amu)	Dwell (msec)	Parameters	Value
114.20	44.2	150.00	DP	20
			EP	6.30
			CEP	8.34
			CE	35
			CXP	4

DEUTERATED CREATININE

Q1 Mass (amu)	Q3 Mass (amu)	Dwell (msec)	Parameters	Value
117.20	47.2	150.00	DP	20
			EP	6.30
			CEP	8.47
			CE	35
			CXP	4

6-CHLOROPURINE RIBOSIDE

Q1 Mass (amu)	Q3 Mass (amu)	Dwell (msec)	Parameters	Value
285.29	153.2	150.00	DP	30
			EP	7
			CEP	8
			CE	17
			CXP	3

The inosine concentrations identified as a result of the above analysis are shown in Table 11, where serum inosine and urine inosine are shown in ug/dL, and creatinine is shown in mg/dL. A significant decrease in inosine is reflected in each animal over time as kidney disease progresses. These data confirm the role of inosine as a biomarker for kidney disease and tubular failure.

Table 11: Inosine Levels in Dogs with XLHN

Animal ID	DAY	Serum Inosine	Urine Inosine	Serum Creatinine
RASCAL	0	217.03	182.16	0.34
	84	188.54	44.30	1.88
	119	37.10	25.99	3.02
SANTANA	0	288.08	167.91	0.41
	56	241.82	48.45	1.17
	99	85.80	33.92	6.47
STEEL	0	174.74	556.90	0.35
	87	128.38	N/D	1.84
	147	11.25	199.25	4.01
XELLUS	0	115.96	2335.26	0.74
	91	59.87	N/D	1.88
	129	40.61	1640.90	4.05

Example 4

Renal Disease Progression in XLHN

Patient blood samples were collected from heterozygous female XLHN dogs as described in Example 1. The samples were prepared as described in Example 1 with the exception that all fractions were eluted in 0.1% formic acid in 35% acetonitrile/water, and that the samples were reconstituted in 0.1% formic acid in 3.5% acetonitrile/water.

The samples were then subjected to LC/MS as described in Example 2 above, except that the tray temperature was 10 degrees Celsius and the MS run time was 60 minutes.

Table 12 shows the results of LC/MS measurements of five peptides (SEQ ID NO:1 (Apolipoprotein C1); SEQ ID NO:31 (Cystatin A); SEQ ID NO:18 (Fibrinogen α chain); SEQ ID NO:25 (Inter-Alpha Inhibitor H4 (ITIH4)); SEQ ID NO:23 (Kininogen) over time, in four heterozygous female XLHN dogs. In Table 12, "NF" is an abbreviation for "not found" (i.e. below the limit of detection), while "ND" is an abbreviation for "not determined". As the kidney disease progressed, ApoC1 and Inter-Alpha Inhibitor H4 (ITIH4) levels increased, while Fibrinogen alpha levels decreased. Kininogen levels were higher in the XLHN dogs than in the control dogs. Cystatin A levels were higher in at least three out of the four XLHN dogs as compared to the control dogs.

Table 12: Peptide Levels During Renal Disease Progression

Animal ID	Age	Apolipoprotein C1 AA-26 (SEQ ID NO:1)	Cystatin A KA-17 (SEQ ID NO:31)	Fibrinogen α chain EV-11 (SEQ ID NO:18)	Inter-Alpha Inhibitor H4 (ITIH4) GV-22 (SEQ ID NO:25)	Kininogen EQ-9 (SEQ ID NO:23)	Serum Creatinine (mg/dl)
CONTROL 1	3-4 months Old	NF	NF	4386.5	5.9	NF	ND
CONTROL 2	3-4 months Old	20.6	NF	3881.7	2.2	NF	ND
CONTROL 3	3-4 months Old	17.7	NF	2344.1	3.6	NF	ND
CONTROL 4	3-4 months Old	22.3	NF	3741.2	4.3	NF	ND

RASCAL	0	114.4	5.2	6712.9	26.2	42.8	0.34
RASCAL	84	321.6	NF	6819.3	92.3	66.5	1.88
RASCAL	119	247.1	2.7	3741.2	108.1	19.4	3.02
XELLUS	0	122.8	NF	4233.3	58.6	10.7	0.74
XELLUS	91	145.8	NF	3144.7	53.0	1.2	1.88
XELLUS	129	218.6	NF	2595.7	99.0	16.4	4.05
SANTANA	0	152.6	9.8	9439.1	62.2	26.7	0.41
SANTANA	56	149.7	30.9	8811.6	76.6	31.0	1.17
SANTANA	99	202.4	28.2	7140.7	110.9	17.6	6.46
STEEL	0	110.9	5.9	12354.8	58.4	21.3	0.35
STEEL	87	210.9	12.6	8246.6	85.0	38.3	1.84
STEEL	147	305.3	NF	6628.9	71.4	21.5	4.01

Example 5

Renal-Failure Induced Canine Model

Dogs of mixed breeds and sizes were injected with dichromate, inducing acute renal failure, specifically due to tubular injury. *See* Ruegg *et al.*, Toxicol Appl Pharmacol. 1987, 90(2):261-7; Pedraza-Chaverrí *et al.*, BMC Nephrology 2005, 6:4; Chiusolo *et al.*, Toxicol Pathol. 2010, 38:338-45. Specifically, dogs were injected with 0.2 mL/kg of potassium dichromate (5 mg/ml). Serum was prepared from blood samples collected at various time points. NGAL (neutrophil gelatinase-associated lipocalin) was assayed with the Dog NGAL ELISA Kit (BioPorto Diagnostics, Gentofte, Denmark) according to the manufacturer's instructions. Inosine concentrations were measured in serum derived from blood samples taken at various times after injection of dichromate. Inosine and creatinine were measured by LC/MS as previously described in the preceding Example (Renal Assay LC/MS).

A time course of inosine, creatinine and NGAL levels following dichromate injection in a single dog is shown in Figure 2. Inosine concentrations dropped within 2 hours of dichromate treatment. Between about 60 and 70 hours post-treatment, inosine levels began to recover. *See*, Fatima, *et al.*, Hum Exp Toxicol 2005, 24:631-8. Creatinine and NGAL were included as reference markers (Figure 2). In summary, these data illustrate that reduced inosine levels provide a marker for renal failure and tubular injury.

In an additional study, serum samples from dichromate-treated dogs were prepared and subjected to LC/MS as described above in Example 4. Figure 3 shows time course measurements of the relative concentrations of three peptides (SEQ ID NO:1 (Apolipoprotein C1); SEQ ID NO:23 (Kininogen); SEQ ID NO:25 (Inter-Alpha Inhibitor H4 (ITIH4))) in two dogs.

SEQ ID NO:1 (Apolipoprotein C1) levels increased between about 4 hours and about 48 hours of dichromate treatment (Figure 3A). Between about 84 and 108 hours post-treatment, peptide SEQ ID NO:1 (Apolipoprotein C1) levels began to recover (decrease). These data illustrate that increased SEQ ID NO:1 (Apolipoprotein C1) levels provide a marker for renal failure and tubular injury.

SEQ ID NO:23 (Kininogen) levels generally decreased within the first 1-2 days of dichromate treatment, and recovered (increased) during later time points (Figure 3B). These data illustrate that decreased SEQ ID NO:23 (Kininogen) levels provide a marker for renal failure and tubular injury.

SEQ ID NO:25 (Inter-Alpha Inhibitor H4 (ITIH4)) levels generally decreased by the day 2 of dichromate treatment, and recovered (increased) after day 2 (Figure 3C). These data illustrate that altered SEQ ID NO:25 (Inter-Alpha Inhibitor H4 (ITIH4)) levels provide a marker for renal failure and tubular injury.

In addition, the invention is not intended to be limited to the disclosed embodiments of the invention. It should be understood that the foregoing disclosure emphasizes certain specific embodiments of the invention and that all modifications or alternatives equivalent thereto are within the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

1. A method for diagnosing renal disease, the method comprising:

(a) determining the amount of at least one polypeptide in Table 1 in a patient sample, wherein said polypeptide(s) comprise one or more of SEQ ID NO: 1 – SEQ ID NO: 59, and

(b) comparing the amount of said at least one polypeptide in the patient sample to a control sample, wherein differential levels of polypeptide in a patient sample versus control sample is an indication of renal disease.

2. The method of claim 1, wherein said polypeptide is Apolipoprotein C-I, Apolipoprotein C-II, Kininogen, Inter-Alpha Inhibitor H4 (ITIH4), Fibrinogen alpha-chain, Fibrinogen A alpha-chain, Cystatin A, Cystatin B and/or Keratin Type I cytoskeletal 10, or a fragment thereof.

3. The method of claim 1 wherein determining the amount of polypeptide is performed by liquid chromatography/mass spectrometry (LC/MS).

4. The methods of claim 1 wherein renal disease is glomerular.

5. The methods of claim 1 wherein renal disease is tubular.

6. The method of claim 1 wherein the patient is a mammal.

7. The method of claim 6 wherein the patient is human, feline, or canine.

8. The method of claim 1 wherein the patient sample is blood, serum, plasma or urine.

9. The method of claim 1 wherein the polypeptide comprises SEQ ID NO: 1, 18, 23, 25 and/or 31.

10. The method of claim 1 wherein determining the amount of polypeptide is performed by immunoassay.

11. An isolated polypeptide comprising one or more of SEQ ID NO: 1-59.

12. A method for diagnosing renal disease, the method comprising:

(a) contacting a patient sample with antibodies that specifically bind to inosine under conditions that allow inosine/antibody complexes to form;

(b) detecting the inosine/antibody complexes, wherein differential levels of inosine/antibody complexes present in patient sample versus control sample is an indication of renal disease.

13. A method of detecting inosine in a patient sample comprising:

(a) contacting antibodies that specifically bind to inosine under conditions that allow inosine/antibody complexes to form;

(b) detecting the inosine/antibody complexes, wherein differential levels of inosine/antibody complexes present in patient sample versus control sample is an indication of renal disease.

14. A method for diagnosing renal disease, the method comprising:

(a) determining the amount of inosine in a patient sample, and

(b) comparing the amount of inosine in the patient sample to a control sample, wherein differential levels of inosine in a patient sample versus control sample is an indication of renal disease.

15. The method of claim 14 wherein determining the amount of inosine is performed by liquid chromatography/mass spectrometry (LC/MS).

16. The method of claims 14 wherein the level of inosine is reduced in the patient sample as compared to the control.

17. The methods of claims 12-14 wherein renal disease is glomerular.

18. The methods of claims 12-14 wherein renal disease is tubular.

19. The method of claims 12-14 wherein the patient is a mammal.

20. The method of claim 19 wherein the patient is human, feline, or canine.

21. The method of claims 12-14 wherein the patient sample is blood, serum, plasma or urine.

22. The method of claims 12 or 13 wherein the antibodies are monoclonal antibodies, polyclonal antibodies, antigen-binding antibody fragments, or single chain antibodies.

23. A kit for diagnosing renal disease, the kit comprising one or a plurality of antibodies that each specifically bind to inosine.

24. A kit for diagnosing renal disease, the kit comprising:

(a) one or a plurality of antibodies that specifically binds inosine;

(b) reagents that facilitate binding of antibody to inosine present in patient sample, wherein differential levels of inosine/antibody complexes present in patient sample versus control sample is an indication of renal disease.

25. The kit of claims 23 or 24, wherein the kit is for diagnosing canine renal disease.

Figure 1

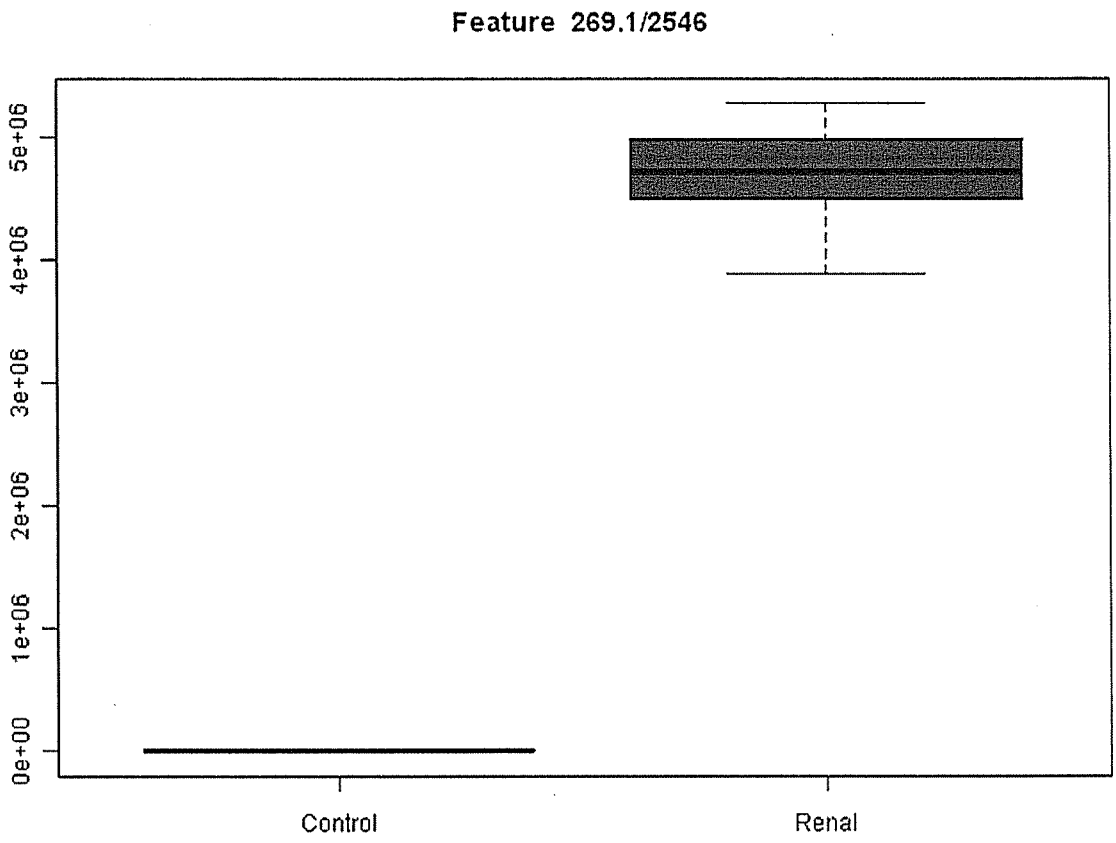

Feature 269.1/2546
0e+00
1e+06
2e+06
3e+06
4e+06
5e+06
Control
Renal

Figure 2

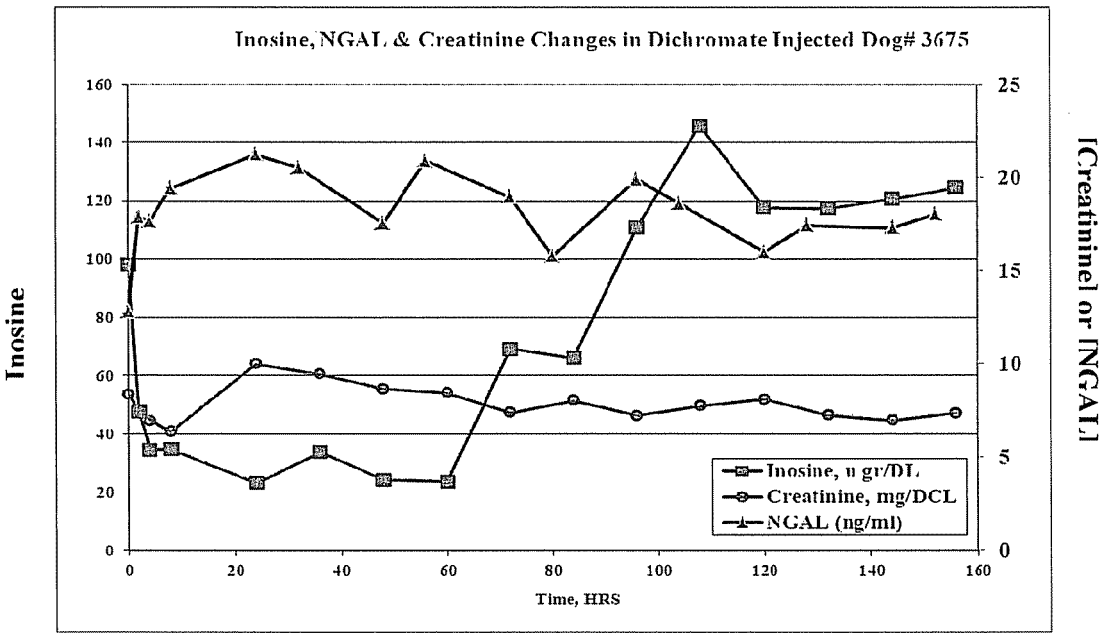

Inosine, NGAL & Creatinine Changes in Dichromate Injected Dog# 3675
Inosine
[Creatininel or [NGAL]
Time, HRS
Inosine, u gr/DL
Creatinine, mg/DCL
NGAL (ng/ml)
0
20
40
60
80
100
120
140
160
0
5
10
15
20
25

Figure 3A

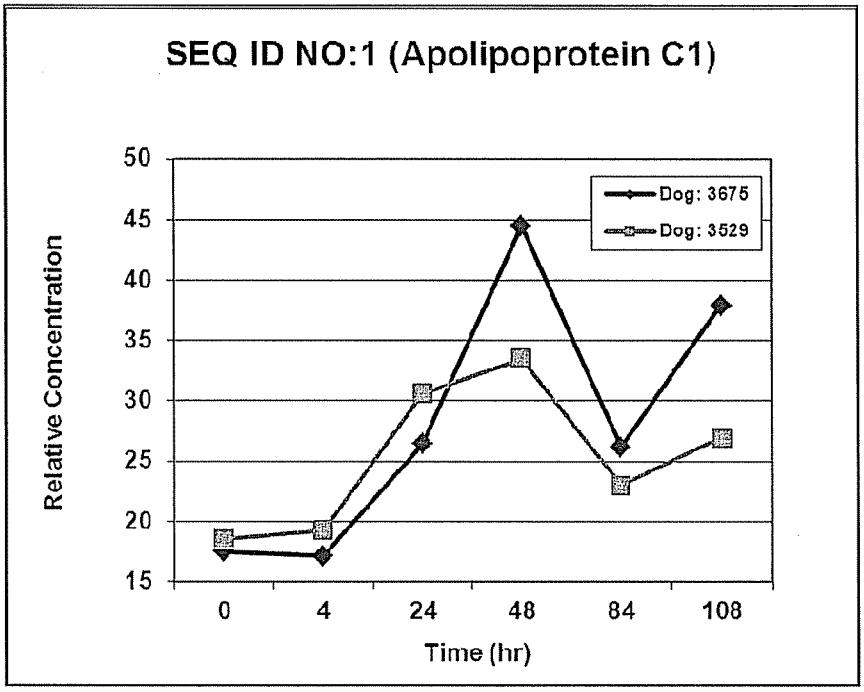


Figure 3B

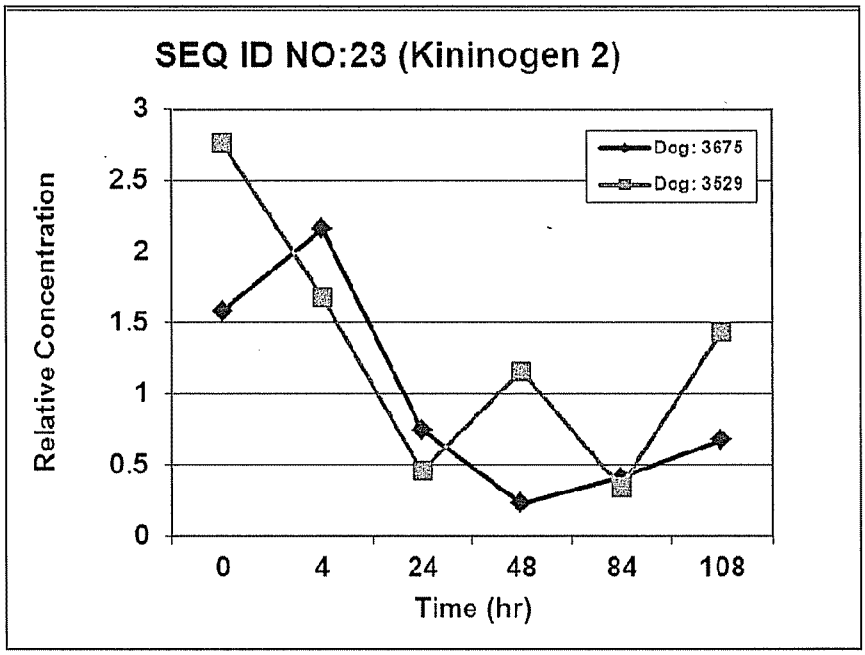
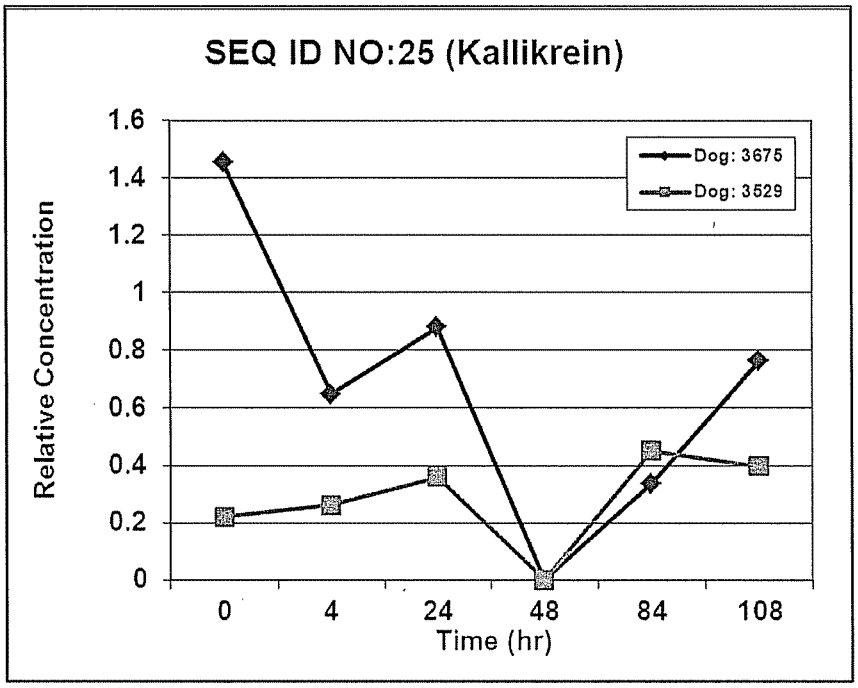


Figure 3C


SEQ ID NO:25 (Kallikrein)
Relative Concentration
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
4
24
48
84
108
Time (hr)
Dog: 3675
Dog: 3529

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2011/039122

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01N33/68 G01N33/53 C07K14/775 C07K14/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G01N C07K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, BIOSIS, EMBASE, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	QIAN ZHANG ET AL: "Identification of novel serum biomarkers in child nephroblastoma using proteomics technology", MOLECULAR BIOLOGY REPORTS ; AN INTERNATIONAL JOURNAL ON MOLECULAR AND CELLULAR BIOLOGY, KLUWER ACADEMIC PUBLISHERS, DO, vol. 38, no. 1, 6 April 2010 (2010-04-06), pages 631-638, XP019866460, ISSN: 1573-4978, DOI: DOI:10.1007/S11033-010-0149-4 abstract ----- -/--	1-10

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 July 2011	09/09/2011

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Fleitmann, J

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2011/039122

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-11(partially)

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2011/039122

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	OLGA GURSKY ET AL: "Thermodynamic Analysis of Human Plasma Apolipoprotein C-1: High-Temperature Unfolding and Low-Temperature Oligomer Dissociation +", BIOCHEMISTRY, vol. 37, no. 5, 1 February 1998 (1998-02-01), pages 1283-1291, XP55003215, ISSN: 0006-2960, DOI: 10.1021/bi971801q page 1284, left-hand column, paragraph 4 - right-hand column, paragraph 1	11
X	WO 2004/002518 A1 (TNO [NL]; RENSEN PATRICK CORNELIS NICOLA [NL]; HAVEKES ALOYSIUS MARIA) 8 January 2004 (2004-01-08) page 6, line 10 - line 17	11
A	FRANK DIETERLE ET AL: "Urinary clusterin, cystatin C, [beta]2-microglobulin and total protein as markers to detect drug-induced kidney injury", NATURE BIOTECHNOLOGY, vol. 28, no. 5, 1 May 2010 (2010-05-01), pages 463-469, XP55003106, ISSN: 1087-0156, DOI: 10.1038/nbt.1622 abstract	1-11
E	WO 2011/079280 A2 (HILLS PET NUTRITION INC [US]; AL-MURRANI SAMER [US]; MALLADI SUKHASWAM) 30 June 2011 (2011-06-30) claims 1,16	1-10

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2011/039122

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2004002518 A1	08-01-2004	AT 396737 T	15-06-2008
		AU 2003280523 A1	19-01-2004
		EP 1517696 A1	30-03-2005
		JP 2005537243 A	08-12-2005
		NL 1020962 C2	30-12-2003
		US 2006111283 A1	25-05-2006
WO 2011079280 A2	30-06-2011	NONE	

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-11(partially)

A method for diagnosing renal disease comprising the comparison of the amount of at least one polypeptide that comprises one or more of SEQ ID NO: 1 - SEQ ID NO: 3 in the patient sample to a control sample, wherein differential levels of polypeptide in a patient sample versus control sample is an indication of renal disease.

---

2. claims: 1-11(partially)

A method for diagnosing renal disease comprising the comparison of the amount of at least one polypeptide that comprises one or more of SEQ ID NO: 4 - SEQ ID NO: 7 in the patient sample to a control sample, wherein differential levels of polypeptide in a patient sample versus control sample is an indication of renal disease.

---

3. claims: 1-11(partially)

A method for diagnosing renal disease comprising the comparison of the amount of at least one polypeptide that comprises one or more of SEQ ID NO: 8 - SEQ ID NO: 13 in the patient sample to a control sample, wherein differential levels of polypeptide in a patient sample versus control sample is an indication of renal disease.

---

4. claims: 1-11(partially)

A method for diagnosing renal disease comprising the comparison of the amount of at least one polypeptide that comprises one or more of SEQ ID NO: 14 - SEQ ID NO: 20 in the patient sample to a control sample, wherein differential levels of polypeptide in a patient sample versus control sample is an indication of renal disease.

---

5. claims: 1-11(partially)

A method for diagnosing renal disease comprising the comparison of the amount of at least one polypeptide that comprises one or more of SEQ ID NO: 21 - SEQ ID NO: 24 in the patient sample to a control sample, wherein differential levels of polypeptide in a patient sample versus control sample is an indication of renal disease.

---

6. claims: 1-11(partially)

A method for diagnosing renal disease comprising the comparison of the amount of at least one polypeptide that comprises one or more of SEQ ID NO: 25 - SEQ ID NO: 28 in the patient sample to a control sample, wherein differential levels of polypeptide in a patient sample versus control sample is an indication of renal disease.

---

7. claims: 1-11(partially)

A method for diagnosing renal disease comprising the comparison of the amount of at least one polypeptide that comprises one or more of SEQ ID NO: 29 - SEQ ID NO: 31 in the patient sample to a control sample, wherein differential levels of polypeptide in a patient sample versus control sample is an indication of renal disease.

---

8. claims: 1-11(partially)

A method for diagnosing renal disease comprising the comparison of the amount of at least one polypeptide that comprises one or more of SEQ ID NO: 32 - SEQ ID NO: 38 in the patient sample to a control sample, wherein differential levels of polypeptide in a patient sample versus control sample is an indication of renal disease.

---

9. claims: 1-11(partially)

A method for diagnosing renal disease comprising the comparison of the amount of at least one polypeptide that comprises one or more of SEQ ID NO: 39 - SEQ ID NO: 59 in the patient sample to a control sample, wherein differential levels of polypeptide in a patient sample versus control sample is an indication of renal disease.

---

10. claims: 12-25

A method for diagnosing renal disease comrpsing the determination of inosine in a patient sample.

专利名称(译)	肾脏疾病的标志物		
公开(公告)号	EP2577315A1	公开(公告)日	2013-04-10
申请号	EP2011725846	申请日	2011-06-03
[标]申请(专利权)人(译)	艾德克斯实验室公司		
申请(专利权)人(译)	IDEXX实验室，INC.		
当前申请(专利权)人(译)	IDEXX实验室，INC.		
[标]发明人	YERRAMILLI MAHALAKSHMI ATKINSON MICHAEL RANDOLPH YERRAMILLI MURTHY V S N		
发明人	YERRAMILLI, MAHALAKSHMI ATKINSON, MICHAEL, RANDOLPH YERRAMILLI, MURTHY, V.S.N.		
IPC分类号	G01N33/68 G01N33/53 C07K14/775 C07K14/00		
CPC分类号	G01N33/5308 G01N33/6893 G01N2800/347 G01N2800/60 G01N33/92		
优先权	61/351183 2010-06-03 US 61/411280 2010-11-08 US		
其他公开文献	EP2577315B1		
外部链接	Espacenet		

摘要(译)

本发明提供了用于诊断肾病的试剂和方法。肌苷代谢物和蛋白质的差异水平：载脂蛋白CI，载脂蛋白C-II，纤维蛋白原α链或纤维蛋白原A-α链，激肽原，α间抑制剂H4（ITIH4），角蛋白I型细胞骨架蛋白10胱抑素A，胱抑素B和其他多肽及其片段提供肾病的生物标志物并在本文中描述。