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(54) **ISOLATED GENOMIC POLYNUCLEOTIDE FRAGMENTS ENCODING HUMAN RESISTIN AND THE HUMAN SYNTAXIN BINDING PROTEIN 2**

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See application file for complete search history.

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(57) **ABSTRACT**

The invention is directed to isolated genomic polynucleotide fragments that encode human resistin and human syntaxin binding protein 2, vectors and hosts containing these fragments and fragments hybridizing to noncoding regions as well as antisense oligonucleotides to these fragments. The invention is further directed to methods of using these fragments to obtain human resistin and human syntaxin binding protein 2 and to diagnose, treat, prevent and/or ameliorate a pathological disorder.

**16 Claims, No Drawings**

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**ISOLATED GENOMIC POLYNUCLEOTIDE  
FRAGMENTS ENCODING HUMAN RESISTIN  
AND THE HUMAN SYNTAXIN BINDING  
PROTEIN 2**

PRIORITY CLAIM

This application claims priority to application Ser. No. 60/697,815, filed Jul. 9, 2005, the contents of which are herein incorporated by reference.

FIELD OF THE INVENTION

The invention is directed to isolated genomic polynucleotide fragments that encode human resistin and human syntaxin binding protein 2, vectors and hosts containing these fragments and fragments hybridizing to noncoding regions as well as antisense oligonucleotides to these fragments. The invention is further directed to methods of using these fragments to obtain human resistin and human syntaxin binding protein and to diagnose, treat, prevent and/or ameliorate a pathological disorder.

BACKGROUND OF THE INVENTION

Chromosome 19 p 13.3-p 13.2 contains genes encoding, for example, zinc-finger protein 14, oncogene VAV1, tartrate-resistant acid phosphatase, bone marrow stromal cell antigen, calponin 1 and syntaxin binding protein 2; the last of which is discussed in detail below. The gene that encodes resistin, is known to be disposed on chromosome 19.

Human Resistin

Human resistin is a protein that interferes with the actions of insulin on liver and muscle. It is disposed largely in white adipose tissue and in crypt epithelium of the intestine. Given its disposition in fatty tissue and its inhibition of insulin effects, resistin is believed to link obesity to type 2 diabetes (Steppan et al., Nature 409: 307-312, 2001). Consistent with this view, antibodies to resistin improve blood sugar levels and insulin actions in mice with diet-induced obesity. Conversely, administration of recombinant resistin impairs glucose tolerance and insulin actions. The resistin cDNA is identical to the cDNAs for entities called FIZZ3, accession number AF205952, and C/EBP-epsilon regulated myeloid-specific secreted cysteine-rich protein precursor, accession number AF352730. The latter sequence contains the intron sequences and some 5'- and 3'-sequences.

Human Syntaxin Binding Protein 2

Human syntaxin binding protein, a member of the STXB/unc-18/Sec1 protein family, is disposed largely in placenta, lung, liver, kidney, peripheral lymphocytes and pancreas. It is believed to play a role in vesicular transport between the golgi apparatus and the cell membrane in non-neuronal tissues. Mouse syntaxin binding protein 2-binds to syntaxins 1A, 2 and 3 but not to syntaxin 4 (Katagiri et al., J. Biol. Chem. 270: 4963-6, 1995). The human gene is upregulated in interleukin-2 activated natural killer cells (Ziegler et al., Genomics 37: 19-23, 1996). The cDNA has been determined (see accession number NM\_006949).

OBJECTS OF THE INVENTION

Although cDNAs encoding the above-disclosed proteins have been isolated, their locations on chromosome 19 have not been determined. Furthermore, genomic nucleic acids encoding these polypeptides have not been isolated. Noncod-

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ing sequences play a significant role in regulating the expression of polypeptides as well as the processing of RNA encoding these polypeptides.

There is clearly a need for obtaining genomic polynucleotide sequences encoding these polypeptides. Therefore, it is an object of the invention to isolate such genomic polynucleotide sequences.

SUMMARY OF THE INVENTION

The invention is directed to isolated genomic nucleic acid molecules or polynucleotides, said polynucleotides obtainable from human chromosome 19 comprising a naturally occurring polynucleotide sequence at least 95% identical to a sequence selected from the group consisting of:

(a) a forward or reverse strand of a nucleic acid molecule encoding a polypeptide selected from the group consisting of human resistin depicted in SEQ ID NO: 1 and/or human syntaxin binding protein 2 depicted in SEQ ID NO:2 or variant of SEQ ID NO: 1 or SEQ ID NO:2;

(b) a forward or reverse strand of a nucleic acid molecule containing SEQ ID NO:3 which encodes human resistin depicted in SEQ ID NO: 1 and/or SEQ ID NO:4 which encodes human syntaxin binding protein 2 depicted in SEQ ID NO:2 or variant of SEQ ID NO:3 and/or SEQ ID NO:4;

(c) a forward or reverse strand of a nucleic acid molecule at least 20 nucleotides in length unique to a noncoding region(s) of SEQ ID NO: 3 or 4, preferably about 20-35,000 in length;

(d) a forward or reverse strand of a nucleic acid molecule at least 60 nucleotides in length unique to a contiguous coding and noncoding nucleic acid sequence(s) of SEQ ID NO:3 or 4, preferably about 60-35,000 nucleotides in length;

(e) a nucleic acid molecule or its reverse strand that extends from the 5'-end of SEQ ID NO:3 through the 3'-end of SEQ ID NO:4 as depicted in SEQ ID NO:5;

(f) a nucleic acid molecule which hybridizes to any one of the nucleic acid molecules specified in (a)-(b) and

as well as nucleic acid constructs, expression vectors and host cells containing these polynucleotide sequences.

The polynucleotides of the present invention may be used for the manufacture of a gene therapy for the prevention, treatment or amelioration of a medical condition by adding an amount of a composition comprising said polynucleotide effective to prevent, treat or ameliorate said medical condition.

The invention is further directed to obtaining these polypeptides by:

(a) culturing host cells comprising these sequences under conditions that provide for the expression of said polypeptide and

(b) recovering said expressed polypeptide.

The polypeptides obtained may be used to produce antibodies by

(a) optionally conjugating said polypeptide to a carrier protein;

(b) immunizing a host animal with said polypeptide or peptide-carrier protein conjugate of step (b) with an adjuvant and

(c) obtaining antibody from said immunized host animal.

The nucleic acid molecules of the present invention may be used for the manufacture of a medicament for prevention, treatment or amelioration of a medical condition. In a specific embodiment, the noncoding regions are transcription regulatory regions. The transcription regulatory regions may be used to produce a heterologous peptide by expressing in a host cell, said transcription regulatory region operably linked

to a polynucleotide encoding the heterologous polypeptide and recovering the expressed heterologous polypeptide.

The polynucleotides of the present invention may be used to diagnose a pathological condition in a subject comprising

(a) determining the presence or absence of a mutation in the polynucleotides of the present invention and

(b) diagnosing a pathological condition or a susceptibility to a pathological condition based on the presence or absence of said mutation.

The invention is further directed to kits and/or microarrays comprising the nucleic acids of the present invention. The kits may comprise microarrays. Furthermore, the kits of the present invention may comprise other sequences, e.g., cDNA sequences.

### DEFINITIONS

In accordance with the present invention there may be employed conventional molecular biology, microbiology, and recombinant DNA techniques within the skill of the art. Such techniques are explained fully in the literature. See, e.g., Sambrook et al, 2001, "Molecular Cloning: A Laboratory Manual"; Ausubel, ed., 1994, "Current Protocols in Molecular Biology" Volumes I-III; Celis, ed., 1994, "Cell Biology: A Laboratory Handbook" Volumes I-III; Coligan, ed., 1994, "Current Protocols in Immunology" Volumes I-III; Gait ed., 1984, "Oligonucleotide Synthesis"; Hames & Higgins eds., 1985, "Nucleic Acid Hybridization"; Hames & Higgins, eds., 1984, "Transcription And Translation"; Freshney, ed., 1986, "Animal Cell Culture"; IRL Press, 1986, "Immobilized Cells And Enzymes"; Perbal, 1984, "A Practical Guide To Molecular Cloning."

Where a range of values is provided, it is understood that each intervening value, to the tenth of the unit of the lower limit unless the context clearly dictates otherwise, between the upper and lower limit of that range and any other stated or intervening value in that stated range is encompassed within the invention.

Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. Although any methods and materials similar or equivalent to those described herein can also be used in the practice or testing of the present invention, the preferred methods and materials are now described.

It must be noted that as used herein and in the appended claims, the singular forms "a," "and" and "the" include plural references unless the context clearly dictates otherwise. The terms "polynucleotide(s)", "nucleic acid molecule(s)" and "nucleic acids" will be used interchangeably.

Furthermore, the following terms shall have the definitions set out below.

As defined herein "isolated" refers to material removed from its original environment and is thus altered "by the hand of man" from its natural state.

The amino acid residues described herein are preferred to be in the "L" isomeric form. However, residues in the "D" isomeric form can be substituted for any L-amino acid residue, as long as the desired functional is retained by the polypeptide. NH<sub>2</sub> refers to the free amino group present at the amino terminus of a polypeptide. COOH refers to the free carboxy group present at the carboxy terminus of a polypeptide.

"Nucleic acid construct" is defined herein, is a nucleic acid molecule, either single- or double-stranded, which is isolated from a naturally occurring gene or which has been modified to contain segments of nucleic acid which are combined and

juxtaposed in a manner which would not otherwise exist in nature. The term nucleic acid construct is synonymous with the term "expression cassette" when the nucleic acid construct contains all the control sequences required for expression of a coding sequence of the present invention.

The term "coding sequence" is defined herein as a portion of a nucleic acid sequence which directly specifies the amino acid sequence of its protein product. The boundaries of the coding sequence are generally determined by a ribosome binding site (prokaryotes) or by the ATG start codon (eukaryotes) of the first open reading frame at the 5'-end of the mRNA and a transcription terminator sequence located just downstream of the open reading frame at the 3'-end of the mRNA. A coding sequence can include, but is not limited to, DNA, cDNA, and recombinant nucleic acid sequences.

A "heterologous" region of a recombinant cell is an identifiable segment of nucleic acid within a larger nucleic acid molecule that is not found in association with the larger molecule in nature.

An "expression vector" may be any vector (e.g., a plasmid or virus) which can be conveniently subjected to recombinant DNA procedures and can bring about the expression of the nucleic acid sequence.

An "origin of replication" refers to those DNA sequences that participate in DNA synthesis.

An "expression control sequence" is a DNA sequence that controls and regulates the transcription and translation of another DNA sequence. A coding sequence is "under the control" of transcriptional and translational control sequences in a cell when RNA polymerase transcribes the coding sequence into mRNA, which is then translated into the protein encoded by the coding sequence. Transcriptional and translational control sequences are DNA regulatory sequences, such as promoters, enhancers, polyadenylation signals, terminators, and the like, that provide for the expression of a coding sequence in a host cell.

A "signal sequence" can be included before the coding sequence of the mature polypeptide. This sequence encodes a signal peptide, N-terminal to the mature polypeptide, that communicates to the host cell to direct the polypeptide to the cell surface or secrete the polypeptide into the media, and this signal peptide is clipped off by the host cell before the protein leaves the cell. Signal sequences can be found associated with a variety of proteins native to prokaryotes and eukaryotes.

A cell has been "transformed" by exogenous or heterologous DNA when such DNA has been introduced inside the cell. The transforming DNA may or may not be integrated (covalently linked) into chromosomal DNA making up the genome of the cell. In prokaryotes, yeast, and mammalian cells for example, the transforming DNA may be maintained on an episomal element such as a plasmid. With respect to eukaryotic cells, a stably transformed cell is one in which the transforming DNA has become integrated into a chromosome so that it is inherited by daughter cells through chromosome replication. This stability is demonstrated by the ability of the eukaryotic cell to establish cell lines or clones comprised of a population of daughter cells containing the transforming DNA.

It should be appreciated that also within the scope of the present invention are nucleic acid sequences encoding the polypeptide(s) of the present invention, which code for a polypeptide having the same amino acid sequence as the sequences disclosed herein, but which are degenerate to the nucleic acids disclosed herein. By "degenerate to" is meant that a different three-letter codon is used to specify a particular amino acid.

The term "polypeptide" refers to a polymer of amino acids and does not refer to a specific length of the product; thus, peptides, oligopeptides, and proteins are included within the definition of polypeptide. This term also does not refer to or exclude post-expression modifications of the polypeptide, for example, glycosylations, acetylations, phosphorylations and the like. Included within the definition are, for example, polypeptides containing one or more analogs of an amino acid (including, for example, unnatural amino acids, etc.), polypeptides with substituted linkages, as well as other modifications known in the art, both naturally occurring and non-naturally occurring.

A nucleic acid molecule is "operatively linked" to an expression control sequence when the expression control sequence controls and regulates the transcription and translation of nucleic acid sequence. The term "operatively linked" includes having an appropriate start signal (e.g., ATG) in front of the nucleic acid sequence to be expressed and maintaining the correct reading frame to permit expression of the nucleic acid sequence under the control of the expression control sequence and production of the desired product encoded by the nucleic acid sequence. If a gene that one desires to insert into a recombinant DNA molecule does not contain an appropriate start signal, such a start signal can be inserted in front of the gene.

The term "stringent hybridization conditions" are known to those skilled in the art and can be found in *Current Protocols in Molecular Biology*, John Wiley & Sons, N.Y. (1989), 6.3.1-6.3.6. A preferred, non-limiting example of stringent hybridization conditions is hybridization in 6× sodium chloride/sodium citrate (SSC) at about 45° C., followed by one or more washes in 0.2×SSC, 0.1% SDS at 50° C., preferably at 55° C., and more preferably at 60° C. or 65° C.

As used herein, "Arrays" or "Microarrays" refers to an array of distinct polynucleotides or oligonucleotides deposited on a substrate, such as paper, nylon or other type of membrane, filter, chip, glass slide, or any other suitable solid support. In one embodiment, the microarray is prepared and used according to the methods described in U.S. Pat. No. 5,837,832, PCT application WO95/11995, Lockhart et al. (1996; *Nat. Biotech.* 14: 1675-1680) and Schena et al. (1996; *Proc. Natl. Acad. Sci.* 93: 10614-10619). In other embodiments, such arrays are produced by the methods described by Brown et al., U.S. Pat. No. 5,807,522.

As defined herein, a "gene" is the segment of DNA involved in producing a polypeptide chain; it includes regions preceding and following the coding region, as well as intervening sequences (introns) between individual coding segments (exons).

As defined herein, "unique to" means a sequence that only occurs once in a genome.

#### DETAILED DESCRIPTION OF THE INVENTION

The invention is directed to isolated genomic polynucleotide fragments that encode human resistin and human syntaxin binding protein 2, which in a specific embodiment are the human resistin and human syntaxin binding protein 2 genes, as well as vectors and hosts containing these fragments and polynucleotide fragments hybridizing to noncoding regions, as well as antisense oligonucleotides to these fragments. The genomic polynucleotide fragments of the present invention may contain both sequences encoding resistin and syntaxin binding protein 2 and specifically may contain SEQ ID NO:3 and/or 4 or portions of SEQ ID NO:3 and/or 4.

The polynucleotides of the present invention may be in the form of RNA or in the form of DNA, which DNA includes

genomic DNA and synthetic DNA. The DNA may be double-stranded or single-stranded and if single stranded may be the coding strand or non-coding strand. The genes encoding human resistin and human syntaxin binding protein 2 are disposed in the chromosome 19 genomic clones of accession numbers AC008763, gi 13699420, last contig (nucleotides 141174-194036), and AC021153, gi 8570240, reverse complement of contig 17 (nucleotide. 77433-94571). A composite of these two contigs, corrected for overlapping sequence, is prepared to yield a 64,700 base pair sequence. In the latter composite, the resistin gene is disposed in nucleotides 1-38587 (SEQ ID NO:3). The syntaxin binding protein 2 gene is disposed in the last 30943 nucleotides (SEQ ID NO:4).

The polynucleotides of the invention are naturally occurring polynucleotide sequences having at least a 95% identity and may have a 96%, 97%, 98%, 99%, 99.5% or 99.9% identity to the polynucleotides depicted in SEQ ID NOS:3, 4 or 5 as well as the polynucleotides in reverse sense orientation, or the polynucleotide sequences encoding the human resistin and human syntaxin binding protein 2 polypeptides depicted in SEQ ID NOS:1 or 2 respectively.

The comparison of sequences and determination of percent identity and similarity between two sequences can be accomplished using a mathematical algorithm. (Lesk, A. M., ed., 1988, *Computational Molecular Biology*, Oxford University Press, New York; Smith, D. W., ed., 1993, *Biocomputing: Informatics and Genome Projects*, Academic Press, New York; Griffin, A. M., and Griffin, H. G., eds, 1994, *Computer Analysis of Sequence Data, Part 1*, Humana Press, New Jersey; von Heinje, G., 1987, *Sequence Analysis in Molecular Biology*, Academic Press; and Gribskov, M. and Devereux, J., eds., 1991, *Sequence Analysis Primer*, M Stockton Press, New York). In a preferred embodiment, the percent identity between two amino acid sequences is determined using the Needleman and Wunsch (1970, *J. Mol. Biol.* 48: 444-453) algorithm which has been incorporated into the GAP program in the GCG software package (available at [www.gcg.com](http://www.gcg.com)), using either a Blossum 62 matrix or a PAM250 matrix, and a gap weight of 16, 14, 12, 10, 8, 6, or 4 and a length weight of 1, 2, 3, 4, 5, or 6. In yet another preferred embodiment, the percent identity between two nucleotide sequences is determined using the GAP program in the GCG software package (Devereux et al., 1984, *Nucleic Acids Res.* 12: 387) (available at <http://www.gcg.com>), using a NWSgapdna.CMP matrix and a gap weight of 40, 50, 60, 70, or 80 and a length weight of 1, 2, 3, 4, 5, or 6. In another embodiment, the percent identity between two amino acid or nucleotide sequences is determined using the algorithm of Myers and Miller (1989, *CABIOS*, 4: 11-17) which has been incorporated into the ALIGN program (version 2.0), using a PAM 120 weight residue table, a gap length penalty of 12 and a gap penalty of 4.

The nucleic acid sequences of the present invention can further be used as a "query sequence" to perform a search against sequence databases to, for example, identify other family members or related sequences. Such searches can be performed using the BLASTN and BLASTX programs (version 2.0) of Altschul, et al. (1990, *J. Mol. Biol.* 215: 403-410). BLAST nucleotide searches can be performed with the BLASTN program, score=100, wordlength=12 to obtain nucleotide sequences homologous to the nucleic acid molecules of the invention. BLASTN protein searches can be performed with the BLASTX program, score=50, wordlength=3 to obtain amino acid sequences homologous to the proteins of the invention. To obtain gapped alignments for comparison purposes, Gapped BLASTN can be utilized as

described in Altschul et al. (1997, *Nucleic Acids Res.* 25: 3389-3402). When utilizing BLAST and gapped BLAST programs, the default parameters of the respective programs (e.g., BLASTX and BLASTN) can be used.

The invention also encompasses polynucleotides that hybridize to the polynucleotides depicted in SEQ ID NOS: 3, 4 and/or 5. This polynucleotide may have a maximum length of SEQ ID NOS: 3, 4 and/or 5. A polynucleotide "hybridizes" to another polynucleotide, when a single-stranded form of the polynucleotide can anneal to the other polynucleotide under the appropriate conditions of temperature and solution ionic strength (see Sambrook et al., *supra*). The conditions of temperature and ionic strength determine the "stringency" of the hybridization. For preliminary screening for homologous nucleic acids, low stringency hybridization conditions, corresponding to a temperature of 42° C., can be used, e.g., 5×SSC, 0.1% SDS, 0.25% milk, and no formamide; or 40% formamide, 5×SSC, 0.5% SDS). "Stringent hybridization conditions" can be found in *Current Protocols in Molecular Biology*, John Wiley & Sons, N.Y. (1989), 6.3.1-6.3.6. A preferred, non-limiting example of stringent hybridization conditions is hybridization in 6× sodium chloride/sodium citrate (SSC) at about 45° C., followed by one or more washes in 0.2×SSC, 0.1% SDS at 50° C., preferably at 55° C., and more preferably at 60° C. or 65° C.

Hybridization requires that the two nucleic acids contain complementary sequences, although depending on the stringency of the hybridization, mismatches between bases are possible. The appropriate stringency for hybridizing nucleic acids depends on the length of the nucleic acids and the degree of complementation, variables well known in the art. The greater the degree of similarity or complementarity between two nucleotide sequences, the greater the value of  $T_m$  for hybrids of nucleic acids having those sequences. The relative stability (corresponding to higher  $T_m$ ) of nucleic acid hybridizations decreases in the following order: RNA:RNA, DNA:RNA, DNA:DNA.

The invention is further directed to a nucleic acid construct comprising the nucleic acid molecules of the present invention. The nucleic acid sequence encoding the desired polypeptide, whether in fused or mature form, and whether or not containing a signal sequence to permit secretion, may be ligated into expression vectors suitable for any convenient host. The vector includes a plasmid, single or double stranded phage, a single or double stranded RNA or DNA viral vector, or artificial chromosome, such as a BAC, PAC, YAC, or MAC.

#### Polynucleotide and Polypeptide Variants

The invention is directed to both polynucleotide and polypeptide variants. A "variant" refers to a polynucleotide or polypeptide differing from the polynucleotide or polypeptide of the present invention, but retaining essential properties thereof. Generally, variants are overall closely similar and in many regions, identical to the polynucleotide or polypeptide of the present invention.

The variants may contain alterations in the coding regions, non-coding regions, or both. Especially preferred are polynucleotide variants containing alterations which produce silent substitutions, additions, or deletions, but do not alter the properties or activities of the encoded polypeptide. Nucleotide variants produced by silent substitutions due to the degeneracy of the genetic code are preferred. Moreover, variants in which 5-10, 1-5 or 1-2 amino acids are substituted, deleted, or added in any combination are also preferred.

The invention also encompasses allelic variants of said polynucleotides. An allelic variant denotes any of two or more alternative forms of a gene occupying the same chromosomal

locus. Allelic variation arises naturally through mutation, and may result in polymorphism within populations and is thought to frequently occur. Gene mutations can be silent (no change in the encoded polypeptide) or may encode polypeptides having altered amino acid sequences. An allelic variant has a high homology to the original gene sequence. An allelic variant of a polypeptide is a polypeptide encoded by an allelic variant of a gene.

The amino acid sequences of the variant polypeptides may differ from the amino acid sequences depicted in SEQ ID NOS:1 or 2 by an insertion or deletion of one or more amino acid residues and/or the substitution of one or more amino acid residues by different amino acid residues. Preferably, amino acid changes are of a minor nature, that is conservative amino acid substitutions that do not significantly affect the folding and/or activity of the protein; small deletions, typically of one to about 30 amino acids; small amino- or carboxyl-terminal extensions, such as an amino-terminal methionine residue; a small linker peptide of up to about 20-25 residues; or a small extension that facilitates purification by changing net charge or another function, such as a poly-histidine tract, an antigenic epitope or a binding domain.

Examples of conservative substitutions are within the group of basic amino acids (arginine, lysine and histidine), acidic amino acids (glutamic acid and aspartic acid), polar amino acids (glutamine and asparagine), hydrophobic amino acids (leucine, isoleucine and valine), aromatic amino acids (phenylalanine, tryptophan and tyrosine), and small amino acids (glycine, alanine, serine, threonine and methionine). Amino acid substitutions which do not generally alter the specific activity are known in the art and are described, for example, by H. Neurath and R. L. Hill, 1979, *In, The Proteins*, Academic Press, New York. The most commonly occurring exchanges are Ala/Ser, Val/Ile, Asp/Glu, Thr/Ser, Ala/Gly, Ala/Thr, Ser/Asn, Ala/Val, Ser/Gly, Tyr/Phe, Ala/Pro, Lys/Arg, Asp/Asn, Leu/Ile, Leu/Val, as well as these in reverse.

#### Noncoding Regions

The invention is further directed to polynucleotide fragments containing or hybridizing to noncoding regions of the human resistin and human syntaxin binding protein 2 genes. These include but are not limited to an intron, a 5'-non-coding region, a 3'-non-coding region (see Tables 1-2), as well as transcription factor binding sites (see Table 3).

The invention is further directed to polynucleotide fragments or nucleic acid molecules containing or hybridizing to contiguous exon/intron and intron/exon sequences of human resistin or human syntaxin binding protein 2 genes. These sequences encompass each splice site, where the intron is removed, the exon-intron junction and additionally includes the consensus sequence spanning the exon and intron sequences immediately adjacent to the splice site: The fragments are at least 20 nucleotides in length and in one embodiment contain at least 10 nucleotides of intron sequences. Thus, the invention would encompass a nucleic acid molecule that contains or hybridizes to a polynucleotide fragment that combines contiguous coding and noncoding nucleic acid sequences of SEQ ID NO:3 or 4. Further, the polynucleotide fragments of the present invention may contain more than one exon-intron and/or intron-exon regions.

The polynucleotide fragment may be a short polynucleotide fragment which is between about 8 nucleotides to about 20 or 40 nucleotides in length. Such shorter fragments may be useful for diagnostic purposes. Such short polynucleotide fragments are also preferred with respect to polynucleotides or nucleic acid molecules containing or hybridizing to polynucleotides or nucleic acid molecules containing noncoding

regions including but not limited to 5' and 3' noncoding region, intron regions, contiguous exon-intron and intron-exon regions. Alternatively larger fragments, e.g., of about 50, 60, 100, 150, 200, 300, 400, 500, 600, 750, 800, 900, 1000, 1,500, 2000, 3000, 4000, 5000 or about 10000 nucleotides in length may be used.

TABLE 1

Exon/Intron Organization of the Resistin Gene in Genomic SEQ ID NO:3 (Reverse Strand Coding).		
EXON	Nucleotide No.	Amino Acid No.
Stop Codon	19611-19613	
3	19614-19742	108-66
2	20063-20140	65-40
1	20517-20633	39-1

TABLE 2

Exon/Intron Organization of the Syntax in Binding Protein 2 Gene in Genomic SEQ ID NO:4 (Reverse Strand Coding).		
Exon	Nucleotide No.	Amino Acid No.
Stop Codon	8391-8393	
19	8394-8477	593-566
18	8691-8849	565-513
17	8956-9039	512-485
16	9857-9952	484-453
15	10895-11005	452-416
14	11450-11590	415-369
13	12959-13036	368-343
12	13153-13221	342-320
11	13378-13434	319-301
10	13667-13774	300-265
9	13870-13998	264-222
8	14083-14166	221-194
7	14347-14502	193-142
6	15204-15302	141-109
5	15393-15470	108-83
4	16394-16471	82-57
3	17102-17182	56-30
2	17426-17476	29-13
1	19016-19051	12-1

TABLE 3

NUMBERS OF TRANSCRIPTION FACTOR BINDING SITES ON GENES THAT ENCODE RESISTIN AND SYNTAXIN BINDING PROTEIN 2 (STXBP2).		
BINDING SITES	RESISTIN	STXBP2
AP1_C	6	2
AP4_Q5	3	4
AP4_Q6	3	4
CAAT_01	7	4
CREBP1CJUN_01	3	
CREB_01	2	
DELTAEF1_01	12	7
GATA_C		2
GC_01		2
GKLF_01	2	2
HFH3_01	2	
IK2_01	3	
LMO2COM_01	5	7
LMO2COM_02	3	4
LYF1_01	36	14
MYOD_Q6	17	11
MZF1_01	51	50
NFAT_Q6	3	
NKX25_01	30	14
NMYC_01		3
PADS_C	2	

TABLE 3-continued

NUMBERS OF TRANSCRIPTION FACTOR BINDING SITES ON GENES THAT ENCODE RESISTIN AND SYNTAXIN BINDING PROTEIN 2 (STXBP2).		
BINDING SITES	RESISTIN	STXBP2
S8_01		2
SOX5_01	5	6
SP1_Q6		3
SREBP1_01	2	
TCF11_01	17	7
USF_01	14	14
USF_C	18	14

In a specific embodiment, such noncoding sequences are expression control sequences. In a more specific embodiment of the invention, the expression control sequences may be operatively linked to a polynucleotide encoding a heterologous polypeptide. Such expression control sequences may be about 50-200 nucleotides in length and specifically about 50, 100, 200, 500, 600, 1000 or 2000 nucleotides in length. The invention is further directed to antisense oligonucleotides and mimetics to these polynucleotide sequences. Antisense technology can be used to control gene expression through triple-helix formation or antisense DNA or RNA, both of which methods are based on binding of a polynucleotide to DNA or RNA. For example, the 5' coding portion of the polynucleotide sequence, which encodes the mature polypeptides of the present invention, is used to design an antisense RNA oligonucleotide of from about 10 to 40 base pairs in length. A DNA oligonucleotide is designed to be complementary to a region of the gene involved in transcription or RNA processing (triple helix (see Lee et al., Nucl. Acids Res., 6: 3073 (1979); Cooney et al, Science, 241: 456 (1988); and Dervan et al., Science, 251: 1360 (1991)), thereby preventing transcription and the production of said polypeptides.

#### Expression of Polypeptides

##### Isolated Polynucleotide Sequences

The human chromosome 19 genomic clones of accession numbers AC008763, gi 13699420, last contig (nucleotides 141174-194036) and AC021153, gi 8570249, reverse complement of contig 17 (nucleotides 77433-94571) have been discovered to contain the human resistin and human syntaxin binding protein 2 genes by Genscan analysis (Burge et al., 1997, J. Mol. Biol. 268: 78-94), BLAST2 and TBLASTN analysis (Altschul et al., 1997, Nucl. Acids Res. 25: 3389-3402). The sequences of AC008763, gi 13699420, and AC021153, gi 8570249 are compared to the human resistin and syntaxin cDNA sequences, accession numbers AF352730 (resistin) and AF205952. It has been found that resistin is disposed immediately adjacent to the syntaxin binding protein 2 gene. A composite of these two contigs, corrected for overlapping sequence, is prepared to yield a 64,700 base pair sequence (SEQ ID NO:5). In the latter composite, the resistin gene is disposed in nucleotides 1-38587 (SEQ ID NO:3). The syntaxin binding protein 2 gene is disposed in the last 30943 nucleotides (SEQ ID NO:4).

The cloning of the nucleic acid sequences of the present invention from such genomic DNA can be effected, e.g., by using the well known polymerase chain reaction (PCR) or antibody screening of expression libraries to detect cloned DNA fragments with shared structural features. See, e.g., Innis et al., 1990, *PCR: A Guide to Methods and Application*, Academic Press, New York. Other nucleic acid amplification

procedures such as ligase chain reaction (LCR), ligated activated transcription (LAT) and nucleic acid sequence-based amplification (NASBA) or long range PCR may be used. In a specific embodiment, 5'- or 3'-non-coding portions of the gene may be identified by methods including but are not limited to, filter probing, clone enrichment using specific probes and protocols similar or identical to 5'- and 3'-"RACE" protocols which are well known in the art. For instance, a method similar to 5'-RACE is available for generating the missing 5'-end of a desired full-length transcript. (Fromont-Racine et al., 1993, Nucl. Acids Res. 21: 1683-1684).

Once the DNA fragments are generated, identification of the specific DNA fragment containing the desired human resistin and/or syntaxin gene may be accomplished in a number of ways. For example, if an amount of a portion of a human resistin or syntaxin gene or its specific RNA, or a fragment thereof, is available and can be purified and labeled, the generated DNA fragments may be screened by nucleic acid hybridization to the labeled probe (Benton and Davis, 1977, Science 196: 180; Grunstein and Hogness, 1975, Proc. Natl. Acad. Sci. U.S.A. 72: 3961). The present invention provides such nucleic acid probes, which can be conveniently prepared from the specific sequences disclosed herein, e.g., a hybridizable probe having a nucleotide sequence corresponding to at least a 10, and preferably a 15, nucleotide fragment of the sequences depicted in SEQ ID NO:2. Preferably, a fragment is selected that is unique to the polypeptides of the invention. Methods are commonly known in the art for preparing such unique sequences and are reviewed in Stoughton, 2005, Annu. Rev. Biochem. 74: 53-82. Those DNA fragments with substantial homology to the probe will hybridize. As noted above, the greater the degree of homology, the more stringent hybridization conditions can be used. In one embodiment, low stringency hybridization conditions are used to identify a homologous human resistin or syntaxin polynucleotide. However, in a preferred aspect, and as demonstrated experimentally herein, a nucleic acid encoding a polypeptide of the invention will hybridize to a nucleic acid derived from the polynucleotide sequence depicted in SEQ ID NO:2 or a hybridizable fragment thereof, under moderately stringent conditions; more preferably, it will hybridize under high stringency conditions.

Alternatively, the presence of the gene may be detected by assays based on the physical, chemical, or immunological properties of its expressed product. For example, cDNA clones, or DNA clones which hybrid-select the proper mRNAs, can be selected which produce a protein that, e.g., has similar or identical electrophoretic migration, isoelectric focusing behavior, proteolytic digestion maps, or antigenic properties as known for the human resistin or syntaxin polynucleotide.

A gene encoding human resistin or syntaxin polypeptide can also be identified by mRNA selection, i.e., by nucleic acid hybridization followed by in vitro translation. In this procedure, fragments are used to isolate complementary mRNAs by hybridization. Immunoprecipitation analysis or functional assays of the in vitro translation products of the products of the isolated mRNAs identifies the mRNA and, therefore, the complementary DNA fragments, that contain the desired sequences.

#### Nucleic Acid Constructs

The present invention also relates to nucleic acid constructs comprising a polynucleotide sequence containing the exon/ intron segments of the human resistin and/or syntaxin gene operably linked to one or more control sequences which

direct the expression of the coding sequence in a suitable host cell under conditions compatible with the control sequences. Expression will be understood to include any step involved in the production of the polypeptide including, but not limited to, transcription, post-transcriptional modification, translation, post-translational modification, and secretion.

"Nucleic acid construct" is defined herein as a nucleic acid molecule, either single- or double-stranded, which is isolated from a naturally occurring gene or which has been modified to contain segments of nucleic acid which are combined and juxtaposed in a manner which would not otherwise exist in nature. The term nucleic acid construct is synonymous with the term expression cassette when the nucleic acid construct contains all the control sequences required for expression of a coding sequence of the present invention. The term "coding sequence" is defined herein as a portion of a nucleic acid sequence which directly specifies the amino acid sequence of its protein product. The boundaries of the coding sequence are generally determined by a ribosome binding site (prokaryotes) or by the ATG start codon (eukaryotes) and a transcription terminator sequence located just downstream of the open reading frame at the 3'-end of the mRNA. A coding sequence can include, but is not limited to, DNA, cDNA, and recombinant nucleic acid sequences.

The isolated polynucleotide of the present invention may be manipulated in a variety of ways to provide for expression of the polypeptide. Manipulation of the nucleic acid sequence prior to its insertion into a vector may be desirable or necessary depending on the expression vector. The techniques for modifying nucleic acid sequences utilizing recombinant DNA methods are well known in the art.

The control sequence may be an appropriate promoter sequence, a nucleic acid sequence which is recognized by a host cell for expression of the nucleic acid sequence. The promoter sequence contains transcriptional control sequences that regulate the expression of the polynucleotide. The promoter may be any nucleic acid sequence that shows transcriptional activity in the host cell of choice including mutant, truncated, and hybrid promoters, and may be obtained from genes encoding extracellular or intracellular polypeptides either homologous or heterologous to the host cell.

The control sequence may also be a suitable transcription terminator sequence, a sequence recognized by a host cell to terminate transcription. The terminator sequence is operably linked to the 3'-terminus of the nucleic acid sequence encoding the polypeptide. Any terminator which is functional in the host cell of choice may be used in the present invention.

The control sequence may also be a suitable leader sequence, a nontranslated region of an mRNA which is important for translation by the host cell. The leader sequence is operably linked to the 5'-terminus of the nucleic acid sequence encoding the polypeptide. Any leader sequence that is functional in the host cell of choice may be used in the present invention.

The control sequence may also be a polyadenylation sequence, a sequence which is operably linked to the 3'-terminus of the nucleic acid sequence and which, when transcribed, is recognized by the host cell as a signal to add polyadenosine residues to transcribed mRNA. Any polyadenylation sequence which is functional in the host cell of choice may be used in the present invention.

The control sequence may also be a signal peptide coding region, which codes for an amino acid sequence linked to the amino terminus of the polypeptide which can direct the encoded polypeptide into the cell's secretory pathway. The 5'-end of the coding sequence of the nucleic acid sequence

may inherently contain a signal peptide-coding region naturally linked in translation reading frame with the segment of the coding region which encodes the secreted polypeptide. Alternatively, the 5'-end of the coding sequence may contain a signal peptide coding region which is foreign to the coding sequence. The foreign signal peptide-coding region may be required where the coding sequence does not normally contain a signal peptide-coding region. Alternatively, the foreign signal peptide-coding region may simply replace the natural signal peptide-coding region in order to obtain enhanced secretion of the polypeptide. However, any signal peptide-coding region which directs the expressed polypeptide into the secretory pathway of a host cell of choice may be used in the present invention.

The control sequence may also be a propeptide coding region, which codes for an amino acid sequence positioned at the amino terminus of a polypeptide. The resultant polypeptide is known as a proenzyme or propolypeptide (or a zymogen in some cases). A propolypeptide is generally inactive and can be converted to a mature active polypeptide by catalytic or autocatalytic cleavage of the propeptide from the propolypeptide. The propeptide coding region may be obtained from the *Bacillus subtilis* alkaline protease gene (*aprE*), the *Bacillus subtilis* neutral protease gene (*npr7*), the *Saccharomyces cerevisiae* alpha-factor gene, the *Rhizomucor miehei* aspartic proteinase gene, or the *Myceliophthora thermophila* laccase gene (WO 95/33836).

Where both signal peptide and propeptide regions are present at the amino terminus of a polypeptide, the propeptide region is positioned next to the amino terminus of a polypeptide and the signal peptide region is positioned next to the amino terminus of the propeptide region.

It may also be desirable to add regulatory sequences which allow the regulation of the expression of the polypeptide relative to the growth of the host cell. Examples of regulatory systems are those which cause the expression of the gene to be turned on or off in response to a chemical or physical stimulus, including the presence of a regulatory compound. Regulatory systems in prokaryotic systems would include the *lac*, *tac*, and *trp* operator systems. In yeast, the ADH2 system or GAL1 system may be used. In filamentous fungi, the TAKA alpha-amylase promoter, *Aspergillus niger* glucoamylase promoter, and the *Aspergillus oryzae* glucoamylase promoter may be used as regulatory sequences. Other examples of regulatory sequences are those which allow for gene amplification. In eukaryotic systems, these include the dihydrofolate reductase gene which is amplified in the presence of methotrexate, and the metallothionein genes which are amplified with heavy metals. In these cases, the nucleic acid sequence encoding the polypeptide would be operably linked with the regulatory sequence.

#### Expression Vectors

Both eukaryotic and prokaryotic host systems are presently used in forming recombinant polypeptides. The polypeptide is then isolated from lysed cells or from the culture medium and purified to the extent needed for its intended use. Purification may be by techniques known in the art, for example, differential extraction, salt fractionation, chromatography on ion exchange resins, affinity chromatography, centrifugation, and the like. See, for example, *Methods in Enzymology* for a variety of methods for purifying proteins. Both prokaryotic and eukaryotic host cells may be used for expression of desired coding sequences when appropriate control sequences, which are compatible with the designated host, are used. Bacterial cells include, but are not limited to, *E. coli*, *Streptomyces*, and *Salmonella typhimurium*. Expression con-

rol sequences for prokaryotes include promoters, optionally containing operator portions, and ribosome binding sites. Transfer vectors compatible with prokaryotic hosts are commonly derived from, for example, pBR322, a plasmid containing operons conferring ampicillin and tetracycline resistance, and the various pUC vectors, which also contain sequences conferring antibiotic resistance markers. These markers may be used to obtain successful transformants by selection. Commonly used prokaryotic control sequences include the Beta-lactamase (penicillinase) and lactose promoter systems, the tryptophan (*trp*) promoter system and the lambda-derived  $P_L$  promoter and N gene ribosome binding site and the hybrid TAC promoter derived from sequences of the *trp* and *lac UV5* promoters. The foregoing systems are particularly compatible with *E. coli*; if desired, other prokaryotic hosts such as strains of *Bacillus* or *Pseudomonas* may be used, with corresponding control sequences.

Eukaryotic cells include, but are not limited to, yeast, insect cells such as *Drosophila*, animal cells such as COS and CHO cells, and plant cells. *Saccharomyces cerevisiae* and *Saccharomyces carlsbergensis* are the most commonly used yeast hosts, and are convenient fungal hosts. Yeast compatible vectors carry markers that permit selection of successful transformants by conferring prototrophy to auxotrophic mutants or resistance to heavy metals on wild-type strains. Yeast compatible vectors may employ the 2 micron origin of replication, the combination of CEN3 and ARS1 or other means for assuring replication, such as sequences which will result in incorporation of an appropriate fragment into the host cell genome. Examples of vectors for expression in yeast e.g., *S. cerevisiae* include pYepSec1 (Baldari, et al., 1987, EMBO J. 6: 229-234; pMFa (Kuijan et al., 1982, Cell 30: 933-943), pJRY88 (Schultz et al., 1987, Gene 54: 113-123), and pYES2 (Invitrogen Corporation, San Diego, Calif.). The nucleic acid molecules can also be expressed in insect cells using, for example, baculovirus expression vectors. Baculovirus vectors available for expression of proteins in cultured insect cells (e.g., Sf 9 cells) include the pAc series (Smith et al., 1983, Mol. Cell. Biol. 3: 2156-2165) and the pVL series (Lucklow et al., 1989, Virology 170: 31-39).

Mammalian cell lines available as hosts for expression are known in the art and include many immortalized cell lines available from the American Type Culture Collection (ATCC), including HeLa cells, Chinese hamster ovary (CHO) cells, baby hamster kidney (BHK) cells, and a number of other cell lines. Suitable promoters for mammalian cells are also known in the art and include viral promoters such as that from Simian Virus 40 (SV40), Rous sarcoma virus (RSV), adenovirus (ADV), and bovine papilloma virus (BPV). Mammalian cells may also require terminator sequences and poly A addition sequences; enhancer sequences which increase expression may also be included, and sequences which cause amplification of the gene may also be desirable. These sequences are known in the art.

It will be understood that not all vectors, expression control sequences and hosts will function equally well to express the polynucleotide sequences of this invention. Neither will all hosts function equally well with the same expression system. However, one skilled in the art will be able to select the proper vectors, expression control sequences, and hosts without undue experimentation to accomplish the desired expression without departing from the scope of this invention. For example, in selecting a vector, the host must be considered because the vector must function in it. The vector's copy number, the ability to control that copy number, and the expression of any other proteins encoded by the vector, such as antibiotic markers, will also be considered.

In selecting an expression control sequence, a variety of factors will normally be considered. These include, for example, the relative strength of the system, its controllability, and its compatibility with the particular DNA sequence or gene to be expressed, particularly as regards potential secondary structures. Suitable unicellular hosts will be selected by consideration of, e.g., their compatibility with the chosen vector, their secretion characteristics, their ability to fold proteins correctly, and their fermentation requirements, as well as the toxicity to the host of the product encoded by the DNA sequences to be expressed, and the ease of purification of the expression products.

Considering these and other factors a person skilled in the art will be able to construct a variety of vector/expression control sequence/host combinations that will express the nucleic acid molecules of this invention on fermentation or in large scale animal culture.

The polypeptides may be detected using methods known in the art that are specific for the polypeptides. These detection methods may include use of specific antibodies, formation of an enzyme product, or disappearance of an enzyme substrate. An enzyme assay may be used to determine the activity of the polypeptide. Resistin can be determined using the immunoassay procedure described by Steppan et al., *Nature* 409: 307-12, 2001. The human syntaxin binding protein 2 may be detected by its ability to bind to syntaxins 1A, 2 and 3 but not to syntaxin 4 (Katagiri et al., *J. Biol. Chem.* 270: 4963-6, 1995).

#### Antibodies

According to the invention, the human resistin or human syntaxin binding protein 2 polypeptides produced according to the method of the present invention may be used as an immunogen to generate any of these antibodies. Such antibodies include but are not limited to polyclonal, monoclonal, chimeric, single chain, Fab fragments, and a Fab expression library.

Various hosts may be used and include but are not limited to goats, rabbits, rats, mice, humans, and others. These hosts may be immunized by injection with the polypeptides of the present invention or any fragment or oligopeptide thereof which has immunogenic properties (e.g., 5-10 peptide fragments with immunogenic properties). Various adjuvants may be used to increase immunological response. Such adjuvants include, but are not limited to, Freund's, mineral gels such as aluminum hydroxide, and surface active substances such as lysolecithin, pluronic polyols, polyanions, peptides, oil emulsions, keyhole limpet hemocyanin, and dinitrophenol. BCG (*Bacillus Calmette-Guerin*) and *Corynebacterium parvum* are especially preferable in humans.

Monoclonal antibodies to the said polypeptides and peptides of the present invention may be prepared using any technique which provides for the production of antibody molecules by continuous cell lines in culture. These include, but are not limited to, the hybridoma technique, the human B-cell hybridoma technique, and the EBV-hybridoma technique. See, e.g., Kohler, et al., 1975, *Nature*, 256: 495-497; Kozbor et al., 1985, *J. Immunol. Methods* 81: 31-42; Cote et al., 1983, *Proc. Natl. Acad. Sci. USA* 80: 2026-2030; Cole et al., 1984, *Mol. Cell. Biol.* 62: 109-120.

Various immunoassays may be used for screening to identify antibodies having the desired specificity. Numerous protocols for competitive binding or immunoradiometric assays using either polyclonal or monoclonal antibodies with established specificities are well known in the art. Such immunoas-

says typically involve the measurement of complex formation between the polypeptide(s) of the present invention and its specific antibody.

Antibodies may be conjugated to a solid support suitable for a diagnostic assay (e.g., beads, plates, slides or wells formed from materials such as latex or polystyrene) in accordance with known techniques, such as precipitation. Antibodies may likewise be conjugated to detectable groups such as radiolabels (e.g. <sup>35</sup>S, <sup>125</sup>I, <sup>131</sup>I), enzyme labels (e.g., horseradish peroxidase, alkaline phosphatase), and fluorescent labels (e.g., fluorescein) in accordance with known techniques.

#### Microarrays and Kits

The microarray generally contains a large number of single-stranded nucleic acid sequences, fixed to a solid support, wherein at least one of which is a nucleic acid hybridizing to at least one 20 (and/or larger) nucleotide fragment unique to a (forward or reverse strand) noncoding region of SEQ ID NO:3 or 4. The fragment may hybridize to the coding and noncoding region. Alternatively larger fragments, e.g., of about 50, 70, 75, 150, 500, 600, 750, 800, 850, 900 or about 950 nucleotides in length may be used. In yet another embodiment, BAC or YAC arrays may be used containing full length cDNA or genomic sequences. The kit may also comprise coding sequences of SEQ ID NO: 3 or 4.

In order to produce oligonucleotides to a known sequence for a microarray or detection kit, the nucleic acid of interest is typically examined using a computer algorithm which starts at the 5' or at the 3' end of the nucleotide sequence. Typical algorithms will then identify oligomers of defined length that are unique to said nucleic acid, have a GC content within a range suitable for hybridization, and lack predicted secondary structure that may interfere with hybridization. In certain situations it may be appropriate to use pairs of oligonucleotides on a microarray or detection kit. The "pairs" will be identical, except for one nucleotide that preferably is located in the center of the sequence. The second oligonucleotide in the pair (mismatched by one) serves as a control. The number of oligonucleotide pairs may range from two to one million. The oligomers may be synthesized at designated areas on a solid support using a light-directed chemical process or prepared elsewhere and then deposited on the solid support. The solid support may be paper, nylon or other type of membrane, filter, chip, glass slide or any other suitable solid support.

The microarrays of the present invention may be used to identify nucleic acids encoding resistin and/or syntaxin.

In another embodiment, the invention is directed to a kit comprising at least one nucleic acid comprising at least 20 nucleotides hybridizing under stringent conditions to a non-coding region of the nucleic acid of the present invention. The kit may also comprise a polynucleotide fragment encompassing the coding region of resistin or syntaxin. In a more specific embodiment, the kit comprises a probe or primer comprising 50, 70, 75, 150, 500, 600, 750, 800, 850, 900 or about 950 nucleotides in length may be used. In yet another embodiment, BAC, PAC or YAC arrays may be used containing full length genomic sequences. The nucleic acid may act as a probe or primer and may be labeled with a detectable label. The detectable label may, for example, be a radioactive label, fluorescer, antibody or enzyme. The kit may further comprise the label. Alternatively, the kit may comprise a microarray. The probes or primers of the present invention may act as a primer to synthesize further nucleic acid probes.

Conditions for incubating a nucleic acid molecule with a test sample vary. Incubation conditions depend on the format employed in the assay, the detection methods employed, and

the type and nature of the nucleic acid molecule used in the assay. One skilled in the art will recognize that any one of the commonly available hybridization, amplification or array assay formats can readily be adapted to employ the novel fragments disclosed herein. Examples of such assays can be found in Chard, 1986, *An Introduction to Radioimmunoassay and Related Techniques*, Elsevier Science Publishers, Amsterdam, The Netherlands; Bullock, G. R. et al., *Techniques in Immunocytochemistry*, Academic Press, Orlando, Fla. Vol. 1 (1982), Vol. 2 (1983), Vol. 3 (1985); Tinsel, Practice and Theory of Enzyme Immunoassays: Laboratory Techniques in Biochemistry and Molecular Biology, Elsevier Science Publishers, Amsterdam, The Netherlands (1985).

#### Therapeutic Uses

##### Antisense Oligonucleotides and Mimetics

The invention is further directed to antisense oligonucleotides and mimetics to these polynucleotide sequences. Antisense technology can be used to control gene expression through triple-helix formation or antisense DNA or RNA, both of which methods are based on binding of a polynucleotide to DNA or RNA. For example, the 5' coding portion of the polynucleotide sequence, which encodes the mature polypeptides of the present invention, is used to design an antisense RNA oligonucleotide of from about 10 to 40 base pairs in length. A DNA oligonucleotide is designed to be complementary to a region of the gene involved in transcription or RNA processing (triple helix (see Lee et al., *Nucl. Acids Res.*, 6: 3073 (1979); Cooney et al, *Science*, 241: 456 (1988); and Dervan et al., *Science*, 251: 1360 (1991)), thereby preventing transcription and the production of said polypeptides. As defined herein, a "mimetic" is an oligonucleotide having non-naturally occurring portions which function similarly to naturally occurring oligonucleotides and may include peptide-nucleic acids (PNAs). Modifications may occur at the phosphate linkage (e.g., methylphosphonates, phosphothioates) or sugar linkage, cyclobutyl moieties in place of the pentofuranosyl sugar or at the purine or pyrimidine bases themselves as described in US 2004/0214325.

The antisense oligonucleotides or mimetics of the present invention may be used to decrease levels of a polypeptide. For example, human resistin inhibits actions of insulin. Therefore, the human resistin antisense oligonucleotides of the present invention could be used to treat insulin-resistant forms of type 2 diabetes. Human syntaxin binding protein 2 plays a role in vesicle trafficking, thus its antisense sequences may be used to treat endocrine tumors such as insulinomas from which hormones such as insulin are secreted in health-threatening excess.

The antisense oligonucleotides of the present invention may be formulated into pharmaceutical compositions. These compositions may be administered in a number of ways depending upon whether local or systemic treatment is desired and upon the area to be treated. Administration may be topical (including ophthalmic and to mucous membranes including vaginal and rectal delivery), pulmonary, e.g., by inhalation or insufflation of powders or aerosols, including by nebulizer; intratracheal, intranasal, epidermal and transdermal), oral or parenteral. Parenteral administration includes intravenous, intraarterial, subcutaneous, intraperitoneal or intramuscular injection or infusion; or intracranial, e.g., intrathecal or intraventricular, administration.

Pharmaceutical compositions and formulations for topical administration may include transdermal patches, ointments, lotions, creams, gels, drops, suppositories, sprays, liquids and

powders. Conventional pharmaceutical carriers, aqueous, powder or oily bases, thickeners and the like may be necessary or desirable.

Compositions and formulations for oral administration include powders or granules, suspensions or solutions in water or non-aqueous media, capsules, sachets or tablets. Thickeners, flavoring agents, diluents, emulsifiers, dispersing aids or binders may be desirable.

Compositions and formulations for parenteral, intrathecal or intraventricular administration may include sterile aqueous solutions that may also contain buffers, diluents and other suitable additives such as, but not limited to, penetration enhancers, carrier compounds and other pharmaceutically acceptable carriers or excipients.

Pharmaceutical compositions of the present invention include, but are not limited to, solutions, emulsions, and liposome-containing formulations. These compositions may be generated from a variety of components that include, but are not limited to, preformed liquids, self-emulsifying solids and self-emulsifying semisolids.

The pharmaceutical formulations of the present invention, which may conveniently be presented in unit dosage form, may be prepared according to conventional techniques well known in the pharmaceutical industry. Such techniques include the step of bringing into association the active ingredients with the pharmaceutical carrier(s) or excipient(s). In general, the formulations are prepared by uniformly and intimately bringing into association the active ingredients with liquid carriers or finely divided solid carriers or both, and then, if necessary, shaping the product.

The compositions of the present invention may be formulated into any of many possible dosage forms such as, but not limited to, tablets, capsules, liquid syrups, soft gels, suppositories, and enemas. The compositions of the present invention may also be formulated as suspensions in aqueous, non-aqueous or mixed media. Aqueous suspensions may further contain substances that increase the viscosity of the suspension including, for example, sodium carboxymethylcellulose, sorbitol and/or dextran. The suspension may also contain stabilizers.

In one embodiment of the present invention, the pharmaceutical compositions may be formulated and used as foams. Pharmaceutical foams include formulations such as, but not limited to, emulsions, microemulsions, creams, jellies and liposomes. While basically similar in nature these formulations vary in the components and the consistency of the final product. The preparation of such compositions and formulations is generally known to those skilled in the pharmaceutical and formulation arts and may be applied to the formulation of the compositions of the present invention.

The formulation of therapeutic compositions and their subsequent administration is believed to be within the skill of those in the art. Dosing is dependent on severity and responsiveness of the disease state to be treated, with the course of treatment lasting from several days to several months, or until a cure is effected or a diminution of the disease state is achieved. Optimal dosing schedules can be calculated from measurements of drug accumulation in the body of the patient. Persons of ordinary skill can easily determine optimum dosages, dosing methodologies and repetition rates. Optimum dosages may vary depending on the relative potency of individual oligonucleotides, and can generally be estimated based on EC<sub>50</sub> as found to be effective in *in vitro* and *in vivo* animal models.

In general, dosage is from 0.01  $\mu$ g to 10 g per kg of body weight, and may be given once or more daily, weekly, monthly or yearly, or even once every 2 to 20 years. Persons

of ordinary skill in the art can easily estimate repetition rates for dosing based on measured residence times and concentrations of the drug in bodily fluids or tissues. Following successful treatment, it may be desirable to have the patient undergo maintenance therapy to prevent the recurrence of the disease state, wherein the oligonucleotide is administered in maintenance doses, ranging from 0.01 ug to 10 g per kg of body weight, once or more daily, to once every 20 years.

#### Gene Therapy

As noted above, human resistin inhibits actions of insulin, and human syntaxin binding protein 2 plays a role in secretory vesicle trafficking. Therefore, the human resistin gene may be used to modulate conditions in which insulin is secreted in excess, as in functional insulinomas. The human syntaxin binding protein 2 gene may be used to stimulate secretory vesicle release from hypofunctional endocrine tissues such as the pancreas islet cells in juvenile diabetes.

As described herein, the polynucleotide of the present invention may be introduced into a patient's cells for therapeutic uses. As will be discussed in further detail below, cells can be transfected using any appropriate means, including viral vectors, as shown by the example, chemical transfectants, or physico-mechanical methods such as electroporation and direct diffusion of DNA. See, for example, Wolff, Jon A, et al., "Direct gene transfer into mouse muscle in vivo," *Science*, 247, 1465-1468, 1990; and Wolff, Jon A, "Human dystrophin expression in mdx mice after intramuscular injection of DNA constructs," *Nature*, 352, 815-818, 1991. As used herein, vectors are agents that transport the gene into the cell without degradation and include a promoter yielding expression of the gene in the cells into which it is delivered. As will be (1) (2) discussed in further detail below, promoters can be general promoters, yielding expression in a variety of mammalian cells, or cell specific, or even nuclear versus cytoplasmic specific. These are known to those skilled in the art and can be constructed using standard molecular biology protocols. Vectors have been divided into two classes: a) Biological agents derived from viral, bacterial or other sources; b) Chemical physical methods that increase the potential for gene uptake, directly introduce the gene into the nucleus or target the gene to a cell receptor.

#### Biological Vectors

Viral vectors have higher transaction (ability to introduce genes) abilities than do most chemical or physical methods to introduce genes into cells. Vectors that may be used in the present invention include viruses, such as adenoviruses, adeno associated virus (AAV), vaccinia, herpesviruses, baculoviruses and retroviruses, bacteriophages, cosmids, plasmids, fungal vectors and other recombination vehicles typically used in the art which have been described for expression in a variety of eukaryotic and prokaryotic hosts, and may be used for gene therapy as well as for simple protein expression. Polynucleotides are inserted into vector genomes using methods well known in the art.

Retroviral vectors are the vectors most commonly used in clinical trials, since they carry a larger genetic payload than other viral vectors. However, they are not useful in non-proliferating cells. Adenovirus vectors are relatively stable and easy to work with, have high titers, and can be delivered in aerosol formulation. Pox viral vectors are large and have several sites for inserting genes, they are thermostable and can be stored at room temperature.

Examples of promoters are SP6, T4, T7, SV40 early promoter, cytomegalovirus (CMV) promoter, mouse mammary tumor virus (MMTV) steroid-inducible promoter, Moloney murine leukemia virus (MMLV) promoter, phosphoglycerate

kinase (PGK) promoter, and the like. Alternatively, the promoter may be an endogenous adenovirus promoter, for example the EI a promoter or the Ad2 major late promoter (MLP). Similarly, those of ordinary skill in the art can construct adenoviral vectors utilizing endogenous or heterologous poly A addition signals.

Plasmids are not integrated into the genome and the vast majority of them are present only from a few weeks to several months, so they are typically very safe. However, they have lower expression levels than retroviruses and since cells have the ability to identify and eventually shut down foreign gene expression, the continuous release of DNA from the polymer to the target cells substantially increases the duration of functional expression while maintaining the benefit of the safety associated with non-viral transfections.

#### Chemical/Physical Vectors

Other methods to directly introduce genes into cells or exploit receptors on the surface of cells include the use of liposomes and lipids, ligands for specific cell surface receptors, cell receptors, and calcium phosphate and other chemical mediators, microinjections directly to single cells, electroporation and homologous recombination. Liposomes are commercially available from Gibco BRL, for example, as LIPOFECTIN and LIPOFECTACE, which are formed of cationic lipids such as N-[1-(2,3 dioleyloxy)-propyl]-n,n,n-trimethylammonium chloride (DOTMA) and dimethyl dioctadecylammonium bromide (DDAB). Numerous methods are also published for making liposomes, known to those skilled in the art.

For example, Nucleic acid-Lipid Complexes—Lipid carriers can be associated with naked nucleic acids (e.g., plasmid DNA) to facilitate passage through cellular membranes. Cationic, anionic, or neutral lipids can be used for this purpose. However, cationic lipids are preferred because they have been shown to associate better with DNA that, generally, has a negative charge. Cationic lipids have also been shown to mediate intracellular delivery of plasmid DNA (Feigner and Ringold, *Nature* 337: 387 (1989)). Intravenous injection of cationic lipid-plasmid complexes into mice has been shown to result in expression of the DNA in lung (Brigham et al., *Am. J. Med. Sci.* 298: 278 (1989)). See also, Osaka et al., *J. Pharm. Sci.* 85(6): 612-618 (1996); San et al., *Human Gene Therapy* 4: 781-788 (1993); Senior et al., *Biochimica et Biophysica Acta* 1070: 173-179 (1991); Kabanov and Kabanov, *Bioconjugate Chem.* 6: 7-20 (1995); Remy et al., *Bioconjugate Chem.* 5: 647-654 (1994); Behr, J-P., *Bioconjugate Chem* 5: 382-389 (1994); Behr et al., *Proc. Natl. Acad. Sci., USA* 86: 6982-6986 (1989); and Wyman et al., *Biochem.* 36: 3008-3017 (1997).

Cationic lipids are known to those of ordinary skill in the art. Representative cationic lipids include those disclosed, for example, in U.S. Pat. No. 5,283,185; and e.g., U.S. Pat. No. 5,767,099. In a preferred embodiment, the cationic lipid is N.sup.4-spermine cholesteryl carbamate (GL-67) disclosed in U.S. Pat. No. 5,767,099. Additional preferred lipids include N4-spermidine cholesteryl carbamate (GL-53) and 1-(N4-spermidine)-2,3-dilauryl glycerol carbamate (GL-89).

The vectors of the invention may be targeted to specific cells by linking a targeting molecule to the vector. A targeting molecule is any agent that is specific for a cell or tissue type of interest, including for example, a ligand, antibody, sugar, receptor, or other binding molecule.

Invention vectors may be delivered to the target cells in a suitable composition, either alone, or complexed, as provided above, comprising the vector and a suitably acceptable carrier. The vector may be delivered to target cells by methods

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known in the art, for example, intravenous, intramuscular, intranasal, subcutaneous, intubation, lavage, and the like. The vectors may be delivered via in vivo or ex vivo applications. In vivo applications involve the direct administration of an adenoviral vector of the invention formulated into a composition to the cells of an individual. Ex vivo applications involve the transfer of the adenoviral vector directly to harvested autologous cells which are maintained in vitro, followed by readministration of the transduced cells to a recipient.

In a specific embodiment, the vector is transfected into antigen-presenting cells. Suitable sources of antigen-presenting cells (APCs) include, but are not limited to, whole cells such as dendritic cells or macrophages; purified MHC class I molecule complexed to beta2-microglobulin and foster antigen-presenting cells. In a specific embodiment, the vectors of

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the present invention may be introduced into T cells or B cells using methods known in the art (see, for example, Tsokos and Nepom, 2000, J. Clin. Invest. 106: 181-183).

The invention described and claimed herein is not to be limited in scope by the specific embodiments herein disclosed, since these embodiments are intended as illustrations of several aspects of the invention. Any equivalent embodiments are intended to be within the scope of this invention. Indeed, various modifications of the invention in addition to those shown and described herein will become apparent to those skilled in the art from the foregoing description. Such modifications are also intended to fall within the scope of the appended claims.

Various references are cited herein, the disclosures of which are incorporated by reference in their entireties.

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What is claimed is:

1. An isolated genomic nucleic acid molecule, said nucleic acid molecule selected from the group consisting of:

(a) a nucleic acid molecule consisting of a nucleic acid sequence which has at least 99% identity to the nucleic acid molecule of SEQ ID NO: 3 and which encodes a polypeptide having the amino acid sequence of SEQ ID NO: 1, wherein said polypeptide inhibits the action of insulin;

(b) a fragment of the nucleic acid molecule of (a), said fragment comprising at least nucleotides 19611-20633 of SEQ ID NO: 3 and which encodes a polypeptide having the amino acid sequence of SEQ ID NO: 1, wherein said polypeptide inhibits the action of insulin, and;

(c) a nucleic acid molecule that is the full complement of the nucleic acid molecule of (a) or (b).

2. A nucleic acid construct comprising the nucleic acid molecule of claim 1.

3. An expression vector comprising the nucleic acid molecule of claim 1.

4. An isolated recombinant host cell comprising the nucleic acid molecule of claim 1.

5. A method for obtaining a polypeptide which inhibits insulin activity, said method comprising:

(a) culturing the recombinant host cell of claim 4 under conditions that provide for the expression of said polypeptide and

(b) recovering said expressed polypeptide.

6. A composition comprising the nucleic acid molecule of claim 1 and a carrier.

7. A kit comprising the nucleic acid molecule of claim 1.

8. The kit according to claim 7, in which the nucleic acid molecule is labeled with a detectable substance.

9. A microarray comprising one or more of the nucleic acid molecules of claim 1.

10. A kit comprising the microarray of claim 9.

11. A method of detecting the presence of a nucleic acid sequence of SEQ ID NO: 3, its complementary sequence or fragment thereof in a sample, said method comprising contacting the sample with the nucleic acid molecule of claim 1 and determining whether the nucleic acid molecule binds to said nucleic acid sequence in the sample.

12. A method of identifying a nucleotide sequence variant of the 5'-noncoding region, 3'-noncoding region or intron region of SEQ ID NO: 3 or its complementary sequence comprising:

(a) isolating genomic DNA from a subject and

(b) determining the presence or absence of a nucleotide sequence variation in said genomic DNA by comparing the nucleotide sequence of SEQ ID NO: 3 with the nucleotide sequence of the isolated genomic DNA and establishing if and where a difference occurs between the two nucleic acid sequences thereby identifying a nucleotide sequence variant of SEQ ID NO: 3, or its complement.

13. The method according to claim 12, wherein said variant encodes a protein that inhibits the action of insulin.

14. An isolated nucleic acid molecule consisting of a non-coding region of the nucleic acid molecule of claim 1, which non-coding region is selected from the group consisting of the 5'-noncoding region shown in sequence segment 20633-38587 of SEQ ID NO:3, the 3'-non coding region shown in sequence segment 1-19610 of SEQ ID NO:3 and the intron region shown in sequence segments 20141-20516 and 19743-20062 of SEQ ID NO:3, or a full complement of said isolated nucleic acid molecule.

15. An isolated nucleic acid molecule consisting of a fragment of the nucleic acid molecule of claim 1, said nucleic acid molecule consisting of a nucleic acid sequence selected from the group consisting of:

(a) a sequence of at least 4000 contiguous nucleotides within a region consisting of the sequence of nucleotides from position 20634-38587 of SEQ ID NO:3 and

(b) a sequence of a least 600 contiguous nucleotides with the region consisting of the sequence of nucleotides from position 1-19610 of SEQ ID NO:3.

16. An isolated nucleic acid molecule consisting of 20-300 contiguous nucleotides in sequence segments of a non-coding region of the nucleic acid molecule of claim 1, which non-coding region is selected from the group consisting of the 5'-noncoding region shown in sequence segment 20633-38587 of SEQ ID NO:3, the 3'-non coding region shown in sequence segment 1-19610 of SEQ ID NO:3 and the intron region shown in sequence segments 20141-20516 and 19743-20062 of SEQ ID NO:3, or a full complement of said isolated nucleic acid molecule.

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