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(72) Inventeurs/Inventors:
NABESHIMA, YOUICHI, JP;
KUROO, MAKOTO, US;
SEKINE, SUSUMU, JP; ...

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(54) Title: NOVEL PEPTIDE, NOVEL DNA, AND NOVEL ANTIBODY

(57) **Abrégé/Abstract:**

The present invention relates to a polypeptide having an activity of suppressing aging; DNA encoding the polypeptide; a method for improving livestock, using the DNA; a recombinant DNA prepared by inserting the DNA into a vector; a transformant harboring the recombinant; a method for preparing the polypeptide of the present invention, using the transformant; an antibody which recognizes the polypeptide; a ligand for the polypeptide of the present invention; a compound inhibiting specific binding between the polypeptide and ligand of the present invention; a compound enhancing the expression of an aging-suppressing gene encoding the aging-suppressing polypeptide of the present invention; an oligonucleotide comprising a sequence of 10 to 50 nucleotides in the nucleotide sequence of the DNA; and a therapeutic agent for a syndrome resembling premature aging, a therapeutic agent for adult diseases or an aging-suppressing agent, using the same.



(72) Inventeurs(suite)/Inventors(continued): IIDA, AKIHIRO, JP

(73) Propriétaires(suite)/Owners(continued):

SHIRANKAI KYOTO UNIVERSITY FACULTY OF MEDICINE ALUMNI ASSOCIATION INC., JP

(74) Agent: GOUDREAU GAGE DUBUC

ABSTRACT

The present invention relates to a polypeptide having an activity of suppressing aging; DNA encoding the polypeptide; a method for improving livestock, using the DNA; a recombinant DNA prepared by inserting the DNA into a vector; a transformant harboring the recombinant; a method for preparing the polypeptide of the present invention, using the transformant; an antibody which recognizes the polypeptide; a ligand for the polypeptide of the present invention; a compound inhibiting specific binding between the polypeptide and ligand of the present invention; a compound enhancing the expression of an aging-suppressing gene encoding the aging-suppressing polypeptide of the present invention; an oligonucleotide comprising a sequence of 10 to 50 nucleotides in the nucleotide sequence of the DNA; and a therapeutic agent for a syndrome resembling premature aging, a therapeutic agent for adult diseases or an aging-suppressing agent, using the same.

SPECIFICATION

NOVEL PEPTIDE, NOVEL DNA, AND NOVEL ANTIBODY

TECHNICAL FIELD

The present invention relates to a novel aging-suppressing polypeptide in animals, DNA encoding the polypeptide, an antibody recognizing the polypeptide, a ligand for the polypeptide of the present invention, a compound inhibiting a specific binding between the polypeptide and ligand of the present invention, and a compound enhancing the expression of an aging-suppressing gene encoding the aging-suppressing polypeptide of the present invention.

BACKGROUND ART

The aging phenomenon refers to deterioration of individuals, in terms of change in their functions and appearances, which is generally promoted by the advance in aging. It is known that the frequency of the onset of various adult diseases increases with aging. Therefore, pharmaceutical agents capable of controlling aging in a certain form are expected to be developed as therapeutic agents or preventive agents of adult diseases and as protective agents or preventive agents

against functional and apparent deterioration. However, no pharmaceutical agents having these scientifically verified effects have been reported.

Throughout the world, research directed to aging in individuals at the genetic level has just started, and no molecular genetics information relating to aging in individuals has been presented so far. However, several types of genetic premature aging syndromes are known, including Werner's syndrome, Hutchinson-Gilford syndrome (progeria), Down's syndrome, Turner's syndrome, Louis Barr's syndrome, Rothmond Thomson syndrome and the like (Daizabuzo Fujimoto, eds., *Mechanism and Control of Aging*, IPC, 1993).

The causative gene of Werner's syndrome has been identified as the gene encoding helicase [Science, 272: 258 (1996)]. Various mutations have been observed in the genes from the patients with Werner's syndrome. It is believed that no normal helicase protein is produced in the patients due to the mutation of the gene and, therefore, its function is not expressed so that a syndrome resembling premature aging may develop.

Based on the above, a suggestion has been presented that a gene relating to aging is present and that aging is promoted through the mutation of the gene. Because other causative genes are also present for other

types of genetic premature aging syndromes, it is believed that a plurality of genes may be involved in aging.

If an aging syndrome occurs as a result of loss in function of a gene involved in aging, therapeutic treatment would be useful, such treatment comprising supplementing the function of the gene, i.e. administering a protein product encoded by the gene or expressing the protein product in genetic treatment fashion. Also, if aging can be controlled, except for a genetic premature aging syndrome, various adult diseases occurring in close relation to aging would be treated or prevented.

The gene of the present invention is different from the causative gene of Werner's syndrome.

DISCLOSURE OF THE INVENTION

No measure is known for treating, preventing or diagnosing adult diseases of which the frequency of the occurrence increases based on aging; for protecting, preventing or diagnosing functional and apparent deterioration based on aging; or for treating and diagnosing a premature aging syndrome. The present invention is useful for such a measure.

The present invention relates to a polypeptide having an activity of suppressing aging in animals including humans; a therapeutic agent for a syndrome resembling premature aging, a therapeutic agent for adult diseases or an aging-suppressing agent, each comprising the polypeptide; DNA encoding the polypeptide; a therapeutic agent for a syndrome resembling premature aging, a therapeutic agent for adult diseases or an aging-suppressing agent, each comprising the DNA; a method for improving livestock using the DNA; a recombinant DNA prepared by inserting the DNA into a vector; a transformant harboring the recombinant; a method for producing the polypeptide of the present invention using the transformant; an antibody recognizing the polypeptide; a method for detecting the polypeptide of the present invention or a method for diagnosing aging, each using the antibody; a method for screening a ligand for the polypeptide of the present invention; the ligand; a method for screening a compound inhibiting a specific binding between the polypeptide and ligand of the present invention; and a compound prepared by the screening method.

The present invention further relates to a polypeptide which is selected from the group consisting of the following (a) to (d):

(a) a polypeptide comprising an amino acid sequence selected from amino acid sequences represented by SEQ ID NOS:1, 2, 3, 4 and 5;

(b) a polypeptide comprising an amino acid sequence wherein the 1st to 33rd amino acids are deleted in the amino acid sequence represented by SEQ ID NO:1 or 2;

(c) a polypeptide comprising an amino acid sequence wherein the 1st to 35th amino acids are deleted in the amino acid sequence represented by SEQ ID NO:3 or 4; and

(d) a polypeptide comprising an amino acid sequence wherein the 1st to 23rd amino acids are deleted in the amino acid sequence represented by SEQ ID NO:5.

The present invention further relates to a DNA which is selected from the group consisting of the following (a) to (c):

(a) a DNA encoding the above-mentioned polypeptide;

(b) a DNA comprising a DNA sequence selected from DNA sequences represented by SEQ ID NOS: 6, 7, 8, 9 and 10; and

(c) a DNA that hybridizes to the complement of the DNA described in (a) or (b) under stringent conditions, wherein the stringent conditions comprise hybridization at 65°C in the presence of 0.7 to 1.0 mol/l NaCl and washing at 65°C using 0.1 to 2 x SSC solution, wherein said DNA encodes

a polypeptide having the same biological activity as the above-noted polypeptide.

The present invention further relates to an antibody which recognizes the above-mentioned polypeptide.

The present invention further relates to a hybridoma which produces the above-mentioned antibody.

The present invention further relates to a therapeutic agent comprising the above-mentioned polypeptide.

The present invention further relates to a method for immunologically detecting the above-mentioned polypeptide, the method comprising putting the polypeptide into contact with the above-mentioned antibody and assaying the binding of the polypeptide to the antibody.

The present invention further relates to a vector containing the above-mentioned DNA.

The present invention further relates to a host cell harboring the above-mentioned vector.

The present invention further relates to a method for preparing a polypeptide encoded by the above-mentioned DNA, comprising culturing the above-mentioned host cell in a culture to produce and accumulate the polypeptide during the culturing, and recovering the polypeptide from the culture.

The present invention further relates to a method for improving livestock, comprising expressing the above-mentioned DNA to prolong the life of the livestock.

The present invention further relates to a method of identifying a ligand of the above-mentioned polypeptide, the method comprising providing a first cell which expresses the above-mentioned DNA, providing a second cell which does not express the above-mentioned DNA, contacting the first and second cells with a test sample, and determining cell stimulating activity of the first and second cells in the presence of the test sample, wherein a change in the cell stimulating activity of the first cell relative to the cell stimulating activity of the second cell is indicative that the test sample comprises a ligand of the polypeptide.

The present invention further relates to a method of identifying a compound that enhances expression of the above-mentioned DNA, the method comprising putting a cell expressing the above-mentioned polypeptide in contact with a test sample, assaying the level of the polypeptide expressed by the cell using the above-mentioned antibody, comparing the level of the polypeptide with a corresponding level assayed using a corresponding cell expressing the above-mentioned polypeptide that has not been contacted with the test sample, wherein an increase in the level of the polypeptide in the presence relative to in the absence of the test sample is indicative that the test sample comprises a compound that enhances expression of the above-mentioned DNA.

The present invention further relates to a method of identifying a compound that enhances expression of the above-mentioned DNA, the method comprising putting a cell expressing the above-mentioned polypeptide in contact with a

test sample, assaying the level of the transcription product of the above-mentioned DNA, comparing the level of the transcription product with a corresponding level assayed using a corresponding cell expressing the above-mentioned polypeptide that has not been contacted with the test sample, wherein an increase in the level of the transcription product in the presence relative to in the absence of the test sample is indicative that the test sample comprises a compound that enhances expression of the above-mentioned DNA.

The present invention further relates to a method of identifying a compound that enhances expression of the above-mentioned DNA, the method comprising: (a) contacting a test sample with a cell transformed with a plasmid comprising a reporter gene ligated downstream of a region controlling the transcription of the above-mentioned DNA; and (b) assaying the expression level of a polypeptide encoded by the reporter gene, wherein an increase in the expression level relative to a corresponding expression level assayed in a corresponding cell that has not been contacted with the test sample is indicative that the test sample comprises a compound that enhances expression of the above-mentioned DNA.

The present invention further relates to a method for assaying expression level of the above-mentioned DNA, comprising carrying out Northern hybridization or PCR using an oligonucleotide comprising a sequence identical to or complementary to continuous 10 to 50 nucleotides in a nucleotide sequence selected from nucleotide sequences represented by SEQ ID NO:6 to SEQ ID NO:10.

The polypeptide of the present invention can be produced by the following processes 1 to 7.

(Process 1)

A mouse showing a distinctive syndrome resembling premature aging is screened out from the homozygotes of the mice using transgenic mice, that is a transgenic mouse into which a foreign gene is introduced, e.g., a Na^+/H^+ reverse transporter linked to the known human elongation factor-1 α promoter (EF-1 α promoter) (Japanese Published Unexamined Patent Application No. 268856/1993). The foreign gene introduced into the transgenic mouse, which functions as a marker, is referred to as "introduction gene" hereinafter. Any gene may be used as such introduction gene, so long as the gene can be detected after the gene is introduced into mice.

Mice showing a syndrome resembling premature aging include mice with higher incidence of short lifespan, juvenile arteriosclerosis, osteoporosis, atrophy of gland tissues, reduction of nerve cells and the like, and more specifically, include a mouse showing a syndrome resembling premature aging as reported at the 18th Annual Meeting of The Molecular Biology Society of Japan (Nabeshima et al., 2K-02, 1995).

As the results of observation, the mouse showing a syndrome resembling premature aging has the properties described below:

Observation Example 1

Apparent observation:

A homozygote of an aged mouse (age 8 to 9 weeks) is of a body length of about 4 cm, which is considerably small, compared with the body length of a wild-type mouse of the same age in weeks (about 6 cm). Additionally, the ratio of the head part to the waist length is large. Although the body size of the aged mouse (male, age 8 weeks) is very small, no abnormality is found in the luster of body hair or the nail of limbs. The performance is normal.

As to longevity,

- 1) the growth stops around three weeks of age after birth, involving gradual reduction of activity;
- 2) the longevity is shortened such that mean longevity is 8.0 ± 0.9 weeks ($n = 13$) in males while in females, the mean longevity is 9.3 ± 0.9 weeks ($n = 13$); these mice are characteristic in their syndrome resembling premature aging such that all the mice are dead by 15 weeks of age after birth.

Five homozygous males and 5 homozygous females, around age 8 weeks, and 4 wild-type male mice and 4 female mice as litters from the same mother, were subjected to autopsy, followed by macroscopic

observation, and then, these mice were subjected to formalin fixing, paraffin embedding, thin-sectioning procedures and HE staining, for pathological observation by a known method (edited by Kei-ichi Watanabe and Kazuho Nakane, Enzyme Antibody Method, Gakusai Kikaku, 1992, the 3rd revised edition) (up to Observation Example 12, hereinafter, animals were observed by the same procedures).

Observation Example 2

Pathological examination of pituitary gland:

Reduction numbers of acidophil cells were observed. The acidophil cells of the pituitary gland are cells that produce growth hormone (GH) or prolactin (PRL), and the numbers thereof are reduced. It is known that GH secretion is reduced in aged individuals.

Observation Example 3

Pathological observation of gonad:

Gonad is distinctively atrophied, which indicates that the animals are infertile. In males, the testicle is prominently atrophied, which can be visualized with the naked eye. The size of the seminiferous tubule is atrophied to an extent as small as about 1/3 the size in the wild-type, so that sperm maturation is advanced only

to the pachytene stage of spermatocytes, with absolutely no observed sperm. In females, ovary and uterus are markedly atrophied even macroscopically. Egg maturation is advanced only to primary ovarian follicle, with no observed secondary ovarian follicle or corpus luteum.

Observation Example 4

Pathological examination of submaxillary salivary gland:

In normal males, a vast amount of acidophil granules is contained at their striated part, while in homozygotes, the cells at the striated part are short in length, with almost no acidophil granules observed.

Observation Example 5

Pathological examination of kidney:

Mineralization is observed in the epidermis of uriniferous tubule, the wall of Bowman's capsule and the like. The wall of Bowman's capsule is composed of squamous epidermis.

Observation Example 6

Pathological examination of vascular system:

Arteriosclerosis was prominent in homozygotes. The size of the thoracic aorta was irregular and a higher degree of mineralization was present on the

tunica media. Additionally, hypertrophy of the tunica intima was observed. Arteriosclerosis, primarily involving mineralization of the tunica media and hypertrophy of the tunica intima, was observed in a medium blood vessel such as renal artery to small blood vessel in parenchymatous organs. Particularly, the mineralization of the tunica media of the blood vessel in renal parenchyma was distinctive, but glomerulus and uriniferous tubule were nearly normal. Kossa staining verified that the deposit was certainly Ca^{2+} . Mineralization of the tunica media of the aorta was frequently observed in aged individuals.

Observation Example 7

Pathological observation of lung tissue:

The damage to the structure, particularly the wall, of alveoli pulmonis was prominent. Mineralization was also observed in the wall of alveoli pulmonis.

Observation Example 8

Observation of soft tissue and cartilage:

Mineralization was observed in the tunica mucosa tracheae intrinsic layer, gastric mucosa intrinsic layer and mucosa fascia, and the epidermis of alveoli pulmonis. Mineralization was also observed in fundus ventricule

gland cells and submucosal connective tissue and muscle layer. The mineralization of gastric mucosa is similar to the finding observed in rats and mice fed for a prolonged term. Additionally, the mineralization of the mitral ring of the heart was observed in some individuals. The mineralization of the mitral ring is a finding characteristic to aged persons. Furthermore, mineralization was also observed in joint cartilage, tracheal cartilage, and costochondral cartilage. The mineralization of these glass cartilages is a finding frequently observed in aged persons.

Observation Example 9

Pathological observation and X-ray observation of bone tissue:

An increase in the bone density of the metaphysis of the distal end of the femur was observed, together with chondroepiphyseal hypertrophy. An image of irregular mineralization over cartilage cells was observed in joint cartilage. X-ray transmission of the femur and tibia was escalated, which possibly indicates the reduction of mineral density. Actual mineral density of the diaphyseal area, tibia distal end and femur proximal end was measured and showed reduction at maximum by about 1/2 the densities in the wild-type.

Histologically, cortex bone was prominently reduced. Primary sponge bone proliferated exceptionally on the diaphyses of the tibia proximal end and femur distal end, and the mineral density adversely increased, only on that part.

Observation Example 10

Pathological observation of cerebellum:

The reduction of the number of Purkinje's cells in the cerebellum nerve cell layer, as well as isolated necrosis and expansion of axon, was observed. It has been known that Purkinje's cells are decreased in the cerebellum following aging, which involves the expansion of axon protrusion.

Observation Example 11

Pathological observation of liver:

Almost no glycogen granule stained as acidophil is observed. The cytoplasm of liver cells is slightly small, compared with the cytoplasm in normal subjects.

Observation Example 12

Pathological observation of thymus:

The thymus is prominently atrophied, but cannot be confirmed in some individuals visually with the naked eye.

(Process 2)

The chromosomal part damaged and inactivated by insertion of the introduction gene was isolated from a mouse showing a syndrome resembling premature aging. The DNA present in the chromosomal region was then analyzed by cloning techniques.

(Process 3)

After confirming the expression state of the DNA in individual tissues of normal mice, the causative gene of a syndrome resembling premature aging (hereinafter referred to as "aging-suppressing gene"), the expression of which is unlikely to be observed in normal mice, is determined.

(Process 4)

The aging-suppressing gene in humans and the like is determined by cloning a gene with high homology to

the murine aging-suppressing gene from a cDNA library of humans and the like.

(Process 5)

A polypeptide encoded by the gene is produced and accumulated by expressing the aging-suppressing gene of mice, humans and the like in *Escherichia coli*, insect cells and mammalian cells and the like through conventional methods using genetic recombinant technology.

(Process 6)

By purifying the accumulated polypeptide by a conventional method and using the polypeptide as an immunogen, an antibody against the polypeptide is raised in rats, mice, rabbits, sheep, guinea pigs, horses, cow, monkeys and the like.

(Process 7)

It should be confirmed that the antibody raised recognizes the polypeptide produced and accumulated by *Escherichia coli*, insect cells, mammalian cells and the like.

The present invention will now be described in detail.

The DNA of the present invention is DNA encoding a polypeptide having an activity of suppressing aging, for example, DNA encoding the polypeptide of an amino acid sequence selected from amino acid sequences represented by SEQ ID NOS:1, 2, 3, 4 and 5; DNA encoding a peptide comprising an amino acid sequence wherein at least one amino acid of the amino acid sequence of a polypeptide comprising an amino acid sequence selected from amino acid sequences represented by SEQ ID NOS:1, 2, 3, 4 and 5 is deleted, substituted or added, and the peptide having an activity of suppressing aging; and DNA which hybridizes with the DNA under stringent conditions.

The DNA which hybridizes under stringent conditions means the DNA obtained by colony hybridization, plaque hybridization or Southern blot hybridization using DNA encoding a polypeptide having an activity of suppressing aging as the probe, specifically including DNA identified after hybridization, using a filter on which colony- or plaque-derived DNA has been immobilized in the presence of 0.7 to 1.0 M NaCl at 65°C and washing the resulting filter using 0.1 to 2 × SSC solutions (the composition of 1 × SSC solution comprises 150 mM sodium chloride and 15 mM sodium citrate) at 65°C.

Hybridization can be carried out according to a method described, for example, in *Molecular Cloning, A Laboratory Manual*, the 2nd edition [Sambrook, Fritsch, & Maniatis eds., Cold Spring Harbor Laboratory Press, 1989 (hereinafter referred to as "*Molecular Cloning*, 2nd ed.")]. Specific examples of the DNA which hybridizes include DNA having a homology of 60% or more with a nucleotide sequence of the DNA encoding the polypeptide of an amino acid sequence selected from amino acid sequences represented by SEQ ID NOS:1, 2, 3, 4 and 5, preferably DNA having a homology of 80% or more, and more preferably DNA having a homology of 95% or more.

The oligonucleotide of the present invention includes an oligonucleotide comprising a nucleotide sequence which is identical or complementary to a partial nucleotide sequence of the nucleotide sequence of the DNA, for example, an oligonucleotide comprising a nucleotide sequence which is identical or complementary to a nucleotide sequence of continuous 5 to 60 residues, preferably 10 to 50 residues, in the nucleotide sequence of DNA selected from SEQ ID NOS:6 to 10, and derivatives of the oligonucleotide.

The polypeptide of the present invention includes the polypeptide encoded by the DNA, specifically including a polypeptide of an amino acid sequence

selected from amino acid sequences represented by SEQ ID NOS:1, 2, 3, 4 and 5, or DNA encoding a peptide comprising an amino acid sequence wherein at least one amino acid of the amino acid sequence of a polypeptide comprising an amino acid sequence selected from amino acid sequences represented by SEQ ID NOS:1, 2, 3, 4 and 5 is deleted, substituted or added and the peptide having an activity of suppressing aging.

The peptide comprising an amino acid sequence in which at least one in the amino acid sequence of the polypeptide is deleted, substituted or added and having an activity of suppressing aging can be prepared according to a method described, for example, in *Nucleic Acids Research*, 10: 6487 (1982); *Proc. Natl. Acad. Sci., USA*, 79: 6409 (1982); *Proc. Natl. Acad. Sci., USA*, 81: 5662 (1984); *Science*, 224: 1431 (1984); PCT WO 85/00817 (1985); *Nature*, 316: 601 (1985); *Gene*, 34: 315 (1985); *Nucleic Acids Research*, 13: 4431 (1985); and *Current Protocols in Molecular Biology*, Chapter 8, *Mutagenesis of Cloned DNA*, John Wiley & Sons, Inc. (1989).

The antibody of the present invention includes antibodies recognizing the polypeptide described above.

The ligand of the present invention means a molecule specifically binding to the polypeptide of the present invention, and any molecule can be used as the

ligand of the present invention, so long as it is capable of specifically binding to the polypeptide of the present invention.

A method for preparing DNA encoding the polypeptide having an activity of suppressing aging in accordance with the present invention is described below.

1) Cloning of murine chromosomal DNA adjacent to the introduction site of gene

(i) Detection of introduction gene

Multiple copies of an introduction gene can be incorporated into a transgenic mouse, but generally, the copies are inserted in succession in tandem into one site of the chromosomal DNA.

To confirm that the insertion site of an introduction gene resides at one site in a transgenic mouse showing a syndrome resembling premature aging, the chromosomal DNAs prepared from the livers of the wild-type, the heterozygote and the homozygote are digested with restriction enzymes (*EcoRV*, *XbaI*, etc.) with no cleavage potency of the introduction gene, for Southern blotting using the full length of the introduction gene as the probe.

By confirming that a single signal is detected in the heterozygote and homozygote by Southern blotting, it

is indicated that the introduction gene is inserted at only one site in the murine chromosome.

Introduction gene insertion can also be confirmed by fluorescent *in situ* hybridization (FISH) using the introduction gene as the probe.

(ii) The cloning of the murine chromosomal DNA adjacent to the site of insertion of the introduction gene can be carried out as follows.

If the introduction gene inserted into a transgenic mouse contains a plasmid vector, such as pUC or the like, the plasmid rescue process can be used.

That is, after the chromosomal DNA of the homozygote is digested with an arbitrary restriction enzyme with no cleavage potency of the plasmid vector, which is capable of self-circularization, the resulting DNA is then transformed into *Escherichia coli*. Only transformed *Escherichia coli* harboring the auto-circularized DNA containing a plasmid expressing a chemical resistance gene (for example, ampicillin resistant gene) derived from the plasmid vector form colonies on a selective medium. The plasmid obtained from the *Escherichia coli* may possibly contain the introduction gene *per se* and a fragment of the murine chromosomal DNA adjacent to the gene.

Southern blotting is carried out to confirm that the segment adjacent to the introduction gene is derived from the fragment of the murine chromosomal DNA using the fragment of the murine chromosomal DNA segment contained in the rescued plasmid as the probe and the same membrane used for the aforementioned Southern blotting. More specifically, it should be confirmed that only the signal from the wild allele (wild allele is hereinafter sometimes referred to as "+") is observed in the wild-type mouse; only the signal from the mutant allele (mutant allele is hereinafter sometimes referred to as "pg") is observed in the homozygote; and signals from both alleles are observed in the heterozygote.

In addition to the rescue method, common chromosomal DNA cloning may also be used. More specifically, chromosomal DNA is digested with a restriction enzyme, and the resulting digested fragments are cloned using general plasmid vectors or phage vectors to prepare a library. By using the fragments of the introduction gene as the probe and according to a method similar to the rescue method, the cloning of the murine chromosomal DNA adjacent to the site of the introduction gene can be carried out by screening the library.

2) Cloning of aging-suppressing gene derived from mouse

A phage clone that hybridizes with the probe is obtained by using the fragments of the murine chromosomal DNA segment contained in the plasmid obtained by the chromosomal DNA cloning or rescue method as the probe and screening the wild-type mouse genomic library (Stratagene, murine genomic library, λ FIXII) according to the attached manual.

In order to identify the aging-suppressing gene, the nucleotide sequence is sequentially determined, in which the murine chromosomal DNA contained in the plasmid obtained by centering the chromosomal DNA cloning method or rescue method.

Because it is known that the first exon and second exon of a gene are frequently present in the CpG island (Bruce Alberts et al., *Molecular Biology of the Cell*, Keiko Nakamura and Kenichi Matsubara as responsible translators, Kyoikusha, April 25, 1985), the CpG island region should be identified during the determination of the nucleotide sequence, and then, the murine chromosomal DNA contained in the plasmid obtained by the chromosomal DNA cloning method or rescue method should be digested with an appropriate restriction enzyme, for example, SacII or the like so as to contain the CpG island.

If no CpG island region is observed, an exon region should be predicted by an exon trapping method [for example, using Exon Trapping System (manufactured by GIBCO BRL, CO.)] or by using a computer software for predicting an exon region on a nucleotide sequence [For example, HEXON: Human Genome Center, Baylor College of Medicine, Houston on Internet; described in Solovyev, V.V., et al., *Nucleic Acids Research*, 22, 5156-5163 (1994) at page 5163, left column, lines 30-36, and thereafter, a DNA fragment possibly containing an exon can be isolated using restriction enzymes.

It can be confirmed by the following method that the DNA fragment is involved in the aging-suppressing gene.

The DNA fragment is labeled with α -[³²P]-dCTP, for example, using Megaprime DNA Labeling Kit (manufactured by Amersham Co.) or the like.

Northern hybridization is carried out using the labeled DNA as the probe and using a poly(A)⁺ RNA filter of murine heart, brain, spleen, lung, liver, skeletal muscle, kidney and spleen [Filter of Mouse Multiple Tissue Northern Blots (manufactured by Clontech Co.)] according to the manual conditions for Hybond N⁺TM.

Through the Northern hybridization, tissues with bands are identified.

From the wild-type, homozygote and heterozygote mice, the tissues specifically described above are collected, from which poly(A)⁺ RNAs are prepared using QuickPrep mRNA Purification Kit (manufactured by Pharmacia Co.) or the like.

The RNAs from the individual murine tissues are electrophoresed and transferred on a Hybond N⁺ filter by a conventional method, and Northern hybridization is carried out using the labeled DNA fragment as the probe.

Based on the bands obtained by the Northern hybridization, it should be confirmed that the expression in the homozygote is different from the expression in the wild-type and heterozygote. Examples of such different expression include absolutely no expression with not any band observed. Based on the confirmation, it can be verified that the restriction cleaved DNA fragment has some relation with the aging-suppressing gene.

Subsequently, the tissue specified above is drawn out from the wild-type mouse, and a cDNA library is prepared from the tissue by a conventional method. For example, a cDNA library can be prepared by synthetically preparing cDNA from the renal poly(A)⁺ RNA using cDNA Synthesis System (manufactured by GIBCO BRL, CO.) and adding an EcoRI-NotI-SalI adapter (SuperScript ChoiceTM

System for cDNA Synthesis; manufactured by GIBCO BRL, CO.) to both the termini, and subsequently incorporating the resulting cDNA into the *EcoRI* site of a cloning vector λ ZAP II [λ ZAP II Cloning Kit (manufactured by STRATAGENE Co.)].

The cloning vector for preparing the cDNA library can be any phage vector or plasmid vector and the like, so long as such vector can autonomously replicate in *Escherichia coli* K12. Specific examples of the vector include ZAP Express [manufactured by STRATAGENE Co., *Strategies*, 5: 58 (1992)] , pBlueScript II SK(+) [*Nucleic Acids Research*, 17: 9494 (1989)], λ ZAP II (manufactured by STRATAGENE Co.), λ gt10, λ gtII [*DNA Cloning, A Practical Approach*, 1: 49 (1985)], λ TriplEx (manufactured by CloneTech Co.), λ ExCell (manufactured by Pharmacia Co.), pT7T318U (manufactured by Pharmacia Co.), pcD2 [H. Okayama and P. Berg; *Mol. Cell. Biol.*, 3: 280 (1983)].

As the host microorganism, any microorganism can be used, so long as it belongs to *Escherichia coli*. Preferred examples include *Escherichia coli* XL1-Blue and the like.

Specific examples include *Escherichia coli* XL2-Blue, *Escherichia coli* XL1-Blue MRF' [manufactured by STRATAGENE Co., *Strategies*, 5: 81 (1992)], *Escherichia*

coli C600 [R.K. Appleyard; *Genetics*, 39: 440 (1954)], *Escherichia coli* Y1088 [R. A. Young and R. W. Davis; *Science*, 222: 778 (1983)], *Escherichia coli* Y1090 [R. A. Young and R. W. Davis; *Science*, 222: 778 (1983)] *Escherichia coli* NM522 [J.A. Gough and N.E. Murray; *J. Mol. Biol.*, 166: 1 (1983)], *Escherichia coli* K802 [W.B. Wood; *J. Mol. Biol.*, 16: 118 (1966)], *Escherichia coli* JM105 [L.J. Reha-Krantz; *Gene*, 38: 275 (1985)], *Escherichia coli* DH1, *Escherichia coli* MC1000 and the like.

One example of preparation of a cDNA library follows: cDNA is synthesized from the renal poly(A)⁺ RNA of the wild-type mouse using a cDNA synthesis system (cDNA Synthesis System; manufactured by GIBCO BRL, CO.), an *EcoRI*-*NotI*-*SalI* adapter (SuperScript Choice System for cDNA Synthesis; manufactured by GIBCO BRL, CO.) is added to both the termini, and the resulting cDNA is inserted into the *EcoRI* site of a cloning vector λ ZAP II [λ ZAP II Cloning Kit (manufactured by STRATAGENE Co.)].

The cDNA library is screened by colony or plaque hybridization using the labeled DNA fragment as the probe according to conventional methods.

From the clone (transformant) obtained through the screening, the aging-suppressing gene is isolated

and its DNA sequence determined by conventional methods, for example, the dideoxy method by Sanger et al. [Proc. Natl. Acad. Sci., USA, 74: 5463 (1977)] or the like. The nucleotide sequence can be analyzed using an automatic nucleotide sequence analyzer, for example, 373A DNA Sequencer, manufactured by Applied Biosystems Co. or the like.

Examples of an aging-suppressing gene sequence determined following the examples above include DNA comprising a sequence represented by SEQ ID NO:8. *Escherichia coli* ENKM101 harboring plasmid pNKM101 containing the DNA is deposited as FERM BP-5765 on December 5, 1996 at National Instituted of Bioscience and Human Technology, Agency of Industrial Science and Technology, 1-3, Higashi 1 chome, Tsukuba-shi, Ibaraki-ken, Japan (Zip code 305).

The DNA obtained above can be prepared by chemical synthesis based on the nucleotide sequence of DNA using a DNA synthesizer.

Such DNA synthesizer includes a DNA synthesizer according to a thiophosphite method, as manufactured by Shimadzu Corporation; a DNA synthesizer of Model 1392 according to a phosphoramidite method, as manufactured by Perkin Elmer Co. and the like. In the similar manner, the DNA having the sequence determined in the present

invention described below can be synthesized using a DNA synthesizer.

The DNA of the present invention can be prepared by PCR using a sense primer DNA having the same sequence of successive 10 to 50 nucleotides in the nucleotide sequence of DNA selected from DNAs represented by SEQ ID NOS:6 to 10, an antisense primer DNA of a complementary sequence to the DNA, and using as a template the cDNA prepared from the mRNA of a cell expressing mRNA complementary to the DNA. As such sense primer and antisense primer, the aforementioned oligonucleotides having similar melting temperatures and nucleotide numbers from each other are preferred.

Examples of the polypeptide encoding the aging-suppressing gene obtained as described above include a polypeptide comprising a sequence represented by SEQ ID NO:3.

3) Cloning of cDNA of mouse-derived secretory aging-suppressing gene

A mouse-derived secretory aging-suppressing gene can be obtained using the aging-suppressing gene obtained above in 2) or 4). More specifically, the gene can be obtained by the following method.

With reference to the amino acid sequence of the 535th to 549th amino acids in the amino acid sequence represented by SEQ ID NO:2 different from SEQ ID NO:1 in terms of the amino acid sequence of the 535th to 549th amino acids as obtained from human renal poly(A)⁺ RNA screening from the murine kidney-derived cDNA library is carried out according to a 5' RACE method using a synthetic DNA encoding an amino acid sequence with homology to the sequence. The resulting cDNA fragment is used to isolate a gene in a method similar to the above described, and the nucleotide sequence is determined.

A gene having a high homology to SEQ ID NO:2 is included as the mouse-derived secretory aging-suppressing gene of interest. One example of a gene having high homology to SEQ ID NO:2 is DNA having a sequence represented by SEQ ID NO:9 and the like. An example of the polypeptide encoded by the gene includes a polypeptide comprising a sequence represented by SEQ ID NO:4.

Escherichia coli ENKM 112 harboring the plasmid pNKM112 containing the DNA is deposited as FERM BP-6184 on date November 28, 1997 at National Instituted of Bioscience and Human Technology, Agency of Industrial

Science and Technology, 1-3, Higashi 1 chome, Tsukubashi, Ibaraki-ken, Japan (Zip code 305).

4) Cloning of cDNA of human-derived aging-suppressing gene

(i) Aging-suppressing genes derived from other animals, for example humans, can be obtained using the mouse-derived aging-suppressing gene obtained above by the following method.

The DNA fragment containing the mouse-derived aging-suppressing gene obtained above is labeled with α - $[^{32}\text{P}]$ -dCTP using, for example, Megaprime DNA Labeling Kit (manufactured by Amersham Co.).

From an objective animal tissue, for example, human kidney, human hippocampus tissue or the like, a cDNA library is prepared by a method similar to that mouse described above for mouse.

Colony hybridization or plaque hybridization is carried out using the labeled DNA fragment as the probe for screening the cDNA library.

The gene is isolated from a clone (transformant) obtained by the screening to determine the nucleotide sequence in a method similar to that described above for mouse.

The nucleotide sequence having high homology to the nucleotide sequence of the murine aging-suppressing gene is considered to be the aging-suppressing gene of the animal of interest.

Examples of the gene sequence include DNA comprising a sequence represented by SEQ ID NO:6 or 7 as derived from human kidney. *Escherichia coli* ENKM103 harboring plasmid pNKM103 and *Escherichia coli* ENKH106 harboring plasmid pNKH106 each containing the DNA are deposited individually as FERM BP-5942 and FERM BP-5767, respectively, on date May 15, 1997 and December 5, 1996, respectively, at National Instituted of Bioscience and Human Technology, Agency of Industrial Science and Technology, 1-3, Higashi 1 chome, Tsukuba-shi, Ibaraki-ken, Japan (Zip code 305).

(ii) cDNA of an aging-suppressing gene derived from other tissues of the animal or derived from other animals can be obtained using the animal-derived aging-suppressing genes thus obtained by the following method.

By labeling the DNA fragment containing the aging-suppressing gene as obtained above with α -[³²P]-dCTP using, for example, Megaprime DNA Labeling Kit (manufactured by Amersham Co.), the resulting DNA fragment is defined as a probe. By conducting PCR using

an appropriate primer set and a template RNA or cDNA from an objective animal tissue, such as human pancreas or the like, and then isotopically labeling the amplified DNA fragment in the same manner as described above or labeling the fragment with digoxigenin (DIG) and the like using, for example, DIG DNA Labeling Kit (manufactured by Boehringer Mannheim Co.), the resulting labeled product is defined as a probe. Specifically as such primer set, preference is given for example to synthetic DNAs with the nucleotide sequences represented by SEQ ID NOS:19 and 20.

Colony hybridization or plaque hybridization is carried out on a cDNA library derived from an objective animal tissue, such as human pancreas or the like, using the labeled DNA fragment as the probe for screening the cDNA library.

The gene is isolated from a clone (transformant) obtained by the screening in a method similar to the mouse and human methods as described above to determine the nucleotide sequence.

The nucleotide sequence having high homology to the nucleotide sequence of the murine aging-suppressing gene is considered to be the aging-suppressing gene of the animal of interest.

Examples of the DNA sequence include DNA with the sequence represented by SEQ ID NO:10 derived from human pancreas and the like. *Escherichia coli* XL1-Blue/pRYHH02 harboring plasmid pRYHH02 containing the DNA is deposited as FERM BP-6193 on date December 4, 1997 at National Instituted of Bioscience and Human Technology, Agency of Industrial Science and Technology, 1-3, Higashi 1 chome, Tsukuba-shi, Ibaraki-ken, Japan (Zip code 305).

5) Production of aging-suppressing polypeptide

In order to express the aging-suppressing gene obtained above in a host cell, a DNA fragment containing the aging-suppressing gene is first digested with restriction enzymes or cleaved with DNase to prepare a DNA fragment of an appropriate length containing the DNA encoding the aging-suppressing polypeptide; then the DNA fragment is inserted downstream of a promoter in an expression vector, and finally the expression vector inserted with the DNA is introduced into a host cell suitable to the expression vector.

Any host cell can be used, so long as it can express the gene of interest. Examples include procaryotes belonging to the genus *Escherichia*, *Serratia*, *Corynebacterium*, *Brevibacterium*, *Pseudomonas*, *Bacillus*,

Microbacterium, and the like; yeasts belonging to the genus *Kluyveromyces*, *Saccharomyces*, *Schizosaccharomyces*, *Trichosporon*, *Schwanniomyces*, and the like; animal cell hosts, and the like.

Examples of the expression vector include those which can replicate autonomously in the host cell or which can be integrated into chromosomes and have a promoter at such a position that the aging-suppressing gene can be transcribed.

When a procaryote, such as a bacterium or the like, is used as the host cell, it is preferred that the aging-suppressing gene expression vector can replicate autonomously in the procaryote and is a recombinant vector constructed with a promoter, a ribosome binding sequence, the aging-suppressing gene and a transcription termination sequence. A promoter controlling gene may also be contained.

Examples of the expression vector include pBTrp2, pBTac1, pBTac2 (all commercially available from Boehringer Mannheim Co.), pKK233-2 (manufactured by Pharmacia Co.), pSE280 (manufactured by Invitrogen Co.), pGEMEX-1 (manufactured by Promega Co.), pQE-8 (manufactured by QIAGEN Co.), pKYP10 (Japanese Published Unexamined Patent Application No. 110600/1983), pKYP200 [Agricultural Biological Chemistry, 48: 669 (1984)],

pLSA1 [Agricult. Biol. Chem., 53: 277 (1989)], pGEL1 [Proc. Natl. Acad. Sci. USA, 82: 4306 (1985)], pBluescript II SK(-) (manufactured by Stratagene Co.), pGEX (manufactured by Pharmacia Co.), pET-3 (manufactured by Novagen Co.), pTerm2 (U.S. Patents 4,686,191, 4,939,094, and 5,160,735), pSupex, pUB110, pTP5, pC194, and the like.

Any promoter can be used, so long as it can be expressed in a host cell, such as *Escherichia coli* or the like. Examples include promoters derived from *Escherichia coli*, phages and the like, such as trp promoter (Ptrp), lac promoter (Plac), P_L promoter, P_R promoter, P_{SE} promoter, and the like; SPO1 promoter, SPO2 promoter, penP promoter, and the like. Additionally, promoters artificially designed and modified may be used, such as a promoter with two Ptrp linked together in series (Ptrp × 2), tac promoter, letI promoter, lacT7 promoter, and the like.

With regard to the ribosome binding sequence, any sequence can be used so long as it can be expressed in the host cell, such as *Escherichia coli* or the like. However, it is preferred to use a plasmid in which the space between Shine-Dalgarno sequence and the initiation codon is adjusted to an appropriate distance (for example, 6 to 18 bases).

The transcription termination sequence is not always necessary for the expression of the aging-suppressing gene of the present invention. However, it is preferred to arrange the transcription terminating sequence just downstream of the structural gene.

Examples of the host cell include microorganisms belonging to the genus *Escherichia*, *Serratia*, *Corynebacterium*, *Brevibacterium*, *Pseudomonas*, *Bacillus*, and the like, such as *Escherichia coli* XL1-Blue, *Escherichia coli* XL2-Blue, *Escherichia coli* DH1, *Escherichia coli* MC1000, *Escherichia coli* KY3276, *Escherichia coli* W1485, *Escherichia coli* JM109, *Escherichia coli* HB101, *Escherichia coli* No.49, *Escherichia coli* W3110, *Escherichia coli* NY49, *Bacillus subtilis*, *Bacillus amyloliquefacines*, *Brevibacterium ammoniagenes*, *Brevibacterium immariophilum* ATCC 14068, *Brevibacterium saccharolyticum* ATCC 14066, *Corynebacterium glutamicum* ATCC 13032, *Corynebacterium glutamicum* ATCC 14067, *Corynebacterium glutamicum* ATCC 13869, *Corynebacterium acetoacidophilum* ATCC 13870, *Microbacterium ammoniaphilum* ATCC 15354, and the like.

As the method for introducing the recombinant vector, any method for introducing DNA into the host cell can be used, such as the method using a calcium ion [Proc. Natl. Acad. Sci. USA, 69: 2110 (1972)], the

protoplast method (Japanese Published Unexamined Patent Application No. 2483942/1988), the methods described in *Gene*, 17: 107 (1982) and *Molecular & General Genetics*, 168: 111 (1979), and the like.

When yeast is used as the host cell, examples of the expression vector include YEp13 (ATCC 37115), YEp24 (ATCC 37051), YCp50 (ATCC 37419), pHS19, pHS15 and the like.

Any promoter can be used, so long as it can drive the expression in yeast. Examples include PH05 promoter, PGK promoter, GAP promoter, ADH promoter, gal 1 promoter, gal 10 promoter, heat shock protein promoter, MF α 1 promoter, CUP 1 promoter, and the like.

Examples of the host cell include *Saccharomyces cerevisiae*, *Schizosaccharomyces pombe*, *Kluyveromyces lactis*, *Trichosporon pullulans*, *Schwanniomyces alluvius*, and like.

As the method for introducing the recombinant vector, any method for introducing DNA into yeast can be used, such as an electroporation method [*Methods. Enzymol.*, 194: 182 (1990)], a spheroplast method [*Proc. Natl. Acad. Sci. USA*, 75: 1929 (1978)], a lithium acetate method [*J. Bacteriol.*, 153: 163 (1983)], a method described in *Proc. Natl. Acad. Sci. USA*, 75: 1929 (1978), and the like.

When animal cells are used as the host cell, examples of the expression vector include pcDNAI, pcDM8 (commercially available from Funakoshi Co.), pAGE107 [Japanese Published Unexamined Patent Application No. 22979/1991; Cytotechnology, 3: 133 (1990)], pAS3-3 (Japanese Published Unexamined Patent Application No. 227075/1990), pCDM8 [Nature, 329: 840 (1987)], pcDNAI/Amp (manufactured by Invitrogen Co.), pREP4 (manufactured by Invitrogen Co.), pAGE103 [J. Biochem., 101: 1307 (1987)], and pAGE210.

Any promoter can be used, so long as it can be expressed in animal cells. Examples include a promoter for the IE (immediate early) gene of cytomegalovirus (human CMV), an early promoter for SV40, a retrovirus promoter, a metallothionein promoter, a heat shock promoter, and SR α promoter. Additionally, these promoters may be used in combination with the enhancer of the IE gene of human CMV.

Examples of the host cell include Namarba cell, HBT5637 (Japanese Published Unexamined Patent Application No. 299/1988), COS1 cell, COS7 cell, CHO cell and the like.

As the method for introducing the recombinant vector into the animal cells, any method to introduce DNA into animal cells can be used, such as an

electroporation method [*Cytotechnology*, 3: 133 (1990)], calcium phosphate method (Japanese Published Unexamined Patent Application No. 227075/1990), a lipofection method [*Proc. Natl. Acad. Sci., USA*, 84: 7413 (1987)], a method described in *Virology*, 52: 456 (1973), and the like. According to the method described in Japanese Published Unexamined Patent Application No. 227075/1990 or Japanese Published Unexamined Patent Application No. 257891/1990, transformants can be obtained and cultured.

When insect cells are used as hosts, protein can be expressed according to a method described in, for example, *Baculovirus Expression Vectors, A Laboratory Manual, Current Protocols in Molecular Biology*, Supplement 1-38 (1987-1997), *Bio/Technology*, 6, 47 (1988), and the like.

That is, a recombinant gene transfer vector and baculovirus are simultaneously incorporated into insect cells to obtain a recombinant virus in an insect cell culture supernatant, and then the insect cells are infected with the thus obtained recombinant virus to express the protein.

Examples of the gene-introduced vector for use in the method include pVL1392, pVL1393, and pBlueBacIII (all manufactured by Invitrogen Co.).

Examples of the baculovirus include *Autographa californica* nuclear polyhedrosis virus with which insects of the family *Barathra* are infected, and the like.

Examples of the insect cell include Sf9 and Sf21 as ovarian cells of *Spodoptera frugiperda* [*Baculovirus Expression Vectors, A Laboratory Manual*, W. H. Freeman and Company, New York, (1992)], High 5 as the ovarian cell of *Trichoplusia ni* (manufactured by Invitrogen Co.), and the like.

Examples of the method for co-introducing the recombinant gene-introduced vector and the baculovirus to prepare a recombinant virus include calcium phosphate method (Japanese Published Unexamined Patent Application No. 227075/1990), a lipofection method [*Proc. Natl. Acad. Sci. USA*, 84: 7413 (1987)], and the like.

As the method for expressing the gene, secretion and generation, fused protein expression and the like can be carried out according to the method described in *Molecular Cloning*, 2nd ed. and the like.

When the gene is expressed in yeast, animal cells or insect cells, a polypeptide to which a sugar or sugar chain has been added can be obtained.

The aging-suppressing polypeptide can be produced by culturing a transformant harboring the recombinant

DNA to which the aging-suppressing gene is incorporated in a culture, producing and accumulating the aging-suppressing polypeptide in the culture, and recovering the aging-suppressing peptide from the culture.

The method for culturing the transformant for producing the aging-suppressing polypeptide of the present invention can be carried out according to the conventional method used in culturing of hosts.

If the transformant for producing the aging-suppressing polypeptide of the present invention is a procaryote, such as *Escherichia coli* or the like, or a eucaryote, such as yeast or the like, the medium for culturing these organisms may be any of natural culture media and synthetic culture media, so long as they contain a carbon source, a nitrogen source, inorganic salts and the like which can be assimilated by these organisms and can make the culturing of the transformant effective.

As the carbon source, any such source which can be assimilated by individual organisms can be used. Examples include carbohydrates, such as glucose, fructose, sucrose, molasses, starch, starch hydrolysate, and the like; organic acids, such as acetic acid, propionic acid, and the like; and alcohols, such as ethanol, propanol, and the like.

Examples of the nitrogen source include ammonia, various ammonium salts of inorganic acids or organic acids, such as ammonium chloride, ammonium sulfate, ammonium acetate, ammonium phosphate, and the like; other nitrogen-containing compounds, peptone, meat extract, yeast extract, corn steep liquor, casein hydrolysate, soybean meal and soybean meal hydrolysate, various fermented cells and hydrolysates thereof, and the like.

Examples of inorganic substance include potassium dihydrogen phosphate, dipotassium hydrogen phosphate, magnesium phosphate, magnesium sulfate, sodium chloride, ferrous sulfate, manganese sulfate, copper sulfate, calcium carbonate, and the like.

The culturing is carried out under aerobic conditions by means of shaking, aeration stirring or the like. The culturing temperature is preferably from 15 to 45°C, and the culturing time is generally for 16 to 96 hours. The pH of the medium is maintained at 3.0 to 9.0 during the culturing. Adjustment of the medium pH is carried out using an inorganic or organic acid, an alkali solution, urea, calcium carbonate, ammonia and the like.

Also, antibiotics, such as ampicillin, tetracycline, and the like, may be added to the medium during the culturing as occasion demands.

When a microorganism transformed with an expression vector containing an inducible promoter is cultured, an inducer may be added to the medium as occasion demands. For example, isopropyl- β -D-thiogalactopyranoside (IPTG) or the like may be added to the medium when a microorganism transformed with an expression vector containing *lac* promoter is cultured, or indoleacrylic acid (IAA) or the like may be added thereto when a microorganism transformed with an expression vector containing *trp* promoter is cultured.

Examples of the medium for culturing a transformant obtained from animal cells as a host cell include media conventionally used, such as RPMI1640 medium [*The Journal of the American Medical Association*, 199: 519 (1967)], Eagle's MEM medium [*Science*, 122: 501 (1952)], DMEM medium [*Virology*, 8: 396 (1959)], 199 medium [*Proceeding of the Society for the Biological Medicine*, 73: 1 (1950)], and media to which calf fetus serum or the like is added.

The culturing is generally carried out under conditions at pH 6-8 and 30 to 40°C in the presence of 5% CO₂ for 1 to 7 days.

Also, antibiotics, such as kanamycin, penicillin, and the like, may be added to the medium during culturing.

Examples of the medium for culturing the transformant obtained from insect cells as a host cell include media conventionally used, such as TNM-FH medium [manufactured by Pharmingen Co.], Sf-900 II SFM medium [manufactured by GIBCO BRL, CO.], ExCell 400 and ExCell 405 [both manufactured by JRH Biosciences Co.], Grace's Insect Medium [Grace, T.C. C., *Nature*, 195: 788 (1962)], and the like.

The culturing is generally carried out under conditions at pH 6 to 7 and 25 to 30°C for 1 to 5 days.

Furthermore, antibiotics, such as gentamycin and the like, may be added to the medium during culturing.

In order to isolate and purify the aging-suppressing polypeptide of the present invention from the culture of the transformant for producing the aging-suppressing polypeptide, conventional methods for isolating and purifying enzymes can be used.

For example, when the polypeptide of the present invention is expressed under dissolved conditions inside cells, the cells are recovered by centrifugation after the culturing, suspended in an aqueous buffer, and disrupted with an ultrasonic disrupter, French Press,

Manton-Gaulin homogenizer, Dinomill or the like to give a cell-free extract solution. From the supernatant recovered after the centrifugation of the cell-free extract solution, a purified specimen can be obtained by a single conventional method or a combination of conventional methods for isolating and purifying enzymes of a solvent extraction method, a salting-out method using ammonium sulfate, a desalting method, a precipitation method using an organic solvent, an anion exchange chromatography method using a resin, such as diethylaminoethyl (DEAE)-Sephacrose, DIAIONTM HPA-75 (manufactured by Mitsubishi Chemical Industry Co.), or the like, a cation exchange chromatography method using a resin, such as S-Sephacrose FF (manufactured by Pharmacia Co.) or the like, a hydrophobic chromatography method using a resin, such as butyl Sepharose, phenyl Sepharose, or the like, a gel filtration method using a molecular sieve, an affinity chromatography method, a chromato-focusing method, and an electrophoresis method, such as isoelectric focusing or the like.

When the polypeptide is expressed after the polypeptide forms an insoluble matter inside cells, the cells are similarly recovered and disrupted, and are centrifuged to recover a precipitate fraction. From the precipitate fraction, the polypeptide is recovered

according to conventional methods, and the insoluble matter of the polypeptide is solubilized in a polypeptide modifier. The solubilized solution is diluted with or dialyzed against a solution containing no polypeptide modifier or at a concentration of a polypeptide modifier being nearly at a dilution degree such that no modification of the polypeptide does not occur to compose the polypeptide having a normal stereostructure, a purified specimen can be recovered according to an isolation and purification method similar to the above.

When the polypeptide of the present invention or a derivative thereof, such as sugar modified product or the like, is secreted outside cells, the polypeptide or a derivative thereof, such as the sugar chain adduct thereof, can be recovered from the culturing supernatant. More specifically, a soluble fraction is collected by treating the culture in a method similar to the above, such as centrifugation, and a purified specimen is obtained from using an isolation and purification method similar to the above.

The polypeptide expressed by the method can be produced by a chemical synthesis method, such as an Fmoc method (fluorenylmethyloxycarbonyl method), a tBoc method (t-butyloxycarbonyl method), and the like.

Additionally, the polypeptide can be produced using a peptide synthesizer produced by, for example, Souwa Trade (manufactured by Advanced ChemTech Co., USA), Perkin Elmer Japan (manufactured by Perkin-Elmer Co.), Pharmacia Biotech (manufactured by Pharmacia Biotech Co., Sweden), Aloka (manufactured by Protein Technology Instrument Co., USA), Kurabo (manufactured by Synthecell-Vega Co., USA), Japan PerSeptive Limited (manufactured by PerSeptive Co., USA), Shimadzu Corporation, and the like.

6) Preparation of antibody recognizing aging-suppressing polypeptide

(i) Preparation of polyclonal antibody

Along with an appropriate adjuvant [for example, complete Freund's adjuvant or aluminium hydroxide gel together with pertussoid vaccine, or the like], a purified specimen (antigen) of the full length or a partial fragment of the aging-suppressing polypeptide obtained above in 4) or 5) is subcutaneously, intravenously or peritoneally administered at a dose of 50 to 100 μ g/animal into rabbits, goat or rats, mice or hamsters of age 3 to 20 weeks.

The antigen is boosted once, and thereafter, the antigen is boosted 3 to 10 times, every 1 to 2 weeks.

After each booster, blood is collected from plexus basilaris on day 3 to 7. It is confirmed by enzyme immunoassay [ELISA, published by Igaku Shoin, 1976; *Antibodies, A Laboratory Manual*, Cold Spring Harbor Laboratory (1988)] and the like, that the serum reacts with the antigen used for immunization.

From rabbits, goat, mice, rats or hamsters with the sera of sufficient antibody titers against the antigen used for immunization, the sera are collected, and purified antibodies can be obtained using a conventional method, such as a salting-out method using 40 to 50% saturated ammonium sulfate, a caprylic acid precipitation method, a chromatographic method using, such as a DEAE-Sepharose column, a protein A-column, a gel filtration column, and the like.

(ii) Preparation of monoclonal antibody

(a) Preparation of antibody-producing cell

A rat having serum of a sufficiently high antibody titer against the partial fragment of the aging-suppressing polypeptide used for immunization is used as a supply source of antibody-producing cells.

On day 3 to 7 after the final dosing of the antigen substance to the rat showing the antibody titer, the spleen is resected from the rat.

The spleen is cut into pieces in MEM medium (manufactured by Nissui Pharmaceuticals Co.), and the pieces are then loosened with tweezers and centrifuged at 1,200 rpm for 5 minutes to discard the resulting supernatant.

The splenic cells in the resulting precipitate fraction are treated with a Tris-ammonium chloride buffer (pH 7.65) for 1 to 2 minutes to remove the erythrocytes, and the resulting cells are washed with MEM medium three times to use the resulting splenic cells as antibody-producing cells.

(b) Preparation of myeloma cell

As myeloma cells, cells of an established cell line obtained from mice or rats are used. Examples include 8-azaguanine resistant mouse (derived from BALB/c) myeloma cell lines P3-X63Ag8-U1 (hereinafter referred to as "P3-U1") [*Curr. Topics Microbiol. Immunol.*, 81: 1 (1978)], [*Europ. J. Immunol.*, 6: 511 (1976)], SP2/0-Ag14 (SP-2) [*Nature*, 276: 269 (1978)], P3-X63-Ag8653 (653) [*J. Immunol.*, 123: 1548 (1979)], P3-X63-Ag8 (X63) [*Nature*, 256: 495 (1975)] and the like. These cell lines are sub-cultured in an azaguanine medium [RPMI-1640 medium supplemented with glutamine (1.5 mM), 2-mercaptoethanol (5×10^{-5} M), gentamycin (10

µg/ml) and fetus calf serum (FCS) (manufactured by CSL Co.; 10%) (hereinafter referred to as "normal medium") and further supplemented with 8-azaguanine (15 µg/ml)]. The cells are cultured in the normal medium for 3 to 4 days before cell fusion, and for the cell fusion, the cells are used at 2×10^7 or more

(c) Preparation of hybridoma

The antibody-producing cells as obtained in (a) and the myeloma cells as obtained in (b) are thoroughly washed with MEM medium or PBS (disodium phosphate (1.83 g), monopotassium phosphate (0.21 g), common salt (7.65 g), and distilled water (1 liter), pH 7.2) to mix to give a final cell number ratio of 5 : 1 to 10 : 1 as the ratio of number of the antibody-producing cells : the number of the myeloma cells, the mixture is centrifuged at 1,200 rpm for 5 minutes, and the supernatant is discarded.

The cell population in the resulting precipitate fraction is sufficiently loosened, and to the cell population under stirring is added 0.2 to 1 ml of a mixture solution of polyethylene glycol-1000 (PEG-1000; 2 g), MEM (2 ml) and dimethylsulfoxide (DMSO; 0.7 ml) per 10^8 antibody-producing cells, and 1 to 2 ml of MEM medium is further added every 1 to 2 minutes.

After addition, MEM medium is added to the resulting mixture to give the final volume of 50 ml.

The prepared solution is centrifuged at 900 rpm for 5 minutes, and the resulting supernatant is discarded.

The cells in the resulting precipitate fraction are gently loosened and gently suspended in HAT medium (100 ml) [a medium prepared by adding hypoxanthine (10^{-4} M), thymidine (1.5×10^{-5} M) and aminopterin (4×10^{-7} M) to the normal medium] through aspiration and blowing by means of a measuring pipette.

The suspension is divided in 100 μ l portions into each well of a 96-well culture plate for culturing at 37°C in a 5% CO₂ incubator for 7 to 14 days.

After culturing, a part of the culture supernatant is sampled, and hybridomas which specifically reacts with a partial fragment of the aging-suppressing polypeptide are screened by the enzyme immunoassay described in *Antibodies, A Laboratory manual*, Cold Spring Harbor Laboratory, Chapter 14 (1988) and the like.

Specific examples of the enzyme immunoassay include the following method.

The method comprises coating the partial fragment of the aging-suppressing polypeptide used as the antigen

in the immunoization on an appropriate plate; reacting it with the hybridoma supernatant or the purified antibody obtained in section (d) described above as a first antibody; reacting it with a second antibody anti-rat immunoglobulin antibody labeled with biotin, an enzyme, a chemiluminescent substance or a radioactive compound; carrying out a reaction depending on the labeling substance, and screening a substance having a specific reactivity to the aging-suppressing polypeptide as a hybridoma producing anti-aging-suppressing polypeptide monoclonal antibody.

Specific examples of the hybridoma include a hybridoma KM1902. The hybridoma KM1902 is deposited as FERM BP-5983 on June 17, 1997 at National Instituted of Bioscience and Human Technology, Agency of Industrial Science and Technology.

Using the hybridoma, cloning is repeated two times by limiting dilution [for first dilution, HT medium (HAT medium from which aminopterin is excluded) is used; for second dilution, the normal medium is used]. Then, a cell line having a stable strong antibody titer is selected as a hybridoma producing an anti-aging-suppressing polypeptide antibody.

(d) Preparation of monoclonal antibody

To a mouse or nude mouse aged 8 to 10 weeks, 5×10^6 to 20×10^6 cells of the anti-aging-suppressing polypeptide monoclonal antibody producing hybridoma cells obtained in (c) are injected peritoneally, and treated with Pristane [after peritoneal administration of 0.5 ml of 2,6,10,14-tetramethylpentadecane (Pristane), feeding was continued for 2 weeks]. The hybridoma turns ascites tumor in 10 to 21 days.

From the mouse with the ascites tumor, the ascites is collected, and centrifuged at 3,000 rpm for 5 minutes to remove the solid matters.

By a salting-out method using 40 to 50% saturated ammonium sulfate, a caprylic acid precipitation method [Antibodies, A Laboratory Manual, Cold Spring Harbor Laboratory (1988)], a chromatographic method using a DEAE-Sepharose column, a protein A-column or a Cellulofine GSL2000 (manufactured by Biochemical Industry Co.), an IgG or IgM fraction is collected from the resulting supernatant, and the fraction is used as a purified monoclonal antibody.

The subclass of the antibody is determined using a mouse monoclonal antibody typing kit or a rat monoclonal antibody typing kit. The protein level is

calculated by the Lowry's method or based on the absorbance at 280 nm.

7) Staining of immune cell using monoclonal antibody

For staining immune cells using adhesive cells, preferably, the adhesive cells are preliminarily subjected to the following treatment to tear away the cells from the culture flask.

That is, cultured adhesive cells are washed with a PBS buffer, and a PBS buffer (3 ml) containing 0.05% trypsin and 0.02% EDTA (ethylenediaminetetraacetic acid) is added thereto. From the resulting mixture, an excess solution is removed, and the cells are tore away from the flask by incubation at 37°C for 5 minutes (hereinafter this procedure is referred to as "trypsin-EDTA treatment").

As to suspension cells, the cultured cells are used as they are.

The cells for immune cell staining are suspended in an immune cell staining buffer (PBS containing 1% BSA, 0.02% EDTA, and 0.05% sodium azide), and is divided as each portion of 1×10^5 to 20×10^5 cells into a 96-well round bottom plate.

The culture supernatant of the hybridoma producing an anti-aging-suppressing polypeptide

monoclonal antibody obtained in (c), the purified monoclonal antibody obtained in (d) or the monoclonal antibody labeled with biotin according to the known method (*Enzyme Antibody Method*, issued by Gakusai Kikaku, 1985) which is diluted with the immune cell staining buffer or the immune cell staining buffer containing 10% animal serum to give a final concentration of 0.1 to 50 $\mu\text{g/ml}$ is divided into the wells to give a final volume of 20 to 500 $\mu\text{l/well}$, and the plate is allowed to stand under ice cooling for 30 minutes.

If the culture supernatant of the anti-aging-suppressing polypeptide monoclonal antibody obtained in (c) or the purified monoclonal antibody obtained in (d) is used in the above procedure, the immune cell staining buffer is added to the plate to rinse the cells, and the immune cell staining buffer containing an anti-mouse immunoglobulin antibody or anti-rat immunoglobulin antibody preliminarily labeled with a fluorescent dye, such as FITC, phycoerythrin, or the like, at a concentration of about 0.1 to 50 $\mu\text{g/ml}$ is divided at 50 to 500 $\mu\text{l/well}$. Then, the resulting plate is allowed to stand in darkness under ice cooling for 30 minutes.

If the monoclonal antibody labeled with biotin is used, streptoavidin is divided into the plate at 50 to

500 μ l/well, and the plate is allowed to stand in darkness under ice cooling for 30 minutes.

In both the procedures, after the reaction, an immune cell staining buffer is added to the plates, and the cells are thoroughly washed and analyzed with a cell sorter.

8) Immunoprecipitation of aging-suppressing polypeptide

The CHO cells or insect cells expressing the aging-suppressing polypeptide of the present invention is cultured in a culture container such as a Petri dish.

PBS is added to the culture container to rinse the cells.

To the culture container, 100 to 500 μ l of a buffer preliminarily cooled in ice which is capable of solubilizing cell membrane, such as a buffer containing 1% TritonTM X100, 20 mM Tris-HCl, 150 mM NaCl (hereinafter referred to as "Buffer 1"), is added at 100 to 500 μ l, and the resulting mixture is allowed to stand in ice for 30 minutes and is then gently vibrated as solubilization treatment.

For preparing a sample from the culture supernatant, the supernatant is concentrated by a method, such as ultrafiltration membrane, freeze-drying, or the

like, and then immunoprecipitation reaction is carried out using the sample by the following method.

The solution after the solubilization treatment is recovered in a 1.5 ml centrifuge tube, and centrifuged at 14,000 rpm for 30 minutes.

To the resulting supernatant, 10 to 50 μ l of protein G-Sepharose or protein A-Sepharose equilibrated with the buffer is added under stirring at 4°C for one hour and centrifuged at 5,000 rpm for 2 minutes to recover the supernatant.

To the supernatant, the culture supernatant of the hybridoma producing the anti-aging-suppressing polypeptide monoclonal antibody obtained in (c) or the purified monoclonal antibody obtained in (d) is added to give a final concentration of 0.01 to 50 μ g/ml, followed by shaking at 4°C for one hour or more.

To the shaken solution, 10 to 50 μ l of protein G-Sepharose or protein A-Sepharose is added, followed by shaking at 4°C for one hour or more, and the mixture is centrifuged at 5,000 rpm for 2 minutes.

To the resulting precipitate fraction, 200 μ l of the buffer solubilizing the cell membrane as described above is added to suspend the precipitate. The same procedures are repeated 3 times or more to rinse the precipitate fraction.

To the precipitate, a sample buffer for SDS-polyacrylamide gel electrophoresis is added, the mixture is heated using a heat block, and SDS-PAGE is carried out.

After the SDS-PAGE, the polypeptide in the resulting gel is transferred on a PVDF membrane or the like to detect the aging-suppressing polypeptide by Western blotting or the like using an anti-aging-suppressing partial fragment polypeptide polyclonal antibody in accordance with the present invention and the like.

By cutting the detected aging-suppressing polypeptide from the PVDF membrane, the protein can be purified. The structural analysis of the purified polypeptide of the present invention can be carried out according to the method described in, for example, *Protein Structural Analysis for DNA Cloning* (Hisashi Hirano, issued by Tokyo Kagaku Dojin, 1993).

9) Production of mouse showing ameliorated syndrome resembling premature aging from mice showing syndrome resembling premature aging using the aging-suppressing gene derived from mouse (verification of the efficacy of the aging-suppressing gene for the treatment of a syndrome resembling premature aging, because of the

amelioration of the syndrome resembling premature aging owing to the introduction of the aging-suppressing gene)

In order to produce a transgenic mouse excessively expressing the aging-suppressing gene obtained above, DNA containing the aging-suppressing gene to introduce and express the gene in a mouse (hereinafter referred to as "aging-suppressing DNA for introduction") is constructed. The aging-suppressing DNA for introduction is injected into the male pronucleus of a fertilized egg of a wild-type mouse and is then transplanted into a female mouse which is preliminarily induced into a false pregnancy.

A new-born transgenic mouse (+/+) excessively expressing the aging-suppressing gene is mated with a heterozygote (pg/+) obtained from mice showing a syndrome resembling premature aging to produce a mouse expressing the aging-suppressing gene and showing pg/+.

The mouse is mated together or the mouse is mated with a mouse showing pg/+ to obtain a mouse expressing the aging-suppressing gene and showing pg/pg.

By confirming that the mouse does not show a syndrome resembling premature aging, it is verified that the aging-suppressing gene obtained above is effective for the treatment.

By the method described below, for example, a mouse showing an ameliorated syndrome resembling premature aging from mice showing a syndrome resembling premature aging can be obtained.

(i) Construction of aging-suppressing DNA for introduction

The aging-suppressing DNA for introduction is preferably composed of a promoter, the aging-suppressing gene and a cassette of SV40 early splicing region & poly adenylation signal (hereinafter referred to as "SV40 cassette").

As the promoter, any promoter can be used, so long as it can cause expression in mice; however, a stronger promoter is preferably used. Examples include a *HindIII* treated fragment (2.5 kb promoter region containing partially the 1st exon and 2nd exon of 5' UTR) of human elongation factor 1 α [pEF321CAT (Kim DW et al., *Gene*, 91: 217, 1990)].

As the aging-suppressing gene, any of the genes obtained above in 2) can be used. Specifically, DNA encoding the amino acid sequence represented by SEQ ID NO:3 is exemplified.

As the SV40 cassette, the nucleotide Nos. 1551-2427 of an expression vector pMAMneo (commercially available from Clontech Co.) can be utilized.

By a conventional method, the promoter, the aging-suppressing gene and the SV40 cassette are ligated together in this order, and then the ligation product is cleaved with an appropriate enzyme, such as NotI or the like, and is then dissolved in a PBS buffer to give a final concentration of about 500 copies/ml for use as an aging-suppressing DNA for introduction.

(ii) Production of transgenic mouse

A transgenic mouse can be produced by a routine microinjection method (*Developmental Engineering Experimental Manual - How to Prepare Transgenic Mouse*, Tatsuji Nomura as responsible editor, Motoya Katsuki as editor, Kodansha Scientific, 1987).

More specifically, 7 units of Serotropin (manufactured by Teikoku Hormone Mfg. Co., Ltd.) are administered peritoneally into F1 females (BCF1), aged 8 to 16 weeks, from C57BL/6 and C3H. After 48 hours, 7 units of gonadotropin (manufactured by Teikoku Hormone Mfg. Co., Ltd.) are peritoneally administered into them, and they are mated with males of C3H.

On the next day, a fertilized egg is collected from the ampulla of uterine tube of the mated females. The DNA solution is injected into the male pronucleus of the fertilized egg using a micro-manipulator (manufactured by Narumo Co.) under an erect microscope.

The fertilized egg is transplanted into a female which is mated with a vasoligated male (ICR) on the previous day, so as to induce false pregnancy in the female.

On day 20 after the transplantation, litter mice are born, and their tails are cut when they are at age 4 to 5 weeks to extract the chromosomal DNA for DNA typing using PCR as described below.

(iii) Analysis of Genotype

To the mouse's tail obtained above, 2 ml of a lysis buffer [lysis buffer; a buffer containing 50 mM Tris-HCl (pH 8.0), 100 mM NaCl, 20 mM EDTA, 1% SDS, 0.15 ml/ml Proteinase K (manufactured by SIGMA Co.), and 1 mg/ml Pronase E (manufactured by SIGMA Co.)] is added, and the resulting mixture is allowed to stand at 50°C overnight.

The buffer is extracted into an equal volume of phenol, and 1 ml of the supernatant is used as a PCR template.

As the PCR primers, the following 5 primers are prepared and are mixed together for use.

From a segment of a nucleotide sequence derived from the aging-suppressing gene obtained in 2) and corresponding to a region with an inserted intron in the sequence of genomic DNA, two primers (primers 1 and 2) are prepared; a primer is prepared from a region present commonly in mutant allele and wild-type allele (primer 3); a primer is prepared from a region present only in mutant allele (primer 4); and a primer is prepared from a region present only in mutant allele (primer 5).

Examples of the primers 1 and 2 include DNA sequence represented by SEQ ID NO:25 or 26.

Examples of the primer 3 include DNA sequence represented by SEQ ID NO:27.

Examples of the primer 4 include DNA sequence represented by SEQ ID NO:28.

Examples of the primer 5 include DNA sequence represented by SEQ ID NO:29.

If the aging-suppressing gene obtained in 2) is present in a mouse, a fragment which can be amplified by PCR with the primers 1 and 2 is produced; a fragment which can be amplified with the primers 3 and 4 is produced in the homozygote (pg/pg); a fragment which can be amplified with the primers 3 and 5 is produced in the

wild-type (+/+); two fragments which can be amplified with the primers 3 and 4 and with the primers 3 and 5 are produced in the heterozygote (pg/+). Thus, the genotype of the mice can be analyzed.

PCR can be carried out by a conventional method. Specifically, PCR is carried out in a 50 μ l system [1 $\times$ LA PCR buffer II (Mg plus), dNTP mixture solution of each ingredient at 400 mM, each primer of 0.2 mM, 2.5 U TaKaRa LATaq] by heating at 94°C for 1.5 minutes using TaKaRa PCR Thermal Cycler 480 and an LA PCR kit (manufactured by Takara Shuzo Co., Ltd.), followed by 30 cycles, each cycle consisting of 94°C for 30 seconds, 56°C for 30 seconds, and 72°C for 1.5 minutes, and subsequent heating at 72°C for 10 minutes.

(iv) Mating of transgenic mouse with mouse showing pg/+

The genotype about a litter mouse obtained from the mating of the transgenic mouse obtained in (ii) with a mouse showing pg/+ is analyzed according to the method described in (iii) to confirm that the mouse expressing the aging-suppressing gene and showing pg/pg does not show a syndrome resembling premature aging.

10) Obtaining a mouse showing ameliorated syndrome resembling premature aging from mice showing syndrome

resembling premature aging using recombinant adenovirus containing the aging-suppressing gene derived from mice

In order to introduce and express the aging-suppressing gene obtained above in a mouse, a recombinant adenovirus containing the aging-suppressing gene is constructed, and the recombinant virus is then dosed to a mouse showing a syndrome resembling premature aging to confirm that the mouse does not show the syndrome resembling premature aging and thereby verify that the aging-suppressing gene obtained above is therapeutically effective.

By the method described below, for example, a mouse showing an ameliorated syndrome resembling premature aging can be obtained from mice showing a syndrome resembling premature aging.

(i) Construction of recombinant cosmid containing aging-suppressing gene

Preferably, the introduction aging-suppressing gene DNA contains a promoter, the aging-suppressing gene and a splicing region, and type 5 adenovirus genomic DNA containing a poly(A) additive signal from which E1A, E1B and E3 are deleted.

As a cosmid containing the individual composition elements except for the aging-suppressing gene, pAxCawt [Nucl. Acids. Res., 23: 3816 (1995)] is included.

As the aging-suppressing gene, any of the genes obtained above in 2) can be used. Specifically, DNA encoding the amino acids represented by SEQ ID NO:3 may be used.

According to a conventional method, the cosmid is digested with an appropriate enzyme, such as SmaI or the like, and ligated with the aging-suppressing gene to prepare a recombinant cosmid.

(ii) Preparation of recombinant adenovirus containing aging-suppressing gene

Recombinant viruses can be prepared by the method described by Miyake et al. [Proc. Natl. Acad. Sci. USA, 93: 1320 (1996)] and the like.

More specifically, the recombinant cosmid containing the aging-suppressing gene as prepared in (i) is mixed with an EcoT22I-cleaved type 5 adenovirus Ad5dIX DNA with deletion of E3, E1A and E1B [J. Virology, 54: 711 (1985)], and the resulting mixture is then introduced into a cell line harboring E1A and E1B genes, for example, human fetus kidney-derived 293 cells using, for example, a potassium phosphate method (Japanese

Published Unexamined Patent Application No. 227075/1990) or the like. If the recombination between the cosmid and the adenovirus DNA occurs inside the cells, a recombinant adenovirus is produced, which kills the cells, and therefore, confirms that a recombinant adenovirus containing the aging-suppressing gene is produced and acts as a marker therefor. By recovering the killed cells and by disrupting the cells through repeating freezing and thawing the cells using a cell disrupter, for example, a recombinant adenovirus solution containing the aging-suppressing gene is obtained.

Furthermore, the DNA of the resulting recombinant virus is extracted from the virus by a conventional method, and cleaved with a restriction enzyme, such as *XhoI* or the like, to confirm the structure thereof.

(iii) Purification of recombinant adenovirus

According to the method by Kanegae, et al. [*Jpn. J. Med. Sci. Biol.*, 47: 157 (1994)], for example, the resulting recombinant virus is purified twice on cesium chloride density gradient, and is then suspended in a solution, such as PBS containing 10% glycerol, HEPES-MgCl₂ containing 10% glycerol, HEPES-EDTA containing 10%

glycerol, or the like, and can be stored at -80°C prior to appropriate use.

(iv) Dosing of recombinant adenovirus containing aging-suppressing gene into mice showing syndrome resembling premature aging

The recombinant virus thus obtained is administered at 10^8 to 10^{10} plaque forming units (PFU) through the caudal vein of a mouse showing a syndrome resembling premature aging, preferably aged about 3 to 4 weeks. After the administration of the recombinant virus, elimination of the syndrome resembling premature aging is observed.

11) Screening and identification of ligand specifically binding to aging-suppressing polypeptide of the present invention

By putting the aging-suppressing polypeptide of the present invention in contact with a test sample, such ligand can be screened and identified.

Examples of the test sample include urine, body fluids, tissue extracts, cell culture supernatant, cell extracts, and the like from mammals (for example, mouse, rat, guinea pig, hamster, pig, sheep, bovine, horse, dog, cat, monkey, humans, and the like).

By appropriately diluting, concentrating and fractionating urine, body fluids, tissue extracts, cell culture supernatants, and cell extracts, subsequently putting them in contact with the aging-suppressing polypeptide of the present invention, and further fractionating them using the cell stimulating activity as an index, a single ligand can be isolated.

More specifically, by putting a test sample in contact with both cells essentially never expressing the aging-suppressing gene and the cells after introduction and expression of the aging-suppressing gene, assaying various cell stimulating activities in the two types of the cells, for example, the change in concentrations of cellular information transmission molecules, such as cellular calcium, cAMP, cGMP, and the like, the phosphorylation of cellular protein, the change of the expression of early transcription factor gene, the change of cell membrane potential, the change of cellular pH, the release of extracellular information transmission molecules, the morphological change of cells, and the like, and comparing and analyzing the difference in the two types of the cells, a ligand is screened and identified.

By labeling naturally occurring or artificially synthesized protein, sugar and lipid, and their modified

products and derivatives with radioisotopes and the like, and assaying the binding of the labeled compounds onto the aging-suppressing polypeptide expressing cells, the cell membrane fractions, or the aging-suppressing polypeptide immobilized on microtiter plates and the like in accordance with the present invention, it is possible to identify whether or not the ligand described above is the ligand of the present invention.

By the known method comprising covalently bonding the aging-suppressing polypeptide of the present invention, or a partially modified product or a partial peptide thereof to the sensor chip of BIAcore (manufactured by Pharmacia Biotech Co.) and then putting a test sample in contact with the covalently bonded polypeptide [Nature, 368: 558 (1994)], the ligand can be screened and identified.

By using further the aging-suppressing gene polypeptide, labeled or non-labeled, together with a labeled antibody against the polypeptide, a ligand specifically associating with the polypeptide can be screened and identified by the following method.

That is, by appropriately fractionating urine, body fluids, tissue extracts, cell culture supernatants, cell extracts, or the like, further fractionating them by electrophoresis, such as polyacrylamide

electrophoresis, agarose electrophoresis, two-dimensional electrophoresis, or the like, column chromatography, such as HPLC or the like, and thin-layer chromatography, thereafter comparing and analyzing in detail the difference between individuals expressing the aging-suppressing gene and individuals never expressing the gene or the difference between the aging-suppressing gene-expressing cells and the gene-non-expressing cells, bands, spots and peaks make appearance (disappearance) with a specific correlation with the expression of the aging-suppressing gene is identified.

The bands, spots and peaks are transferred onto a support, such as nitrocellulose membrane, nylon membrane, PVDF membrane, or the like, from gel or thin-layer plate, using blotting procedures, bands or spots specifically binding to the polypeptide are screened using the aging-suppressing gene polypeptide, labeled or non-labeled, together with a labeled antibody against the polypeptide, and a ligand is extracted from the band or spots and identified.

12) Screening and identification of compounds inhibiting specific binding between aging-suppressing polypeptide of the present invention and ligand of the present invention

By comparing the case when the aging-suppressing polypeptide of the present invention is put in contact with the ligand of the present invention and the case when the aging-suppressing polypeptide, the ligand of the present invention and a test compound are put in contact with each other, a compound inhibiting the specific binding between the aging-suppressing polypeptide and the ligand (for example, protein, peptide, sugar, lipid, non-peptide compounds, synthetic compounds, fermentation compounds, biological components, or the like) can be screened from the test sample. The compound obtained through the screening includes for example a compound (antagonist) inhibiting the specific binding of the ligand to the aging-suppressing polypeptide and inhibiting the activity of the aging-suppressing polypeptide, and a compound (agonist) inhibiting the specific binding but having the same functions as those of the ligand or having an alternative activity.

In addition to synthetic compounds, protein, sugar, and lipid from natural origin or artificially synthesized, their modified products and derivatives thereof, and the like, the test sample includes, for example, urine, body fluids, tissue extracts, cell culture supernatants, and cell extracts of mammals (for

example, mouse, rat, guinea pig, hamster, pig, sheep, bovine, horse, dog, cat, monkey, humans, etc.), and additionally includes fermentation products and extracts from plants, other biological organisms, and the like.

The method for screening the compound includes, for example, the following method.

A method for screening and identifying the compound inhibiting the specific binding between the aging-suppressing gene polypeptide of the present invention and the ligand of the present invention is illustrated, comprising putting a cell with the aging-suppressing gene introduced and expressed therein or a cell essentially expressing the aging-suppressing gene in contact with the ligand alone or in combination with a test sample and comparing then the case of the ligand alone with the case of the ligand put in contact with the test sample from the various cell stimulating activities, for example, the change of the concentrations of cellular information transmission molecules, such as cellular calcium, cAMP, cGMP, or the like, the phosphorylation of cellular protein, the change of the expression of early transcription factor gene, the change of cell membrane potential, the change of cellular pH, the release of extracellular information

transmission molecules, the morphological change of cells, and the like.

By labeling the ligand of the present invention with radioactivity or the like, and assaying the binding of the labeled ligand onto the aging-suppressing polypeptide-expressing cells, the cell membrane fraction thereof, or the aging-suppressing polypeptide immobilized on a microtiter plate or the like in accordance with the present invention, and then comparing the binding level between the case of the ligand alone and the case of the ligand put in contact with the test sample, a compound inhibiting the binding between the aging-suppressing polypeptide and the ligand can be screened and identified.

13) Screening and identification of a compound induced as a consequence of binding of aging-suppressing polypeptide of the present invention and ligand of the present invention

The culture supernatant, cells, cytoplasmic fraction, cell membrane fraction and the like of the cells expressing the polypeptide of the present invention and the polypeptide-non-expressing cells, separately in contact with the ligand of the present invention or not in contact with the ligand, are

subjected to electrophoresis, such as polyacrylamide electrophoresis, agarose electrophoresis, two-dimensional electrophoresis or the like, column chromatography, such as HPLC or the like, and thin-layer chromatography to fractionate individual components, and the components are compared with each other. Hence, bands, spots or peaks and the like are identified, which specifically develop or are eliminated on contact to the ligand or which specifically develop or are eliminated with a correlation to the expression of the polypeptide to obtain an objective molecule from the bands, spots, and peaks.

It is believed that the specific binding between the polypeptide and the ligand constantly occurs in individuals expressing the polypeptide of the present invention, and that such interaction does not occur in individuals who do not express the polypeptide (preferable specific examples include the premature aging mouse described in the present specification). Thus, various organs, tissues, body fluids, blood, urine and the like of the normal mouse and the premature aging mouse described in the present specification) are appropriately fractionated, and are then further fractionated using electrophoresis, such as polyacrylamide electrophoresis, agarose electrophoresis,

two-dimensional electrophoresis, or the like, column chromatography, such as HPLC or the like, thin-layer chromatography, or the like. Through the comparison between these mice, bands, spots, peaks and the like having a difference in performance between the two types of the mice are screened to collect molecules based on the bands, spots and peaks and identify an objective compound from the bands, spots and peaks.

14) Screening and identification of a compound enhancing expression of the aging-suppressing polypeptide of the present invention (hereinafter referred to as "expression enhancing compound")

(i) Screening and identification using an antibody recognizing the aging-suppressing polypeptide of the present invention

After putting cells expressing the aging-suppressing polypeptide of the present invention in contact with a test sample, an expression enhancing compound present in the cell culture supernatant of the cells can be screened and identified using an antibody which recognizes the aging-suppressing polypeptide of the present invention.

The cells expressing the aging-suppressing polypeptide of the present invention include murine

kidney-derived uriniferous tubule cells, which can be prepared by a known method, such as a concentration density method, an osmotic pressure-resistant separation method, and a tubular separation method [*Kidney and Dialysis*, Extra issue, 588 (1991)].

In addition to synthetic compounds, protein, peptide, non-peptide compounds, sugar, and lipid from natural origin and lipid artificially synthesized, their modified products and derivatives, and the like, the test compound includes urine, body fluids, tissue extracts, cell culture supernatant, cell extracts of mammalian animals (for example, mice, rats, guinea pigs, hamsters, pigs, sheep, horse, bovine, dogs, cats, monkeys, humans, and the like); and further includes fermentation products, extracts from plants and other biological organisms, and the like; however, it is not limited thereto.

After suspending the cells expressing the aging-suppressing polypeptide of the present invention, for example, in a medium capable of growing the cells, and adding a test sample into the medium to put the cells in contact with the test sample, the content of the aging-suppressing polypeptide expressed by the cells is assayed using the polyclonal antibody or monoclonal

antibody described in 6) according to the method described above in 7).

By screening a test sample which could increase the content of the aging-suppressing polypeptide, compared with a system with no addition of the test sample, an expression enhancing compound can be identified.

(ii) Screening and identification using an assay system of the transcription product of the aging-suppressing gene of the present invention

After putting the cells expressing the aging-suppressing polypeptide of the present invention in contact with a test sample and assaying the transcription product of the aging-suppressing gene of the present invention, an expression enhancing compound can be screened and identified.

An example of the cells expressing the aging-suppressing polypeptide of the present invention and the test sample is described above in (i).

After suspending the cells expressing the aging-suppressing polypeptide of the present invention, for example, in a medium capable of growing the cells, and adding a test sample into the medium to thereby put the cells in contact with the test sample, the amount of the

transcription product of the aging-suppressing polypeptide expressed by the cells is assayed by conventional Northern blot hybridization, RNA dot blot hybridization, RT-PCR, or the like.

The probe which can be used for hybridization and the primer which can be used for RT-PCR include fragments of the aging-suppressing gene of the present invention. Specific examples include DNA fragments comprising DNA sequences selected from DNA sequences represented by SEQ ID NOS:6, 7, 8, 9 and 10.

By screening a test sample which could increase the content of the transcription product of the aging-suppressing polypeptide, compared with a system with no addition of the test sample, an expression enhancing compound can be identified.

(iii) Screening and identification using a reporter gene

After putting a transformant harboring a plasmid containing DNA with a reporter gene ligated downstream of a region controlling the transcription of the gene encoding the aging-suppressing polypeptide of the present invention (hereinafter referred to as "transcription controlling region") in contact with a test sample and assaying the expression level of the

polypeptide encoded by the reporter gene, an expression enhancing compound can be screened and identified.

The transcription controlling region includes a region of about 8 kb present in a site about 6 kb upstream the aging-suppressing gene in which it is observed that the region is deleted in the homozygote described in Example 2 described below. Additionally, a fragment of an appropriate length can also be used as the transcription controlling region. Such a fragment is prepared by excising the region using an appropriate restriction enzyme.

Any reporter gene can be used, so long as the translation product of the reporter gene is stable inside cells and the amount of the translation product present is readily assayed. Examples include chloramphenicol acetyltransferase (CAT), β -galactosidase (β -gal), luciferase (luc), green fluorescent protein (GFP), and the like.

As the test sample, those described above in (i) can be used.

After ligating the reporter gene downstream of the transcription controlling region by a conventional method, a host cell is transformed using the prepared plasmid by a conventional method.

By suspending the transformant for example in a medium capable of growing the cells, adding a test sample into the medium and putting the cells in contact with the test sample, the content of the transcription product of the reporter gene as expressed by the cells is detected and assayed by a method appropriate for the transcription product.

Examples of the detection and assay methods include the method described in *Molecular Cloning*, 2nd ed., Chapter 16, page 60 for CAT, the method described in *Experimental Medicine, Supplementary Volume, Biomanual Series, 4, Gene Introduction and Expression Analysis*, 81 (1994) for luc, and the method described in *Proc. Natl. Acad. Sci. USA*, 94: 4653 (1997) for GFP.

By screening a test sample which could increase the content of the transcription product of the aging-suppressing polypeptide of the present invention, compared with a system with no addition of the test sample, an expression enhancing compound can be identified.

15) Preparation of the oligonucleotide of the present invention

Using the DNA of the present invention and the DNA fragments thereof, oligonucleotides (both antisense

and sense oligonucleotides, and the like) containing a partial sequence of the DNA of the present invention can be prepared.

The oligonucleotide includes DNA comprising a sequence which is identical to or complementary to continuous 10 to 50 nucleotides of the DNA sequence. Specific examples include DNA comprising a sequence which is identical to or complementary to continuous 10 to 50 nucleotides in the nucleotide sequence of DNA selected from DNAs represented by SEQ ID NOS:6 to 10.

The oligonucleotide is included as the oligonucleotide of the present invention, and furthermore, the derivatives of such oligonucleotide is also included as the oligonucleotide of the present invention. The derivative DNA includes a derivative DNA prepared in which the phosphate diester bonding in DNA is modified to phosphorothioate bonding, a derivative DNA in which the phosphate diester bonding in DNA is modified to N3'-P5' phosphoramidate bonding, a derivative DNA in which the ribose and phosphate diester bonding in DNA is modified to peptide-nucleic acid bonding, a derivative DNA in which the uracil in DNA is substituted with C-5 propionyluracil, a derivative DNA in which the uracil in DNA is substituted with C-5 thiazole uracil, a derivative DNA prepared in which the

cytosine in DNA is substituted with phenoxazine-modified cytosine, a derivative DNA in which the ribose in DNA is substituted with 2'-O-propylribose, or a derivative DNA in which the ribose in DNA is substituted with 2'-methoxyethoxyribose, and the like [*Cell Engineering*, 16: 1463 (1997)].

16) Use of the aging-suppressing polypeptide, DNA encoding the polypeptide, the antibody recognizing the polypeptide, oligonucleotide of the present invention, the ligand of the present invention, and the expression enhancing compound

(i) The aging-suppressing polypeptide can be detected and assayed in samples of blood, some organs, cells, and the like, using the anti-aging-suppressing polypeptide antibody of the present invention. Specific examples of the preferable means include ELISA, a fluorescent antibody method, and Western blotting, and additionally, immune cell staining using pathological tissue sections. Therefore, the antibody is useful for diagnosing the possibility of the occurrence of a syndrome resembling premature aging and various adult diseases due to the decrease in the expression of the aging-suppressing polypeptide. Similarly, the antibody is also useful as

a laboratory reagent for research works of the subject peptide.

(ii) Aging can be suppressed by administering the full length or a partial length of the aging-suppressing polypeptide of the present invention into biological organisms. Therefore, the aging-suppressing polypeptide is useful as a therapeutic agent or a preventive agent for various adult diseases occurring in close relation with the progress of aging, for example, arteriosclerosis, hypertension, osteoporosis, and the like. Based on the suppression of aging, additionally, the polypeptide is effectively useful for the prolongation of the life.

(iii) The aging-suppressing gene of the present invention can be used for therapeutic treatment by gene therapy after the aging-suppressing gene of the present invention is incorporated into viral vectors and other vectors, such as retrovirus, adenovirus, and the like.

(iv) According to Northern hybridization or PCR using the aging-suppressing gene or oligonucleotides of the present invention, the expression level of the gene is assayed, and aging and adult diseases are diagnosed.

Additionally, the aging-suppressing gene or oligonucleotides can be used for suppressing aging or suppressing the onset of adult diseases. By detecting an individual who is aging and has a higher possibility of adult diseases due to the congenital defect of the aging-suppressing gene, using the aging-suppressing gene or oligonucleotides according to Southern blotting or PCR, gene diagnosis can be carried out based on the information of the sequence of the nucleic acids in the detected individual. Furthermore, the aging-suppressing gene or oligonucleotide is extremely useful as the reagent for genetic research works.

(v) By administering the product of the aging-suppressing gene derived from objective livestock, such as bovine, sheep, goat, pig, horse, chicken, and the like, as provided in accordance with the present invention to an adequate animal or by expressing the gene in an individual using an appropriate vector, such as virus or the like, for gene therapy, the life of the objective livestock can be prolonged or the aging thereof can be suppressed. As a result, the livestock can be raised well for a long term, so that milk, egg and fetus can be harvested for a prolonged term. Furthermore, so-called transgenic livestock may be

generated by introducing the gene into a fertilized egg and inserting the gene into the chromosomes of the cells of the whole body for expressing the gene therein, and the same effect can be expected, which may be useful in stock breeding.

Additionally, a mutant clone wherein the aging-suppressing gene on the chromosome in an embryonic stem cell is inactivated or substituted with an appropriate sequence by a known homologous recombinant technique [for example, *Nature*, 326: 6110, 295 (1987); *Cell*, 51: 3, 503 (1987), etc.] can be prepared [for example, *Nature*, 350: 6315, 243 (1991)] using a vector containing the gene. A chimera comprising the embryonic stem cell and normal cells can be prepared using the embryonic stem cell clone thus prepared according to technique, such as an injection chimera method, a coeno-chimera method, or the like into the blastocyst of a fertilized egg of an animal. Through the mating of the chimera with a normal subject, an individual with an appropriate mutation in the aging-suppressing gene in the cells of the whole body can be prepared, and through the mating of such individuals, a homozygote in which mutations inserted into both the homologous chromosomes can be obtained.

In such a manner, in animal individuals, mutations can be introduced into an appropriate site of

the aging-suppressing gene. By introducing mutations, such as substitution, deletion, insertion, or the like, of nucleotides into the translation region of the aging-suppressing gene, the activity of the product can be modified. Additionally, through similar insertion of mutations into the expression controlling region, the extent, timing and tissue specificity and the like of the expression can be modified. Through the combination with the Cre-loxP line, the expression timing, expression site, expression level and the like can be more actively controlled. Known examples of these ideas include the situation wherein an objective gene is deleted in a specific cerebral region using a promoter expressed in the region [Cell, 87: 7, 1317 (1996)] and an example wherein an objective gene is deleted at an objective timing in a specific method to organs using an adenovirus expressing Cre [Science, 278: 5335 (1997)]. Regarding the aging-suppressing gene of the present invention, an animal individual capable of controlling the expression in an appropriate tissue at an appropriate time or having an appropriate insertion, deletion or substitution in the translation region or expression controlling region can be prepared. In such an animal, a syndrome of aging and various diseases, such as adult diseases based on aging and the like, can

be induced at an appropriate site and at an appropriate time. Thus, the animal serves as an extremely useful model for therapeutically treating or preventing aging or various diseases such as adult diseases. In particular, the animal is very useful as an assessment model of the therapeutic agents and preventive agents thereof, functional foods, health food, and the like.

(vi) The aging-suppressing polypeptide of the present invention is useful as a reagent for screening and determining a ligand specifically binding to the polypeptide.

(vii) The aging-suppressing polypeptide of the present invention is used, together with the ligand of the present invention, to screen and identify a compound inhibiting the specific binding between the polypeptide and the ligand.

(viii) A molecule induced as the consequence of the binding of the polypeptide to the ligand can be screened and identified using the aging-suppressing polypeptide of the present invention and the ligand of the present invention,.

(ix) It is possibly suggested that a compound inhibiting the specific binding between the aging-suppressing polypeptide of the present invention and the ligand of the present invention as well as the molecule induced as the consequence of the binding between the polypeptide and ligand of the present invention serves as an alternative to the aging-suppressing functions of the aging-suppressing gene polypeptide or supplement the functions, and therefore, pharmaceutical agents containing such molecules are useful as therapeutic agents of a syndrome resembling premature aging, therapeutic agents of adult diseases, and aging-suppressing agents.

(x) A compound enhancing the expression of the aging-suppressing gene encoding the aging-suppressing polypeptide of the present invention (expression enhancing compound), which is useful as a therapeutic agent for a syndrome resembling premature aging, a therapeutic agent for adult diseases and an aging-suppressing agent, is useful for suppressing aging and therapeutically treating or preventing adult diseases, like the aging-suppressing polypeptide.

BRIEF DESCRIPTION OF THE DRAWINGS

The symbols used in the drawings are described below.

bp: base pairs

kb: kilobase pairs

IFN- γ : interferon- γ gene

Amp, Ap or Ap^r:

ampicillin resistant gene derived from pBR322

rop⁺: rop gene

PletI: letI promoter

Ptrp: trp promoter

P_{SE}: simian virus 40 (SV40) early gene promoter

P_{MO}: long terminal repeat (LTR) promoter of Molony
mouse leukemia virus

Hyg: hygromycin resistant gene

G418^r: G418 resistant gene

dhfr: dihydrofolic acid reductase gene

P1: P1 promoter derived from pBR322

Ptk: promoter of herpes simplex virus (HSV) thymidine
kinase (tk) gene

Sp. β G: rabbit β -globin gene splicing signal

A. β G: rabbit β -globin gene poly(A) addition signal

A.SE: simian virus 40 (SV40) early gene poly(A)
addition signal

Atk: poly(A) addition signal of herpes simplex virus
(HSV) thymidine kinase (tk) gene

The drawings are simply described below.

Fig. 1 is an electrophoretic pattern depicting the results of chromosomal Southern blot hybridization with the full length of an introduction gene as the probe; lane 1 shows the results from a homozygote; lane 2 shows the results from a heterozygote; and lane 3 shows the results from a wild-type mouse.

Fig. 2 depicts restriction maps of the introduction gene and plasmids practically rescued.

Fig. 3 is an electrophoretic pattern depicting the outcome of chromosomal Southern blot hybridization with a chromosome fragment contained in the rescued plasmid as the probe; lane 1 shows the results from a homozygote; lane 2 shows the results from a heterozygote; and lane 3 shows the results from a wild-type mouse.

Fig. 4 depicts a restriction map of a phage clone with the chromosomal DNA in the proximity of the introduction gene to be inserted.

Fig. 5 is an electrophoresis pattern depicting the results of the Northern blot hybridization on poly(A)⁺ RNAs of murine individual organs and SacII 450 bp as the probe.

Fig. 6 is an electrophoresis pattern depicting the results of the Northern blot hybridization on poly(A)⁺ RNA prepared from the kidney of each of a wild-type mouse, a heterozygote, a homozygote (mouse showing a syndrome resembling premature aging), and wild-type mice at individual stages from the birth (0 W) to 7 weeks, together with SacII 450 bp as the probe.

Fig. 7 schematically depicts the cDNAs of the aging-suppressing polypeptides of human full length (upper), human secretory type (center) and murine full length (lower), and the proteins encoded by the cDNAs.

Fig. 8 is a view depicting the restriction map of plasmid pNKM101; the longer arrow represents the mouse-derived aging-suppressing gene and the direction of transfer.

Fig. 9 is a view depicting the restriction map of plasmid pNKM112; the longer arrow represents the mouse-derived aging-suppressing gene derived and the direction of transfer.

Fig. 10 is an electrophoresis pattern showing the results of examining the expression of the murine secretory aging-suppressing gene toward the poly(A)⁺ RNA of each of mouse organs by RT-PCR.

Fig. 11 is a view depicting the restriction map of plasmid pNKM103; the longer arrow represents the

human-derived aging-suppressing gene and the direction of transfer.

Fig. 12 is a view depicting the restriction map of plasmid pNKH106; the longer arrow represents the human-derived secretory aging-suppressing gene and the direction of transfer.

Fig. 13 is a view showing the construction process of plasmid pSupex.

Fig. 14 is a view showing the construction process of plasmid pYT102.

Fig. 15 is a SDS-polyacrylamide gel electrophoresis pattern for confirming the presence of an aging-suppressing polypeptide fragment produced in *Escherichia coli* harboring pYT102; lane 1 represents the production of an aging-suppressing polypeptide fragment in *Escherichia coli* NY49 harboring pYT102, with no addition of IAA, and lane 2 represents the production thereof with addition of IAA.

Fig. 16 is an electrophoresis pattern confirming the expression of an aging-suppressing polypeptide fragment in *Escherichia coli* using a polyclonal antibody against the aging-suppressing polypeptide fragment by Western blotting.

Fig. 17 is a view showing the construction process of pAGE210.

Fig. 18 is a view showing the construction process of pYT103.

Fig. 19 is an electrophoresis pattern confirming the expression of the full length of the aging-suppressing polypeptide in animal cells using a polyclonal antibody against the aging-suppressing polypeptide fragment by Western blotting; lane 1 represents the results using CHO dhfr⁻ cells (as control of a host alone); and lane 2 represents the results using CHO dhfr⁻/pYT103 MTX amplified cells.

Fig. 20 is a view showing the construction process of pAS104.

Fig. 21 is a SDS-polyacrylamide electrophoresis pattern confirming the expression of the full length of the aging-suppressing polypeptide in insect cells; lane 1 represents the results using molecular weight markers; lane 2 represents the results using Sf9 cells; and lane 3 represents the results using Sf9 cells infected with a virus expressing the aging-suppressing polypeptide.

Fig. 22 is an electrophoresis pattern confirming the expression of the full length of the aging-suppressing polypeptide in insect cells using a polyclonal antibody against the aging-suppressing polypeptide fragment by Western blotting; lane 1 represents the results using Sf9 cells; and lane 2

represents the results using Sf9 cells infected with a virus expressing the aging-suppressing polypeptide.

Fig. 23 is a view depicting the construction process of plasmid pYS110.

Fig. 24 is an electrophoresis pattern confirming the expression of the full length of the aging-suppressing polypeptide in CHO cells (CHO dhfr⁻) using the monoclonal antibody KM1902 against the aging-suppressing polypeptide fragment by Western blotting; lane 1 represents the results of Western reaction using CHO cells; lane 2 represents the results of Western reaction using CHO cells (CHO dhfr⁻/pYS110) expressing the human-derived aging-suppressing polypeptide; and lane 3 represents the results using CHO cells (CHO dhfr⁻/pYT103) expressing the mouse-derived aging-suppressing polypeptide.

Fig. 25 is a view of the construction process of plasmid pYS111.

Fig. 26 is an electrophoresis pattern confirming the expression of the full length of the human-derived secretory aging-suppressing polypeptide in CHO cells (CHO dhfr⁻) using the monoclonal antibody KM1902 against the aging-suppressing polypeptide fragment by Western blotting; lane 1 represents the results of Western reaction using CHO cells (CHO dhfr⁻); and lane 2

represents the results of Western reaction using CHO cells (CHO dhfr⁻/pYS111) expressing the human-derived secretory aging-suppressing polypeptide.

Fig. 27 is a view of the construction process of plasmid pYS150.

Fig. 28 is an electrophoresis pattern confirming the expression of the full length of the human-derived secretory aging-suppressing polypeptide in insect cells using the monoclonal antibody KM1902 against the aging-suppressing polypeptide fragment by Western blotting. The results in which Sf21 cells infected with a virus expressing the human-derived secretory aging-suppressing polypeptide were used are shown.

Fig. 29 is a view of the construction process of plasmid pYS112.

Fig. 30 is an electrophoresis pattern confirming the expression of the full length of the mouse-derived secretory aging-suppressing polypeptide in CHO cells (CHO dhfr⁻) using the monoclonal antibody KM1902 against the aging-suppressing polypeptide fragment by immunoprecipitation; lane 1 represents the results of Western reaction using CHO cells; and lane 2 represents the results of Western reaction using CHO cells (CHO dhfr⁻/pYS112) expressing the mouse-derived secretory aging-suppressing polypeptide.

Fig. 31 is a view of the construction process of plasmid pYS151.

Fig. 32 is an electrophoresis pattern confirming the expression of the full length of the mouse-derived secretory aging-suppressing polypeptide in insect cells using the monoclonal antibody KM1902 against the aging-suppressing polypeptide fragment by immunoprecipitation; lane 1 represents the results using Sf21 cells; and lane 2 represents the results using Sf21 cells infected with a virus expressing the mouse-derived secretory aging-suppressing polypeptide.

Fig. 33 is a view showing the analysis of the reactivity of the monoclonal antibody KM1902 by a flow cytometer; (A) represents the results of the comparison between the addition of the monoclonal antibody KM1902 and no addition of the antibody into CHO cells (CHO dhfr⁻); (B) represents the results of the comparison between the addition of the monoclonal antibody KM1902 and no addition of the antibody into CHO cells (CHO dhfr⁻/pYT103) expressing the aging-suppressing polypeptide.

Fig. 34 depicts a Western blotting pattern showing the results of immunoprecipitation with the monoclonal antibody KM1902 using the aging-suppressing polypeptide expressing CHO cells (CHO dhfr⁻/pYT103); on

lane 1, the results of immunoprecipitation with the monoclonal antibody KM1902 using the aging-suppressing polypeptide expressing CHO cells (CHO dhfr⁻/pYT103); and on lane 2, the results of immunoprecipitation with no addition of the monoclonal antibody KM1902 using the aging-suppressing polypeptide expressing CHO cells (CHO dhfr⁻/pYT103).

Fig. 35 depicts a scheme of the construction process of plasmid pEFSA.

Fig. 36 depicts a scheme of the construction process of plasmid pRES.

Fig. 37 depicts the results of the administration of a recombinant adenovirus harboring the murine aging-suppressing gene; A, wild-type with no administration; B, wild-type with administration of virus; C, homozygote (mouse showing a syndrome resembling premature aging) with administration of virus; D, homozygote (mouse showing a syndrome resembling premature aging) with no administration.

Fig. 38 depicts a scheme of the construction process of plasmid pYS201.

Fig. 39 is an SDS-polyacrylamide electrophoresis pattern of the human-derived aging-suppressing polypeptide N-terminal region (peptide SUHN) produced in *Escherichia coli* harboring pYS201.

Fig. 40 depicts a scheme of the construction process of plasmid pYS202.

Fig. 41 is an SDS-polyacrylamide electrophoresis pattern of the human-derived aging-suppressing polypeptide C-terminal region (peptide SUHC) produced in *Escherichia coli* harboring pYS202.

Fig. 42 is an electrophoresis pattern depicting the results of Western blot hybridization of murine tissues. The extract solution of the murine membrane type complete length-expressing CHO cells; murine kidney, the membrane fraction and cytoplasmic fraction of liver, and the murine membrane type complete length-expressing CHO cell extract solution were separated by SDS-polyacrylamide electrophoresis, Western blotting was carried out using KM2076, and detection was carried out through exposure to an X-ray film with a chemiluminescent reagent.

Fig. 43 is an electrophoresis pattern showing the results of Western blot hybridization of a murine tissue and the extract solution of the murine membrane type complete length-expressing CHO cells using KM2119 and KM2116; the membrane fractions and cytoplasmic fractions of murine kidney and liver, and the extract solution of murine membrane-type complete length-expressing CHO cells were separated by SDS-polyacrylamide

electrophoresis; Western blotting was carried out by means of KM2076 or KM2116, for detection through exposure to an X-ray film with a chemiluminescent reagent.

Fig. 44 is an electrophoresis pattern showing the results of Western blot hybridization, comprising preparing a cell extract solution from murine membrane-type complete length-expressing CHO cells, carrying out immunoprecipitation using KM2076, KM2119 and Protein G-Sepharose 4FF for separation by SDS-polyacrylamide electrophoresis, and carrying out Western blotting.

Fig. 45 depicts an electrophoresis pattern showing the results of Western blot hybridization, comprising immune precipitating a culture supernatant of human secretory expressing CHO cells using KM2076 and Protein G-Sepharose 4FF, carrying out SDS-polyacrylamide electrophoresis for separation, and carrying out Western blotting using KM2076; lane 1 represents the results of the immunoprecipitation of the culture supernatant of human secretory CHO cells using KM2076 and Protein G-Sepharose 4FF; lane 2 represents the results of the immunoprecipitation of a serum-free medium using KM2076; and lane 3 represents the results of the immunoprecipitation of the culture supernatant of the human secretory expressing CHO cells using NRIgG.

BEST MODE FOR CARRYING OUT THE INVENTION

Examples are shown hereinafter. Unless otherwise stated, genetic manipulation is carried out according to the known method described in *Molecular Cloning*, 2nd ed.

Example 1

Cloning of murine chromosomal DNA adjacent to gene-introduced site:

(1) Detection of introduction gene

A transgenic mouse into which a foreign gene with a Na⁺/H⁺ reverse transmitter ligated to human elongation factor 1 α promoter (EF-1 α promoter) was introduced was produced (Japanese Published Unexamined Patent Application No. 268856/1993), the resulting heterozygotes were mated to each other to obtain a homozygote showing a syndrome resembling premature aging. From the homozygote, a mouse showing a prominent syndrome resembling premature aging [18th Annual Meeting of The Molecular Biology Society of Japan (Nabeshima et al., 2K-02, 1995)], and a heterozygote used for obtaining the homozygote were used in the following experiments.

From the livers of the heterozygote, homozygote and a wild-type mouse, chromosomal DNAs were prepared.

Each 10 µg of the chromosomal DNAs was completely digested with *EcoRV* and *XbaI*.

The digested DNA fragments were subjected to 0.8% agarose gel electrophoresis, and blotted on a Hybond N⁺ filter (manufactured by Amersham Co.).

The labeled plasmid pEFNaH (Japanese Published Unexamined Patent Application No. 268856/1993), which was used for preparing the transgenic mouse with α -[³²P]-dCTP using Megaprime DNA Labeling Kit (manufactured by Amersham Co.), was also used as a probe for hybridization with the blotted Hybond N⁺ filter according to the attached manual of the Hybond N⁺ filter.

The results are shown in Fig. 1. Because only a single band was detected around about 150 kb in the heterozygote and homozygote, it was indicated that the introduction gene was inserted at only one site on the murine chromosome. The results were also confirmed by FISH using the introduction gene as a probe. More specifically, a single signal was detected on the telomere of the 6th chromosomal long arm (6G2-3).

(2) Cloning of murine chromosomal DNA adjacent to gene-introduced site (1)

Ten µg of the chromosomal DNA of the homozygote described in (1) was completely digested with *EcoRI* or

KpnI, and ligation reaction was carried out at a concentration of 10 ng/ml at 16°C for 30 minutes using a DNA ligation kit (manufactured by Takara Shuzo Co., Ltd.).

Escherichia coli XL1-Blue MRF' (Epicurian Coli, manufactured by STRATAGENE Co.) was transformed using 10 µl of the reaction solution, and then cultured at 37°C for 18 hours, and the plasmids were recovered from the resulting colonies.

When the chromosome was digested with *EcoRI*, two types of plasmids, namely E50 and E70, were rescued as plasmids harboring a fragment of murine genomic DNA. When the chromosome was digested with *KpnI*, K8 plasmid was rescued as such plasmid.

Fig. 2 depicts restriction maps of the introduction gene and the actually rescued plasmids. All three types of plasmids contain DNA fragments different from the introduction gene, and it was indicated that these DNA fragments might possibly be chromosomal fragments adjacent to the introduction gene.

After preparing an *EcoRI*-*PvuII* fragment of the murine chromosomal DNA region contained in the rescued plasmid E50 and subsequently labeling the fragment with a radioisotope by a method similar to that in (1), Southern blotting was carried out using the filter used

in (1) after dehybridization and the labeled product as a probe.

The results are shown in Fig. 3. A single band from only the wild allele was observed in the wild-type mouse; a single band from only the mutant allele was observed in the homozygote; bands from both the alleles were observed in the heterozygote, whereby it was confirmed that the chromosome-derived DNA fragment contained in the rescued plasmid was a region adjacent to the introduction gene.

Example 2

Cloning of murine aging-suppressing gene:

The genomic library of a wild-type mouse (manufactured by STRATAGENE Co., murine genomic library, λ FIXII) was screened using the probe of Example 1(2) (according to the attached manual) to obtain three independent phage clones hybridizable with the probe (E8.5, E2.6, E11.1) (Fig. 4).

In comparison with the genomic DNA rescued from the homozygote in Example 1(2), deletion over about 8 kb was present in the region inside the aging-suppressing gene of the homozygote.

In order to identify a gene transcribed from the region, the nucleotide sequence over the center of the

deletion part was sequentially determined with a sequencer Model 14000L manufactured by Li-Cor Co. (the same sequencer used hereinafter). It was demonstrated that a CpG island was present by about 6 kb apart from the deletion part.

By excising out a 450 bp fragment with SacII from the deletion part and subsequently labeling the fragment by a method similar to that in Example 1(1), the labeled product was used as a probe for Northern hybridization under the conditions according to the manual for Hybond N⁺ filter using a poly(A)⁺ RNA filter of murine heart, brain, spleen, lung, liver, skeletal muscle, kidney and pancreas [Mouse Multiple Tissue Northern Blots' filters; manufactured by Clontech Co.].

The results are shown in Fig. 5. A band of about 5.3 kb was observed in kidney, and it was confirmed that an exon was contained in the SacII-digested fragment of 450 bp.

Poly(A)⁺ RNAs were prepared separately from the murine kidneys of the wild-type, homozygote and heterozygote using QuickPrep mRNA Purification Kit (manufactured by Pharmacia Co.), and 5 µg of each RNA was subjected to 0.8% agarose gel electrophoresis, and then transferred on a Hybond N⁺ filter (manufactured by Amersham Co.).

In the same manner as described above, Northern hybridization was carried out using the SacII digestion fragment of 450 bp as the probe.

The results are shown in Fig. 6. A band was observed individually for the wild-type and heterozygote, which establishes confirmation that the aging-suppressing gene was expressed, while no band was detected for the homozygote, which apparently indicates absolutely no expression of the gene.

Similarly, poly(A)⁺ RNA was prepared from murine kidney at each stage after birth for Northern hybridization using as a probe the SacII-digested fragment of 450 bp. As shown in Fig. 6, almost no expression of the aging-suppressing gene was observed until one to two weeks after birth; but the expression level was elevated gradually from the new born stage and was likely to be stronger on week 3 to 4 after birth.

Example 3

Cloning of cDNA of murine aging-suppressing gene:

A cDNA library was prepared by synthesizing cDNA from the poly(A)⁺ RNA of the kidney of a wild-type mouse using a cDNA synthesis system (cDNA Synthesis System, manufactured by GIBCO BRL, CO.), adding an EcoRI-NotI-SalI adapter (SuperScript Choice System for cDNA

Synthesis; manufactured by GIBCO BRL, CO.) onto both the termini, inserting then the resulting cDNA into the *EcoRI* site of a cloning vector λ ZAP II (λ ZAP II Cloning Kit; manufactured by STRATAGENE Co.) for *in vitro* packaging (Gigapack II Gold manufactured by STRATAGENE Co.).

Plaque hybridization of 5×10^5 clones of the cDNA library was carried out using the *SacII*-digested fragment of 450 bp in Example 2 as a probe. During the hybridization, the filter was washed twice under the conditions that the filter was immersed in a buffer containing $2 \times$ SSPE [$1 \times$ SSPE composition contains 180 mM sodium chloride, 10 mM sodium dihydrogen phosphate, and 1 mM ethylenediaminetetraacetate (EDTA) (pH 7.4)], washed twice under conditions that the filter was immersed in a buffer containing 0.1% SDS at 65°C for 10 minutes, washed once under conditions that the filter was immersed in a buffer of $1 \times$ SSPE and 0.1% SDS at 65°C for 15 minutes, and washed twice under conditions that the filter was immersed in a buffer of $0.2 \times$ SSPE and 0.1% SDS at 65°C for 10 minutes.

Through the hybridization, 40 independent hybridizable clones were obtained. From the clones, plasmids were recovered through *in vivo* excision, and

analyzed with restriction enzymes and nucleotide sequencing.

It was indicated from the nucleotide sequencing that plasmid pNKM101 contains cDNA of about 5 kb represented by SEQ ID NO:8, and that an open reading frame (hereinafter referred to as "ORF") of 3042 bp was present in the cDNA. In the ORF, a novel protein of 1014 amino acid residues was encoded, having a signal sequence of 35 amino acids at the N terminus and a transmembrane region of 19 amino acids at the C terminus, as shown in SEQ ID NO:3 (Fig. 7). The structure of pNKM101 is shown in Fig. 8.

Example 4

Isolation of mouse-derived secretory aging-suppressing gene:

In order to isolate a clone containing the genome region of the murine aging-suppressing gene from the library containing the murine genomic DNA (Bacterial artificial chromosome, BAC), PCR was carried out using as the primers the sequences of two regions in the murine aging-suppressing gene cDNA obtained in Example 3, the regions represented by SEQ ID NOS:11 and 12, along with the murine chromosomal DNA as the template. It was confirmed that a DNA fragment of 127 bp was amplified.

By using DNA Thermal Cycler 480 manufactured by Perkin Elmer Co., PCR was carried out for 30 cycles, each cycle being composed of a process of 94°C for one minute, 56°C for one minute and 72°C for one minute.

From the BAC library containing the murine chromosomal DNA of 100 kb on average a BAC clone was selected wherein a DNA fragment of 127 bp was amplified using the primers and amplification conditions described above by PCR.

After adding a sample of 10 µg of the resulting BAC clone to 50 µl of the buffer B, 3 units of *Sau3AI* were added to the sample and reacted at 37°C for 10 minutes.

Phenol-chloroform extraction and ethanol precipitation were carried out using the reaction solution to recover about 5 µg of the DNA fragment.

Cosmid vector pWE15 (manufactured by Clontech Co.) of 5 µg was added to 30 µl of buffer C, and 30 units of *Bam*HI were added thereto to react at 37°C for 2 hours. Phenol-chloroform extraction and ethanol precipitation using the reaction solution were carried out to recover about 2 µg of the DNA fragment.

The *Sau3AI* treated BAC clone fragment (1 µg) and the *Bam*HI treated pWE 15 fragment (100 ng) were dissolved in a T4-DNA ligase buffer (20 µl), and one

unit of T4 DNA ligase was added thereto for ligation at 16°C for 18 hours. The reaction solution was treated for *in vitro* packaging using Gigapack II Gold Extract (manufactured by STRATAGENE CO.) to prepare a cosmid library.

A clone in which the 127 bp fragment was amplified was obtained from the library using the primers and under the amplification conditions for the selection of the BAC clone by PCR.

The nucleotide sequence corresponding to the C terminus of the human-derived secretory aging-suppressing polypeptide obtained in Example 5 below was compared with the DNA sequence of the corresponding region of the murine aging-suppressing gene sub-cloned in the cosmid, and consequently, a DNA sequence encoding a sequence with homology to the polypeptide sequence from the 535th amino acid to the 549th amino acid of the human-derived secretory aging-suppressing polypeptide represented by SEQ ID NO:2 was found.

Gene amplification was carried out by PCR using a template Mouse Kidney Marathon Ready cDNA kit (manufactured by Clontech Co.), after adding a library-derived adapter primer represented by SEQ ID NO:13 and a primer corresponding to a mouse-derived region homologous to the C terminus of the human secretory

aging-suppressing polypeptide represented by SEQ ID NO:14.

PCR reaction was carried out for 30 cycles using DNA Thermal Cycler 480 manufactured by Perkin Elmer Co., each cycle being composed of a process of 94°C for one minute, 55°C for 30 seconds, and 72°C for one minute.

The resulting reaction product was analyzed by agarose gel electrophoresis, an amplified fragment of about 2 kb was observed, and the fragment was incorporated into pCR2.1 vector (manufactured by Invitrogen Co.).

A nucleotide sequence was determined, and a sequence represented by SEQ ID NO:9 was obtained. This result indicates that the cDNA is a murine secretory aging-suppressing gene of 1650 bp containing an ORF encoding 550 amino acid residues.

The gene was further subjected to PCR using synthetic DNA represented by SEQ ID NOS:15 and 16, *Hind*III and *Bam*HI digestion sites were added on both the termini of the gene, which was then inserted into the *Hind*III and *Bam*HI cleavage sites of plasmid vector pUC118, to prepare pNKM112 (Fig. 9).

In order to examine the expression of the gene in murine tissues, a reverse transcription reaction with a primer random 9-mer was carried out using TaKaRa RNA LA

PCR kit (AMV) Ver. 1.1 (manufactured by Takara Shuzo Co., Ltd.) with a template poly(A)⁺ mRNA (500 ng) prepared from various organs using the primers represented by SEQ ID NOS:17 and 18 and using QuickPrep mRNA Purification Kit (manufactured by Pharmacia Co.), followed by PCR reaction using LA-TaqDNA polymerase (manufactured by Takara Shuzo Co., Ltd.).

The PCR reaction was carried out for 30 cycles using a DNA Thermal Cyclor 480 manufactured by Perkin Elmer Co., each cycle being composed of a process of 94°C for 20 seconds, 60°C for 30 seconds, and 72°C for one minute.

The resulting reaction products were analyzed by agarose gel electrophoresis, and the results are shown in Fig. 10. Expression was observed in kidney, brain, pituitary gland, ovary, spermary, and pancreas.

Example 5

Cloning of cDNA for a human aging-suppressing gene:

(1) Preparation of aging-suppressing gene derived from human kidney

A human kidney cDNA library was constructed using human kidney poly(A)⁺ RNA (manufactured by Clontech Co.) by a method similar to that in Example 3. Plaque hybridization of about 1,000,000 clones of the library

was carried out using a 4.2 kb fragment excised out with the NotI site derived from the 5' terminal adapter in the murine cDNA of Example 2 and the NotI site present in the cDNA.

Through the hybridization, six independent strongly hybridizing clones were obtained. From the clones, plasmids were recovered by *in vivo* excision, and restriction analysis and nucleotide sequencing were carried out.

It was indicated from the nucleotide sequencing that a plasmid obtained from two clones harbored cDNA of about 3.2 kb having high homology over the full length to the murine sequence represented by SEQ ID NO:6, and that an ORF of about 3,036 bp was present in the cDNA, the ORF encoding the 1,012 amino acid residues represented by SEQ ID NO:1.

It was concluded that the amino acid sequence was a human homologue because the sequence had homology as high as 86% to mouse (Fig. 7).

The structure of the plasmid pNKM103 harboring the cDNA is shown in Fig. 11.

It was indicated that the plasmid obtained from the remaining four clones contained cDNA of about 3.4 kb represented SEQ ID NO:7 and an ORF of 1647 bp was

present in the cDNA, the ORF encoding the polypeptide represented by SEQ ID NO:2.

Compared with the polypeptide represented by SEQ ID NO:1, the polypeptide represented by SEQ ID NO:2 does not contain the transmembrane region around the C terminus, and therefore, it is indicated that the polypeptide is a secretory protein (Fig. 7).

The structure of plasmid pNKH106 containing the cDNA is shown in Fig. 12.

(2) Aging-suppressing gene derived from human pancreas

Using a phage solution (1 μ l; containing 1×10^8 phages) of human pancreas cDNA library (manufactured by Clontech Co.) as a template, 1 μ l each of 10 μ M sense primer represented by SEQ ID NO:19 (RYHH-02-5') and 10 μ M antisense primer represented by SEQ ID NO:20 (RYHH-02-3'-2), 4 μ l of 10 $\times$ PCR buffer (using the buffer attached to the enzyme), and 3.2 μ l of 2.5 mM dNTP were mixed together, and the resulting mixture was set on a thermal cycler. After reaction at 97°C for 5 minutes, the mixture was rapidly cooled in ice for 5 minutes, and 0.5 μ l of Taq DNA polymerase (manufactured by Takara Shuzo Co., Ltd.; 5 units/ μ l) was mixed, followed by PCR for 30 cycles, each cycle being composed of a process of 95°C for 60 seconds, 65°C for one minute, and 72°C for

one minute. Then, it was confirmed by agarose gel electrophoresis that a band of about 400 bp was amplified.

The amplified fragment of 0.2 kb was purified from the agarose gel, which was then incorporated into pT7Blue T-vector (Novagen Co.), using a DNA ligation kit ver. 2 (manufactured by Takara Shuzo Co., Ltd.). The method followed the kit instruction. *Escherichia coli* XL1-Blue was transformed in the solution to obtain an ampicillin resistant strain. From the transformant, a plasmid was recovered using a plasmid extruder PI-100 (manufactured by Kurabo Co.), and the nucleotide sequence of two clones was determined using a DNA sequencer 377 [manufactured by Perkin Elmer Co.]. pT7-02 with a sequence homologous to the aging-suppressing gene was detected.

An insertion fragment of the plasmid pT7-02 was labeled with digoxigenin (DIG) using a DIG DNA labeling kit (manufactured by Boehringer Mannheim Co.), and was used as a probe. The labeling method followed the kit instruction.

Human pancreas cDNA library was cultured in five plates each of a diameter of 15 cm, so that about 2×10^5 plaques might appear per one dish, which were then blotted on a nylon membrane filter Hybond N+

(manufactured by Amersham Co.). According to the protocol by Boehringer Mannheim Co. (DIG Luminescent Detection Kit for Nucleic Acids), denaturation and immobilization of DNA and probe hybridization and filter washing were carried out. As the hybridizing solution, solution containing $5 \times$ SSC, 1% blocking solution [DIG Luminescent Detection Kit for Nucleic Acids (Boehringer Mannheim Co.)], 0.1% Sarcosyl, and 0.02% SDS was used for overnight hybridization at 68°C . Under shaking, the solution was washed twice with $2 \times$ SSC containing 0.1% SDS at room temperature for 10 minutes, and twice in $1 \times$ SSC containing 0.1% SDS at 68°C for 15 minutes, and then, a positive plaque was detected using a DIG detection kit (manufactured by Boehringer Mannheim Co.) with anti-DIG antibody. The plaque was scooped out together with the agar medium, and was then placed in 500 μl of an SM buffer (0.1 M NaCl, 0.008 M $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$) to elute the phage into the buffer solution at room temperature overnight. Using 1 μl of the buffer as a template, PCR was carried out in the same manner as described above. It was confirmed on the basis of the amplification of a fragment of 0.4 kb that the objective cDNA was contained in the positive clone, and by subsequently cleaving out an insertion sequence of about 3.5 kb with *EcoRI* from the positive clone, the sequence

was then sub-cloned in the *EcoRI* site of pBluescript II SK(+). The plasmid was recovered from the transformant using a plasmid extruder PI-100 (manufactured by Kurabo Co.), and the nucleotide sequence of one clone was determined using a DNA sequencer 377 [manufactured by Perkin Elmer Co.]. Plasmid pRYH02 harboring the nucleotide sequence represented by SEQ ID NO:10 was observed. It was demonstrated that an ORF capable of encoding the protein of 1,015 amino acids represented by SEQ ID NO:5 was present in the gene. Because the amino acid sequence possibly deduced from the nucleotide sequence showed over its whole region about 45% homology to the aging-suppressing gene, it was demonstrated that the gene was one of the aging-suppressing gene family.

The 100 amino acids from the N terminus of the amino acid sequence represented by SEQ ID NO:10 were analyzed using Signal P ver. 2 [*Protein Engineering*, 10: 1 (1997)] and SPScan (Genetics Computer Group Inc.) as signal sequence cleavage site prediction software. Consequently, the signal sequence cleavage sites predicted by the two types of software agreed with each other, which were present between the 23rd Gly and the 24th Phe. Therefore, it was concluded that the 1st to 23rd amino acids of the amino acid sequence of the polypeptide formed a signal sequence and the amino acids

at position 24 and thereafter formed a maturation peptide.

Example 6

Construction of plasmid pYT102 for expressing partial fragments of murine aging-suppressing polypeptide in *Escherichia coli*:

The expression of partial fragments of the murine aging-suppressing polypeptide in *Escherichia coli* was carried out by inserting a DNA fragment containing cDNA encoding a murine aging-suppressing polypeptide fragment into expression vector pSupex for *Escherichia coli*, as shown below, to prepare pYT102, and introducing pYT102 into *Escherichia coli*.

pSupex was prepared through the following 5-step process by combining pGHA2 (Japanese Published Unexamined Patent Application No. 221091/1985), pTerm2 (Japanese Published Unexamined Patent Application No. 22979/1991) and pGKAA2 (Japanese Published Unexamined Patent Application No. 221091/1985) previously reported, as shown in Fig. 13.

(Process 1) Construction of plasmid pTerm4

After adding 3 μ g of plasmid pGHA2 into 30 μ l of a buffer containing 10 mM Tris-HCl (pH 7.5), 10 mM

magnesium chloride, 50 mM sodium chloride and 1 mM DTT (hereinafter referred to as "Tris A buffer"), 10 units of *Hind*III was added to the buffer, for reaction at 37°C for 4 hours.

Phenol-chloroform extraction and ethanol precipitation were carried out using the reaction solution to recover DNA fragments. After adding the DNA to 30 µl of a buffer containing 10 mM Tris-HCl (pH 7.5), 10 mM magnesium chloride, 100 mM sodium chloride and 1 mM DTT (hereinafter referred to as "Tris B buffer"), 10 units of *Pst*I were added to the buffer to react at 37°C for 4 hours.

The treated DNA fragments in the reaction solution were fractionated using agarose gel electrophoresis to recover about 0.3 µg of an about 0.94 kb *Pst*I/*Hind*III treated fragment of pGHA2 containing the *let*I promoter.

To 30 µl of Tris A buffer, 3 µg of the plasmid pTerm2 was added, and 10 units of *Hind*III were added to the buffer to react at 37°C for 4 hours.

DNA fragments were then recovered by ethanol precipitation from the reaction solution. The DNA was added to 30 µl of Tris B buffer, and 10 units of *Pst*I were added to the buffer to react at 37°C for 4 hours.

The treated DNA fragments in the reaction solution were fractionated using agarose gel electrophoresis to recover an about 1.1 kb *Pst*I/*Hind*III treated fragment of pTerm at a yield of about 0.8 µg, the fragment containing an origin of replication and a translation termination codon.

The *Pst*I/*Hind*III treated fragment (100 ng) of the pGHA2 and the *Pst*I/*Hind*III treated fragment (50 ng) of pTerm2 were dissolved in 20 µl of a T4 DNA ligase buffer, 100 units of T4 DNA ligase (manufactured by Takara Shuzo Co., Ltd.) were added to the solution, and a ligation was carried out at 16°C for 18 hours.

Escherichia coli JM109 was transformed using the recombinant plasmid obtained through the reaction to obtain plasmid pTerm4 shown in Fig. 13.

(Process 2) Construction of plasmid pGBZ2

To 30 µl of a buffer containing 10 mM Tris-HCl (pH 7.5), 70 mM magnesium chloride, 150 mM potassium chloride, 0.01% bovine serum albumin and 7 mM 2-mercaptoethanol (abbreviated as Tris C buffer hereinafter), 3 µg of pGKA2 was added, and 10 units of *Nru*I were added to the buffer to react at 37°C for 4 hours.

Phenol-ethanol extraction and ethanol precipitation were carried out using the reaction solution to recover *Nru*I treated fragments of pGKA2.

*Bgl*III linker (5'-pCAGATCTG-3') was synthesized, and 50 ng of the linker and the *Nru*I treated fragments of the pGKA2 were dissolved in 20 μ l of a T4 DNA ligase buffer, 100 units of T4 DNA ligase to the solution were added, and a ligation was carried out at 16°C for 18 hours.

Escherichia coli JM109 was transformed using the recombinant DNA thus obtained through the reaction to obtain plasmid pGBZ2 shown in Fig. 13.

(Process 3) Construction of plasmid pTerm5

To 30 μ l of Tris B buffer, 3 μ g of plasmid pTerm4 was added, and 10 units of *Pst*I and 10 units of *Bgl*III were added to the buffer to react at 37°C for 4 hours.

The treated DNA fragments in the reaction solution were fractionated using agarose gel electrophoresis to recover a 1.15 kb *Pst*I/*Bgl*III treated fragment of pTerm4 at a yield of about 0.8 μ g, the fragment containing *let*I promoter and a translation termination codon.

To 30 μ l of Tris B buffer, 3 μ g of plasmid pGBZ2 was added, 10 units each of *Pst*I and *Bgl*II were added to the buffer to react at 37°C for 4 hours.

The treated DNA fragments in the reaction solution were fractionated using agarose gel electrophoresis to recover an about 2.63 kb *Pst*I/*Bgl*II treated fragment of pGBZ2 at a yield of about 0.3 μ g, the fragment containing the origin of replication, an ampicillin resistant gene and a *rop* gene.

In 20 μ l of a T4 DNA ligase buffer, 100 ng of the *Pst*I/*Bgl*II treated fragment of pTerm and 50 ng of the *Pst*I/*Bgl*II treated fragment were dissolved, 100 units of T4 DNA ligase were added to the solution, and a ligation was carried out at 16°C for 18 hours.

Escherichia coli JM109 was transformed using the recombinant plasmid obtained through the reaction to obtain plasmid pTerm5 shown in Fig. 13.

(Process 4) Construction of plasmid pTerm6

To 30 μ l of Tris C buffer, 3 μ g of plasmid pTerm5 was added, and 10 units of *Nru*I were added to react at 37°C for 4 hours.

Phenol/chloroform extraction and ethanol precipitation were carried out using the reaction solution to recover DNA fragments. The DNA was added to

30 μ l of Tris A buffer, and 10 units of *Cla*I were added to the buffer to react at 37°C for 4 hours.

The treated DNA fragments in the reaction solution were fractionated using agarose gel electrophoresis to recover an about 3.7 kb *Nru*I/*Cla*I treated fragment of pTerm5 at a yield of about 0.3 μ g, the fragment containing the origin of replication, ampicillin resistant gene, *let*I promoter and *rop* gene.

Synthetic DNAs having the nucleotide sequences represented by SEQ ID NOS:21 and 22 were dissolved at 1 μ g each in 10 μ g of distilled water and heated at 95°C for 5 minutes, and the resulting solution was cooled over 30 minutes to room temperature for annealing (hereinafter referred to as "synthetic DNA-1").

In 20 μ l of T4 DNA ligase buffer, 50 ng of the *Nru*I/*Cla*I treated fragment of pTerm5 and 50 ng of the synthetic DNA-1 were dissolved, 100 units of T4 DNA ligase were added, and a ligation was carried out at 16°C for 18 hours.

Escherichia coli JM109 was transformed using the recombinant plasmid DNA thus obtained through the reaction to obtain plasmid pTerm6 shown in Fig. 13.

(Process 5) Construction of plasmid pSupex

To 30 μ g of a buffer containing 50 mM potassium phosphate, 3 μ g of plasmid pTerm6, 20 mM Tris-acetic acid (pH 7.9), 10 mM magnesium acetate and 1 mM DTT, and 10 units of *Nsi*I were added to the buffer to react at 37°C for 4 hours.

Phenol-chloroform extraction and ethanol precipitation were carried out using the reaction solution to recover DNA fragments. The DNA was added to 30 μ l of Tris A buffer, and 10 units of *Hind*III were added to the buffer to react at 37°C for 4 hours.

The treated DNA fragments in the reaction solution were fractionated using agarose gel electrophoresis to recover an about 3.7 kb *Nsi*I/*Hind*III treated fragment of pTerm6 at a yield of about 0.3 μ g, the fragment containing the origin of replication, ampicillin resistant gene, *let*I promoter and *rop* gene.

Synthetic DNAs having the nucleotide sequences represented by SEQ ID NOS:23 and 24 were dissolved at 1 μ g each in 10 μ g of distilled water and heated at 95°C for 5 minutes, and the resulting solution was cooled over 30 minutes to room temperature for annealing (hereinafter referred to as "synthetic DNA-2").

In 20 μ l of T4 DNA ligase buffer, 50 ng of the *Nsi*I/*Hind*III treated fragment of pTerm6 and 50 ng of the

synthetic DNA-2 were dissolved, 100 units of T4 DNA ligase were added thereto, and a ligation was carried out at 16°C for 18 hours.

Escherichia coli JM109 was transformed using the recombinant plasmid DNA thus obtained through the reaction to obtain plasmid pSupex shown in Fig. 13.

(Process 6) Construction of plasmid pYT102

To 30 µl of a buffer containing 50 mM Tris-HCl (pH 7.5), 10 mM magnesium chloride, 100 mM sodium chloride and 1 mM DTT, 3 µg of plasmid pNKM101 obtained in Example 3 was added, and 10 units of *Eco*47III were added to the buffer to react at 37°C for 4 hours.

Phenol-chloroform extraction and ethanol precipitation were carried out using the reaction solution to recover DNA fragments. The DNA was added to 30 µl of a buffer containing 10 mM Tris-HCl (pH 7.5), 10 mM magnesium chloride and 1 mM DTT, and 10 units of *Kpn*I were added to the buffer to react at 37°C for 4 hours.

The treated DNA fragments in the reaction solution were fractionated using agarose gel electrophoresis to recover an about 0.7 kb *Eco*47III/*Kpn*I treated fragment (Fig. 14) of pNKM101 at a yield of about 0.3 µg, the fragment containing DNA encoding a fragment containing the amino acid residues from Ala³⁵ to

Tyr²⁶⁷ of the aging-suppressing polypeptide represented by SEQ ID NO:3.

To 30 μ l of Tris A buffer, 3 μ g of expression vector pSupex for *Escherichia coli* obtained in Process 5 was added, and 10 units of *Stu*I were added to the buffer to react at 37°C for 4 hours.

Phenol-chloroform extraction and ethanol precipitation were carried out using the reaction solution to recover DNA fragments. The DNA was added to 30 μ l of a buffer containing 10 mM Tris-HCl (pH 7.5), 10 mM magnesium chloride and 1 mM DTT, and 10 units of *Kpn*I were added to the buffer to react at 37°C for 4 hours.

The treated DNA fragments in the reaction solution were fractionated using agarose gel electrophoresis to recover about 0.3 μ g of an about 3.8 kb *Stu*I/*Kpn*I treated fragment of pSupex.

In 20 μ l of T4 DNA ligase buffer, 50 ng of the *Eco*47III/*Kpn*I treated fragment of pNKM101 and 100 ng of the *Stu*I/*Kpn*I treated fragment of pSupex were dissolved, 100 units of T4 DNA ligase were added thereto, and a ligation was carried out at 16°C for 18 hours.

Escherichia coli JM109 was transformed using the recombinant plasmid DNA thus obtained through the reaction to obtain plasmid pYT102 shown in Fig. 14.

Example 7

Expression of aging-suppressing partial fragment polypeptide in *Escherichia coli*:

pYT102 obtained in Example 6 was introduced into *Escherichia coli* NY49. The *Escherichia coli* was cultured in 400 ml of an M9 minimal medium (the medium described in *Molecular Cloning, A Laboratory Manual*) supplemented with 75 µg/ml ampicillin and 2 mg/ml casaminoic acid at 37°C for 2 hours, and 50 µg/ml indole acrylic acid was added thereto, followed by culturing at 37°C for 18 hours.

A 400 ml portion of the culture was centrifuged at 3,000 × g for 15 minutes, the precipitate containing the *Escherichia coli* was then suspended in 7 ml of Buffer 1 [buffer containing 10 mM Tris-HCl (pH 8.0), 1 mM EDTA, and 150 mM sodium chloride], and the *Escherichia coli* was disrupted by ultrasonic treatment.

The treated solution was centrifuged at 10,000 × g for 30 minutes, and the resulting precipitate was dissolved in a sample buffer for SDS-polyacrylamide gel electrophoresis [buffer containing 6 mM Tris-HCl (pH 6.8), 2% SDS, 10% glycerol, and 5% 2-mercaptoethanol]. The solution was fractionated by SDS-polyacrylamide electrophoresis, and the gel was stained with Coomassie Brilliant Blue. The results are shown in Fig. 15. It

was confirmed that an aging-suppressing partial fragment polypeptide of a molecular weight of about 27 kDa was produced. During the electrophoresis, phosphorylase b (97,400), bovine serum albumin (66,200), ovalbumin (45,000), carbonic anhydrase (31,000), soybean trypsin inhibitor (21,500), and lysozyme (14,400) were used as molecular weight markers.

Example 8

Production of anti-murine aging-suppressing polypeptide antibody reacting with murine aging-suppressing partial fragment polypeptide:

(1) The murine aging-suppressing partial fragment polypeptide expressed in *Escherichia coli* as a host in Example 7 was fractionated by SDS-polyacrylamide gel electrophoresis using a 2-mm thick gel under reductive conditions by a conventional method.

The gel was stained with an aqueous 0.1% Coomassie Brilliant Blue solution, and decolorized in water, and a band of about 27 kDa corresponding to the aging-suppressing partial fragment polypeptide was cut out.

The gel was ground and crushed, which was then used to extract and recover the aging-suppressing polypeptide partial fragment at 4°C overnight using 0.1%

SDS-PBS. The protein concentration was determined by SDS-polyacrylamide gel electrophoresis using BSA as a standard for assaying protein concentration.

(2) A rat was immunized using the aging-suppressing partial fragment polypeptide obtained in (1) by a conventional method.

That is, the aging-suppressing partial fragment polypeptide with addition of adjuvant (2 mg of aluminum hydroxide, and pertussoid vaccine at 1×10^9 cells/animal) for a first dosage was intraperitoneally administered at a concentration of 50 μg /animal into a rat, and on weeks 2 and 3 from the first dosing, only the aging-suppressing partial fragment polypeptide was administered intraperitoneally.

Three days after the final immunization, blood was drawn locally to assay the blood antibody titer by the ELISA described below.

[ELISA]

The aging-suppressing partial fragment polypeptide described above was prepared to a concentration of 10 μg /ml in PBS buffer [buffer prepared by dissolving disodium hydrogen phosphate (1.83 g), potassium dihydrogen phosphate (0.21 g) and sodium

chloride (7.65 g) in distilled water to a final volume of one liter (pH 7.2)]. The prepared solution was divided at 50 μ l/well into a 96-well EIA plate (manufactured by Gleiner Co.), and allowed to stand at 4°C overnight.

After washing the plate in a PBS buffer, a PBS buffer containing 1% BSA (hereinafter referred to as "BSA-PBS") was divided at 100 to 200 μ l/well, and the plate was allowed to stand at room temperature for one to two hours or at 4°C for one to two nights. After allowing the plate to stand, the BSA-PBS was discarded, and the resulting plate was thoroughly washed with PBS buffer.

The collected anti-serum was diluted in BSA-PBS, which was then added at 20 to 100 μ l/ well into the plate, and the plate was allowed to stand at room temperature for 2 hours.

After allowing the plate to stand, the plate was washed with a PBS buffer containing 0.05% Tween 20 (hereinafter referred to as "PBS-0.05 Tween"), and then peroxidase-labeled anti-rat immunoglobulin or peroxidase-labeled anti-murine immunoglobulin (manufactured by DAKO CO.) was added at 50 to 100 μ l/well into the plate, and the plate was allowed to stand at room temperature for one hour.

After allowing the plate to stand alone, the plate was washed with PBS-0.05 TweenTM, and then, an ABTS substrate solution [solution prepared by dissolving 2,2-azinobis(3-ethylbenzothiazole-6-sulfonic acid) ammonium (550 mg) in one liter of a 0.1 M citrate buffer (pH 4.2) and adding 1 μ l/ml hydrogen peroxide to the resulting solution just prior to use] was added to the plate for chromogenic reaction to determine the absorbance at OD₄₁₅ nm (NJ2001; Nippon Intermed Co.).

(3) By Western blotting, it was confirmed that the serum reacted with the above murine aging-suppressing partial fragment polypeptide.

According to the method described in Example 7, the bacterial protein of *Escherichia coli*, where the expression of the aging-suppressing partial fragment polypeptide fragment was confirmed, was fractionated by polyacrylamide gel electrophoresis.

The protein fractionated on the gel was transferred onto a transfer membrane (Immobilon Transfer Membranes, manufactured by Millipore Co.). The transfer was continued under conditions of 2 mA/cm² constant current for 2 hours using a transfer membrane immersed in 100% methanol for 20 seconds and then immersed in a solution containing 10 mM CAPS (3-cyclohexylaminopropane

sulfonic acid), 10% methanol and 0.03% SDS (pH 11.0) for 30 minutes.

The transfer membrane was shaken in 200 ml of BSA-PBS for one hour, and was then washed once with a PBS buffer.

The transfer membrane and serum (2 ml) collected from a rat, which serum was preliminarily diluted by 1/25000-fold in a PBS buffer, were placed in a vinyl bag, and the bag was then sealed and gently shaken at 4°C overnight.

The transfer membrane was immersed twice in PBS-0.05 Tween for 5 minutes, followed by washing, and then the resulting membrane was immersed in a PBS buffer for 5 minutes and was then washed.

The transfer membrane and 3 ml of an anti-rat IgG antibody labeled with 0.5 mg/ml peroxidase (anti-rat immunoglobulin, manufactured by Amersham Co.) were placed in a vinyl bag, sealed, and shaken at room temperature for one hour.

After shaking, the transfer membrane was immersed twice in PBS-0.05 Tween for 5 minutes, and the resulting membrane was washed, and immersed in PBS buffer for 5 minutes, followed by washing.

By a luminescent method (ECL Western blotting detection reagents, manufactured by Amersham Co.),

protein present on the transfer membrane and observed to have cross reactivity with the antibody in the rat serum was detected.

The results are shown in Fig. 16.

A band was detected on the same position of the band of about 27 kDa as obtained in Example 7, and it was indicated that the antibody in the rat serum collected in Example 8(2) recognized the murine aging-suppressing polypeptide fragment as the antigen and the polypeptide fragment is usable for Western blotting.

The antibody in the rat serum is referred to as "anti-aging-suppressing polypeptide antibody" hereinafter.

Example 9

Preparation of anti-aging-suppressing polypeptide monoclonal antibody:

(1) Preparation of antibody-producing cell

Spleens were resected from three rats having sufficient serum antibody titers, as obtained in Example 8(2).

The spleens were cut into pieces in MEM medium (manufactured by Nissui Pharmaceutical Co.), and the pieces were loosened with a pair of tweezers, and

centrifuged at 1,200 rpm for 5 minutes, and the resulting supernatant was discarded.

The splenic cells in the resulting precipitate fraction were treated with a Tris-ammonium chloride buffer (pH 7.65) for 1 to 2 minutes to remove erythrocytes, and the resulting cells were washed three times with MEM medium. The resulting splenic cells were used as antibody-producing cells.

(2) Preparation of murine myeloma cell

8-Azaguanine resistant murine myeloma cell line P3-U1 preliminarily sub-cultured in the 8-azaguanine medium was cultured in the normal medium for use as myeloma cells for cell fusion. For the cell fusion, cells of 2×10^7 or more were used.

(3) Preparation of hybridoma

The antibody-producing cells obtained in (1) and the myeloma cells obtained in (2) were thoroughly washed with MEM medium and were then mixed together, so that the cell numbers should be 10 : 1 as the ratio of antibody-producing cells : myeloma cells, and the resulting mixture was centrifuged at 1,200 rpm for 5 minutes to remove the supernatant.

The cell population in the resulting precipitate fraction was thoroughly loosened, and to the cell population, 0.2 to 1 ml of a mixture solution of polyethylene glycol-1000 (PEG-1000) 2 g, MEM 2 ml and dimethyl sulfoxide (DMSO) (0.7 ml) was added per 10^8 antibody-producing cells, 1 to 2 ml of MEM medium was added thereto several times every 1 to 2 minutes.

After addition, MEM medium was further added to the culture to give a final total volume of 50 ml.

The prepared solution was centrifuged at 900 rpm for 5 minutes to discard the supernatant.

The cells in the resulting precipitate fraction were loosened and were then suspended gently in 100 ml of HAT medium under aspiration and blowing using a measuring pipette.

The suspension was divided at 100 μ l/well into a 96-well culture plate, and then cultured in a 5% CO₂ incubator at 37°C for 7 to 14 days.

After culturing, a part of the culture supernatant was sampled, and about 1000 hybridomas specifically reacting with the aging-suppressing partial fragment polypeptide produced in *Escherichia coli* were screened according to the enzyme immunoassay described in Example 8(2).

Cloning was carried out using the hybridomas by limited dilution, firstly in HT medium and secondly in the normal medium, to obtain hybridoma KM1902 producing anti-aging-suppressing polypeptide antibody.

It was determined by an enzyme immunoassay using a subtype typing kit that the antibody class of the monoclonal antibody KM1902 produced by the hybridoma KM1902 was IgG2a.

(4) Purification of monoclonal antibody

Into a Pristane-treated female nude mouse (Balb/c) of age 8 weeks, the hybridoma obtained in (3) at 5 to 20×10^6 cells/animal was intraperitoneally injected the hybridoma turned ascites tumor in 10 to 21 days.

From the mouse having ascites tumor, ascites (1 to 8 ml/animal) was collected, and then centrifuged at 3,000 rpm for 5 minutes to remove the solids.

The resulting supernatant was purified by a caprylic acid precipitation method [Antibodies, A Laboratory Manual, Cold Spring Harbor Laboratory (1988)], and IgG was obtained and used as a purified monoclonal antibody.

Example 10

Construction of plasmid pYT103 for expressing murine aging-suppressing polypeptide in animal cell:

(Process 1) Construction of expression vector pAGE210 for animal cell (Fig. 17)

pAGE207 (Japanese Published Unexamined Patent Application No. 46841/1994) and pAGE148 (Japanese Published Unexamined Patent Application No. 205694/1994), expression vector pAGE210 for animal cells was constructed using expression vectors for animal cells as follows.

In 30 μ l of Tris A buffer, 3 μ g of pAGE207 or pAGE148 was dissolved, 10 units each of *Cla*I and *Kpn*I were added to the solution to react at 37°C for 4 hours.

The treated DNA fragments in the reaction solution were fractionated by agarose gel electrophoresis to recover an about 4.7 kb *Cla*I/*Kpn*I treated fragment of pAGE207 at a yield of about 0.5 μ g from pAGE207, the fragment containing the early promoter and enhancer of SV40 (hereinafter referred to as " P_{SE} "), hygromycin resistant gene and ampicillin resistant gene (hereinafter referred to as "Ap"), while an about 4.3 kb *Cla*I/*Kpn*I treated fragment containing dehydrofolic acid reductase gene (hereinafter referred to as "dhfr") was recovered at a yield of about 0.5 μ g from pAGE148.

In 20 μ l of a T4 DNA ligase buffer, 50 ng of the aforementioned *Cla*I/*Kpn*I treated fragment of pAGE207 and 50 ng of the aforementioned *Cla*I/*Kpn*I treated fragment of pAGE148 were dissolved, 200 units of T4 DNA ligase were added, and a ligation was carried out at 12°C for 16 hours.

Escherichia coli JM109 was transformed using the recombinant plasmid obtained through the reaction to obtain plasmid pAGE210 shown in Fig. 17.

(Process 2)

By ligating together the *Xba*I fragment of pAGE210 as obtained in the above Process 1 and the *Xba*I fragment of pNKM101 described in Example 6 (Process 6), the fragment containing the DNA encoding the aging-suppressing polypeptide, expression vector pYT1103 for the murine aging-suppressing polypeptide was constructed as follows (Fig. 18).

In 30 μ l of Tris A buffer, 3 μ g of pAGE210 was dissolved, 10 units of *Xba*I were added to the buffer to react at 37°C for 4 hours.

Phenol-chloroform extraction and ethanol precipitation were carried out using the reaction solution to recover DNA fragments. The DNA was solubilized in 50 μ l of 1M Tris-HCl buffer (pH 8.0), and

one unit of alkali phosphatase was added to the solution to react at 37°C for one hour.

Phenol-chloroform extraction and ethanol precipitation were carried out using the reaction solution to recover about 0.5 µg of the *Xba*I-dephosphorylated fragment of pAGE210 from the extract solution.

To 30 µl of Tris A buffer containing 0.01% BSA, 3 µg of pNKM101 was added, 10 units of *Xba*I were added to the buffer to react at 37°C for 4 hours.

The reaction solution was fractionated by agarose electrophoresis to recover about 0.3 µg of a 3.2 kb *Xba*I treated fragment of pNKM101.

In 20 µl of T4 DNA ligase buffer, 50 ng of the aforementioned *Xba*I treated fragment of pNKM101 and 300 ng of the above *Xba*I-dephosphorylated fragment of pAGE210 were dissolved, one unit of T4 DNA ligase was added to the solution, and a ligation was carried out at 16°C for 18 hours.

Escherichia coli JM109 was transformed using the recombinant plasmid DNA obtained through the reaction to obtain plasmid pYT103 shown in Fig. 18.

Example 11

Expression of murine aging-suppressing polypeptide in animal cell:

The introduction of plasmid into animal cells was carried out using electroporation according to the method by Miyaji et al. [*Cytotechnology*, 3: 133 (1990)].

pYT103 obtained in Example 10 (Process 2) was introduced at a ratio of 4 μ g per 4×10^6 cells into CHO cells by deleting dhfr gene [*Proc. Natl. Acad. Sci.*, 77: 4216 (1980)], and was then suspended in 10 ml of MEM α 2000-dFCS (5) [MEM α 2000 medium (manufactured by GIBCO, CO.) containing dFCS at 5%, 7.5% NaHCO₃ at a volume of 1/40, 200 mM L-glutamine solution (manufactured by GIBCO, CO.) at 3%, and penicillin-streptomycin solution (manufactured by GIBCO, Co; containing 5000 units/ml penicillin and 5000 μ g/ml streptomycin) at 0.5%], and was then placed in a 10 cm plate (manufactured by Iwaki Glass Co.).

After 24 hour culturing in a 5% CO₂ incubator at 37°C, hygromycin (manufactured by GIBCO, CO.) was added to the culture to a final concentration of 0.3 mg/ml, followed by culturing for 1 to 2 weeks.

When the transformant growing through the culturing reached the confluent state, the cells of the transformant were obtained.

After suspending the cells in MEM α 2000-dFCS (5) medium containing 0.3 mg/ml hygromycin and 50 nM methotrexate (hereinafter referred to as "MTX") at a final concentration of 1 to 2×10^5 cells/ml and dividing then 2 ml thereof into an F75 flask (manufactured by Gliner Co.), the cells were cultured in a CO₂ incubator at 37°C for 1 to 2 weeks to induce 50 nM MTX resistant clone.

The clone was suspended in MEM α 2000-dFCS (5) medium containing 0.3 mg/ml hygromycin and 100 nM MTX to 1 to 2×10^5 cells/ml, and 2 ml of the resulting suspension was divided in an F75 flask, followed by culturing in a CO₂ incubator at 37°C for 1 to 2 weeks to induce 100 nM MTX resistant clone.

The clone was suspended in MEM α 2000-dFCS (5) medium containing 0.3 mg/ml hygromycin and 500 nM MTX to $1-2 \times 10^5$ cells/ml, and 2 ml of the resulting suspension was divided in an F75 flask, followed by culturing in a CO₂ incubator at 37°C for 1 to 2 weeks to induce 500 nM MTX resistant clone.

The 500 nM MTX resistant clone was suspended in MEM α 2000-dFCS (5) medium containing 500 nM MTX to 1 to 2×10^5 cells/ml, and 15 ml of the resulting suspension was divided in an F75 flask, followed by culturing in a CO₂ incubator at 37°C for 5 to 7 days, until the

resistant clone reached 80 to 100% confluency, and then the medium was exchanged to 15 ml of a serum-free medium for CHO cells, namely CHO-S-SFMII medium (manufactured by GIBCO, CO.), for further culturing for 3 days.

The cells obtained through culturing were treated with trypsin and EDTA, and the resulting cells were suspended into 10 ml of MEM α 2000 medium.

The suspension was centrifuged at $1,500 \times g$ for 5 minutes to collect the cells.

After adding 7 ml of a PBS buffer into the cells for washing the cells, the cells were centrifuged at $1,500 \times g$ for 5 minutes to collect the cells.

The cells can be stored at -20°C and thawed for use, if necessary.

Western blotting was carried out using the whole protein of the cells (1×10^5 cells per one lane) by a method similar to that in Example 8(3).

The results are shown in Fig. 19. A band crossing with the anti-aging-suppressing polypeptide antibody was confirmed, and it was indicated that the aging-suppressing polypeptide was prominently expressed using the animal cells.

Additionally, the N-terminal amino acid sequence of the murine membrane-bound aging-suppressing polypeptide was determined by a conventional method.

More specifically, from CHO cells (CHO dhfr-/pYT103) which expressed the aging-suppressing polypeptide and grown to confluency at a volume of 20 Petri dishes of a 10 cm diameter, as described in Example 10, was purified an aging-suppressing polypeptide of about 140 kDa according to the immunoprecipitation described in Example 25 below, and the sequence of 9 amino acid residues at the N terminus of the polypeptide was analyzed using a gas-phase protein sequencer (PPSQ-10, manufactured by Shimadzu Corporation) according to the method recommended by the manufacturer.

As the results of the analysis, the sequence agreed with the sequence of 9 amino acid residues starting from the 36th residue from the N-terminus of the amino acid sequence represented by SEQ ID NO:3.

Example 12

Preparation of recombinant virus for expressing aging-suppressing polypeptide in insect cell:

For producing protein in insect cells, a recombinant virus incorporating an objective gene should necessarily be prepared, and the preparation requires (Process 1) a process of incorporating DNA encoding the objective protein into a specific plasmid and (Process

2) a process of co-transfecting a wild-type virus and a transfer vector into insect cells to obtain a recombinant virus by homologous recombination.

In order to conduct the processes, the following procedures were carried out according to the manual of BaculoGold Starter Kit manufactured by Pharmingen Co. (Product No. PM-21001K).

(Process 1) Preparation of transfer vector (Fig. 20)

To 30 μ l of Tris B buffer to which 0.01% bovine serum albumin and 0.01% Triton X-100 had been added (hereinafter referred to as "Tris D buffer"), 3 μ g of pNKM101 was added, 10 units of NotI were added to the buffer to react at 37°C for 4 hours.

Phenol-chloroform extraction and ethanol precipitation were carried out using the reaction solution to recover DNA fragments. Into the DNA was added 30 μ l of a buffer containing 10 mM Tris-HCl (pH 7.5), 10 mM magnesium chloride, 0.01% bovine serum albumin and 1 mM DTT (hereinafter referred to as "Tris E buffer"), and 10 units of XbaI were added to the buffer to react at 37°C for 4 hours.

The treated DNA fragments in the reaction solution were fractionated using agarose gel electrophoresis to recover about 0.3 μ g of an about 3.2

kb NotI-XbaI treated fragment of pNKM101 containing the DNA encoding the murine aging-suppressing polypeptide fragment.

To Tris D buffer, 3 μ g of plasmid pVL392 contained the BaculoGold Starter Kit manufactured by Pharmingen Co. was added, and 10 units of NotI were added to react at 37°C for 4 hours.

Phenol-chloroform extraction and ethanol precipitation were carried out using the reaction solution to recover DNA. Into the DNA was added 30 μ l of Tris E buffer, and 10 units of XbaI were added to the buffer to react at 37°C for 4 hours.

The treated DNA fragments in the reaction solution were fractionated using agarose gel electrophoresis to recover about 0.9 μ g of an about 9.6 kb NotI-XbaI treated fragment of pVL1392.

In 20 μ l of a T4 DNA ligase buffer, 200 ng of the NotI-XbaI treated fragment of the pVL1392 and 50 ng of the NotI-XbaI treated fragment of the pNKM101 were dissolved, 1 unit of T4 DNA ligase was added thereto, a ligation was carried out at 16°C for 18 hours.

Escherichia coli JM109 was transformed using the recombinant plasmid DNA thus obtained through the reaction to obtain plasmid pAS104 (Fig. 20).

(Process 2) Preparation of recombinant virus

By introducing linear baculovirus DNA [BaculoGold baculovirus DNA, manufactured by Pharmingen Co.] and the plasmid pAS104 into insect cells Sf9 (manufactured by Pharmingen Co.) cultured using TMN-FH insect medium (manufactured by Pharmingen Co.) [*Protein, Nucleic Acids and Enzymes*, 37: 2701 (1992)], a recombinant baculovirus was prepared by the following method.

In 12 μ l of distilled water, 1 μ g of pAS104 and 20 ng of linear baculovirus DNA were dissolved, an intimate mixture of 6 μ l of lipofectin and 6 μ l of distilled water was added thereto, and then the resulting mixture was allowed to stand at room temperature for 15 minutes.

In 2 ml of Sf900-II medium (manufactured by GIBCO, CO.), 1×10^6 cells of Sf9 cells were suspended, and the resulting suspension was placed in a plastic Petri dish of a 35-mm diameter for cell culture, the total volume of an intimate mixture solution of the plasmid DNA, linear baculovirus DNA and lipofectin was added, followed by culturing at 27°C for 3 days.

From the culture, 1 ml of the culture supernatant containing the recombinant virus was collected. Into the Petri dish from which the culture supernatant was recovered was added fresh Sf900-II medium, followed by

culturing at 27°C for 3 days, and in the same manner, the culture supernatant containing the recombinant virus was obtained additionally at 1.5 ml.

Example 13

Expression of murine aging-suppressing polypeptide in insect cell:

(Process 1) Proliferation of recombinant virus

In 10 ml of Sf900-II medium, 2×10^7 cells of Sf9 cells were suspended, and the resulting suspension was placed in a 175 cm² flask (manufactured by Gliner Co.), and allowed to stand at room temperature for one hour to attach the cells onto the flask.

After allowing the cells to stand, the supernatant was removed, and 15 ml of TMN-FH insect medium and 1 ml of the culture supernatant containing the recombinant virus obtained in Example 12 were added to the flask, followed by culturing at 27°C for 3 days.

After culturing, the supernatant was centrifuged at $1,500 \times g$ for 10 minutes to obtain a recombinant virus solution from which the Sf9 cells had been removed.

The virus titer of the recombinant virus solution was calculated by the following method [Manual of BaculoGold Starter Kit manufactured by Pharmingen Co.] .

In 4 ml of Sf900-II medium, 6×10^6 cells of Sf9 cells were suspended, and the suspension was then placed in a plastic Petri dish of a 60-mm diameter for cell culturing, and then allowed to stand at room temperature for one hour to attach the cells onto the Petri dish.

After allowing the solution to stand, the supernatant was removed, and then 400 μ l of the Sf900-II medium and the recombinant virus solution after dilution by 10,000 fold with Sf900-II medium were added to the dish, and then allowed to stand at room temperature for one hour.

After allowing the solution to stand, the medium was removed from the dish, 5 ml of a medium [prepared by intimately mixing together 1 ml of an aqueous 5% Agarplaque plus agarose solution and 4 ml of TMN-FH insect medium and keeping the resulting solution at 42°C] containing 1% low melting agarose [Agarplaque Agarose, manufactured by Pharmingen Co.] was poured into the Petri dish, and then allowed to stand at room temperature for 15 minutes.

After allowing the Petri dish to stand, vinyl tape was wound around the Petri dish, the Petri dish was placed in a plastic container which could be sealed, followed by culturing the recombinant virus therein at 27°C for 6 days.

After adding 1 ml of a PBS buffer containing 0.01% Neutral Red into the Petri dish, followed by further culturing for one day, the number of the developed plaques was counted.

It was indicated from the above procedures that the recombinant virus solution contained the virus at about 1×10^8 plaque forming units (PFU)/ml virus.

(Process 2) Expression of aging-suppressing polypeptide in insect cell

According to the manual attached to the BaculoGold Starter Kit manufactured by Pharmingen Co., the murine aging-suppressing polypeptide was expressed by the following procedures.

In 45 ml of Grace's Insect Medium, 6×10^6 cells of Sf9 cells were suspended, manufactured by GIBCO, CO. containing 10% FCS in a 225 cm² flask (manufactured by Gliner Co.), followed by culturing at 27°C for 3 to 4 days.

After culturing, the culture supernatant was removed, and 30 ml of Grace's Insect Medium containing 10% FCS and 1 ml of a solution containing the recombinant virus from pAS104 at a concentration of about 1×10^8 PFU/ml were added freshly into the flask, followed by culturing at 27°C for one day.

After culturing, the supernatant was removed, and 45 ml of Sf900-II medium was added freshly into the flask, followed by culturing for 2 to 3 days.

After culturing, the supernatant was removed after centrifugation at $1,500 \times g$ for 5 minutes, and the resulting cells were peeled off with trypsin-EDTA treatment.

The resulting cell fraction was suspended in 10 ml of Sf900-II medium, and centrifuged at $1,500 \times g$ for 5 minutes to collect the cells.

To the cell fraction, 7 ml of a PBS buffer was added for washing, and centrifuged at $1,500 \times g$ for 5 minutes to collect the cells.

The cells can be stored at -20°C , and the cells were used after thawing, if necessary.

(Process 3) Verification of expression

By a method similar to that in Example 7, SDS-PAGE was carried out using the total protein of the cells obtained at the above Process 2 (1×10^5 cells per lane).

The results are shown in Fig. 21. A specific band was confirmed around 120 kDa.

Also, by a method similar to that in Example 8(3), Western blotting was carried out using the whole protein

of the cells obtained at the above Process 2 (1×10^5 cells per one lane).

The results are shown in Fig. 22. By Western blotting, a specific band having cross reactivity with the anti-aging-suppressing polypeptide antibody was confirmed at the same position as by SDS-PAGE.

It was thus indicated that a prominent level of the aging-suppressing polypeptide having cross reactivity with the anti-aging-suppressing polypeptide antibody can be expressed using the insect cell.

Additionally, from the inset cells, the aging-suppressing polypeptide was obtained according to the method in Example 8(1).

Example 14

Construction of plasmid pYS110 for expressing human membrane-bound aging-suppressing polypeptide in animal cell:

By ligating together the (*Kpn*I blunt ended)-*Bam*HI fragment of pAGE210 obtained in Example 10 (Process 1) and the *Bam*HI-*Hpa*I fragment of pNKM103 described in Example 5, the fragment containing DNA encoding the human membrane-bound aging-suppressing polypeptide, vector pYS110 expressing the human membrane-bound aging-

suppressing polypeptide was constructed as follows (Fig. 23).

To 30 μ l of a buffer containing Tris-HCl (pH 7.5), 10 mM magnesium chloride and 1 mM DTT, 5 μ g of pAGE210 was added, and 20 units of *Kpn*I were added to the buffer to react at 37°C for 2 hours.

Phenol-chloroform extraction and ethanol precipitation were carried out using the reaction solution to recover about 3 μ g of DNA fragments. After subjecting the DNA to blunt end treatment using a DNA blunting kit (manufactured by Takara Shuzo Co., Ltd.), phenol-chloroform extraction and ethanol precipitation were carried out, and then the precipitate was dissolved in 50 μ l of a buffer containing 20 mM Tris-HCl (pH 7.5), 10 mM magnesium chloride, 1 mM DTT, and 100 mM potassium chloride, and 20 units of *Bam*HI into the buffer were added to react at 37°C for 2 hours.

The reaction solution was fractionated by agarose gel electrophoresis to cut out a 9.0 kb *Bam*HI-(*Kpn*I blunt ended) fragment from the gel, and the fragment was purified by a glass powder method [Gene Clean II, manufactured by Bio101 Co.] to recover about 1 μ g.

To 50 μ l of a buffer containing 20 mM Tris-HCl (pH 8.5), 10 mM magnesium chloride, 1 mM DTT, and 100 mM potassium chloride, 10 μ g of pNKM103 was added, and 30

units of *Bam*HI and 30 units of *Hpa*I were added to the buffer to react at 37°C for 2 hours.

The reaction solution was fractionated by agarose gel electrophoresis to recover about 0.5 µg of a 3.2 kb *Bam*HI-*Hpa*I fragment.

In 20 µl of a T4 DNA ligase buffer, 100 ng of the *Bam*HI-*Hpa*I fragment of the pNKM103 and 100 ng of the *Bam*HI-(*Kpn*I blunt ended) fragment of the pAGE210 were dissolved, one unit of T4 DNA ligase was added, and a ligation was carried out at 16°C for 18 hours.

Escherichia coli JM109 was transformed using the recombinant plasmid DNA obtained through the reaction to obtain plasmid pYS110 shown in Fig. 23.

Example 15

Expression of human membrane-bound aging-suppressing polypeptide in animal cell:

The introduction of plasmid into animal cells was carried out using electroporation according to the method by Miyaji et al. [*Cytotechnology*, 3: 133 (1990)].

pYS110 obtained in Example 14 was introduced at a ratio of 4 µg per 4×10^6 cells into CHO cells by deleting *dhfr* gene [*Proc. Natl. Acad. Sci.*, 77: 4216 (1980)], and was then suspended in 10 ml of MEMα2000-dFCS (5) [MEMα2000 medium (manufactured by GIBCO, CO.) containing

dFCS at 5%, 7.5% NaHCO_3 at a volume of 1/40, 200 mM L-glutamine solution (manufactured by GIBCO, CO.) at 3%, and a penicillin-streptomycin solution (manufactured by GIBCO, CO; containing 5000 units/ml penicillin and 5000 $\mu\text{g/ml}$ streptomycin) at 0.5%] and was placed in a 10 cm plate (manufactured by Iwaki Glass Co.). The following procedures were carried out by a method similar to that in Example 11 to induce 500 nM MTX resistant clone.

After suspending the 500 nM MTX resistant clone in an MEMa2000-dFCS (5) medium containing MTX of 500 nM to 1×10^5 to 2×10^5 cells/ml and dividing then 15 ml of the suspension in an F75 flask, and culturing the clone in a CO_2 incubator at 37°C for 5 to 7 days until the resistant clone reached 80 to 100% confluency, the culturing was terminated to remove the culture and to recover the cells through trypsin-EDTA treatment.

The resulting cells were suspended in 10 ml of MEMa2000 medium, and the resulting suspension was centrifuged at $1,500 \times g$ for 5 minutes to collect the cells.

To the cells, 7 ml of a PBS buffer was added for washing, and the mixture was centrifuged at $1,500 \times g$ for 5 minutes to collect the cells.

The cells can be stored at -20°C , and can be used after thawing if necessary.

By a method similar to that in Example 8(3), Western blotting was carried out using the whole protein of the cells (1×10^5 cells per one lane). Herein, the monoclonal antibody KM1902 described in Example 9 was used as a primary antibody.

The results are shown in Fig. 24. A band having cross reactivity with the anti-aging-suppressing polypeptide antibody was confirmed, and it was indicated that the human membrane-bound aging-suppressing polypeptide was expressed at a higher level using the animal cells.

Additionally, the N-terminal amino acid sequence of the human membrane-bound aging-suppressing polypeptide was determined by a conventional method in the field of protein chemistry.

That is, a human membrane-bound aging-suppressing polypeptide having about 140 kDa which was purified according to immunoprecipitation from CHO cells (CHO dhfr-/pYS110) grown to confluency at a volume of 20 Petri dishes of a 10 cm diameter, as described in Example 14, which expressed the human membrane-bound aging-suppressing polypeptide, was then subjected to SDS-PAGE under 2-mercaptoethanol reduction conditions to transfer the reduced product in an electric manner on a PVDF membrane (ProBlott, PERKIN ELMER Co.) according to

the method by P. Matsudaira et al. [*J. B. C.*, 262: 10035 (1987)] .

The transferred membrane was stained with Coomassie Blue, and a band around 140 kDa which was positive by Western blotting described in the present Example was cut out. Analysis of the sequence of the N-terminal 10 amino acid residues was determined using a gas-phase protein sequencer (PPSQ-10, manufactured by Shimadzu) according to the method recommended by the manufacturer.

As the results of the analysis, the sequence was identical to the sequence of 10 amino acid residues starting from the 34th residue from the N-terminus of the amino acid sequence represented by SEQ ID NO:1.

Additionally, the human membrane-bound aging-suppressing polypeptide was obtained from the animal cells by the method in Example 8(1) .

Example 16

Preparation of plasmid pYS111 for expressing human secretory aging-suppressing polypeptide in animal cell:

By ligating together the *Bam*HI-(*Kpn*I blunt ended) fragment of pAGE210 obtained in Example 10 (Process 1) and the *Bam*HI-*Hpa*I fragment of pNKM106 described in Example 5, the fragment containing DNA encoding the

human membrane-bound aging-suppressing polypeptide, vector pYS111 expressing the human membrane-bound aging-suppressing polypeptide was constructed as follows (Fig. 25).

To 30 μ l of a buffer containing Tris-HCl (pH 7.5), 10 mM magnesium chloride and 1 mM DTT, 5 μ g of pAGE210 was added, and 20 units of KpnI were added to the buffer to react at 37°C for 2 hours.

Phenol-chloroform extraction and ethanol precipitation were carried out using the reaction solution to recover about 3 μ g of a DNA fragment.

After subjecting the DNA to blunt end treatment using a DNA blunting kit (manufactured by Takara Shuzo Co., Ltd.), phenol-chloroform extraction and ethanol precipitation were carried out, and then the precipitate was dissolved in 50 μ l of a buffer containing 20 mM Tris-HCl (pH 7.5), 10 mM magnesium chloride, 1 mM DTT, and 100 mM potassium chloride, and 20 units of BamHI were added to the buffer to react at 37°C for 2 hours. The reaction solution was fractionated by agarose gel electrophoresis to cut out a 9.0 kb BamHI-(KpnI blunt ended) fragment of pAGE210 from the gel, and the fragment was then purified by a glass powder method to recover about 1 μ g.

To 50 μ l of a buffer containing 20 mM Tris-HCl (pH 8.5), 10 mM magnesium chloride, 1 mM DTT, and 100 mM potassium chloride, 10 μ g of pNKH106 was added, and 30 units of *Bam*HI were added to the buffer to react at 37°C for 2 hours.

Phenol-chloroform extraction and ethanol precipitation were carried out using the reaction solution, and the resulting precipitate was dissolved in 50 μ l of a buffer containing 50 mM potassium acetate, 20 mM Tris-acetic acid (pH 7.9), 10 mM magnesium acetate, and 1 mM DTT, and 30 units of *Msc*I were added thereto to react at 37°C for 2 hours.

The reaction solution was fractionated by agarose electrophoresis to recover about 0.5 μ g of a 1.9 kb *Bam*HI-*Msc*I treated fragment of pNKH106.

In 20 μ l of a T4 DNA ligase buffer, 100 ng of the *Bam*HI-*Msc*I treated fragment of the pNKH106 and 100 ng of the *Bam*HI-(*Kpn*I blunt ended) fragment of the pAGE210 were dissolved, one unit of T4 DNA ligase was added thereto, and a ligation was carried out at 16°C for 18 hours.

Escherichia coli JM109 was transformed using the recombinant plasmid DNA obtained through the reaction to obtain plasmid pYS111 shown in Fig. 25.

Example 17

Expression of human membrane secretory aging-suppressing polypeptide in animal cell:

The introduction of plasmid into animal cells was carried out using electroporation according to the method by Miyaji, et al. [*Cytotechnology*, 3: 133 (1990)].

pYS111 obtained in Example 16 was introduced at a ratio of 4 μg per 4×10^6 cells into CHO cells by deleting dhfr gene [*Proc. Natl. Acad. Sci.*, 77: 4216 (1980)], and was then suspended in 10 ml of MEMa2000-dFCS (5) [MEMa2000 medium containing dFCS at 5%, 7.5% NaHCO_3 at a volume of 1/40, 200 mM L-glutamine solution (manufactured by GIBCO, CO.) at 3%, and penicillin-streptomycin solution (manufactured by GIBCO, Co; containing 5000 units/ml penicillin and 5000 $\mu\text{g}/\text{ml}$ streptomycin) at 0.5%] and was placed in a 10 cm plate (manufactured by Iwaki Glass Co.).

The following procedures were carried out by a method similar to that in Example 11 to induce 500 nM MTX resistant clone.

After suspending the 500 nM MTX resistant clone in MEMa2000-dFCS (5) medium containing MTX of 500 nM to a final concentration of 1×10^5 to 2×10^5 cells/ml, and dividing then 15 ml of the suspension in an F75 flask, and culturing the clone in a CO_2 incubator at 37°C for 5

to 7 days, until the resistant clone reached 80 to 100% confluency, the medium was exchanged to 15 ml of a serum-free medium for CHO cells, namely CHO-S-SFMII medium (manufactured by GIBCO, CO.), followed by further culturing for 3 days.

After termination of the culturing, acetone of 1.5 ml was added to the culture of 0.5 ml, and the resulting culture was allowed to stand at 20°C for 30 minutes. The sample was centrifuged at -10°C under conditions of 15,000×g for 10 minutes to obtain a precipitate fraction, 70% ethanol was added thereto, followed by centrifugation at 4°C for 5 minutes.

The resulting precipitate was subsequently dried to obtain an acetone-concentrated sample of the culture supernatant.

The culture supernatant can be stored at -20°C and may be used after thawing, if necessary.

The products were analyzed using the recombinant plasmid DNA obtained through the reaction by Western blotting.

The results are shown in Fig. 26.

A band having cross reactivity with the anti-aging-suppressing polypeptide antibody was confirmed, and it was indicated that the human secretory aging-

suppressing polypeptide was expressed at a prominent level using the animal cells.

According to the method described in Example 15, the human secretory aging-suppressing polypeptide after concentration from 300 ml of the culture supernatant by immunoprecipitation was determined of the N-terminal amino acid sequence. The resulting amino acid sequence agreed with the sequence of 9 amino acid residues from the 34th residue from the N-terminus of the amino acid sequence represented by SEQ ID NO:2.

Additionally, the human secretory aging-suppressing polypeptide was obtained from the animal cell culture according to the method in Example 8(1).

Example 18

Preparation of recombinant virus for expressing human secretory aging-suppressing polypeptide in insect cell:

The preparation of a recombinant virus for expressing the human secretory aging-suppressing polypeptide in insect cells was carried out according to the method described in Example 12.

More specifically, 10 μ g of pNKH106 was dissolved in 50 μ l of a buffer containing 20 mM Tris-HCl (pH 8.5), 10 mM magnesium chloride, 1 mM DTT and 100 mM potassium chloride, and 30 units of BamHI were added to the buffer

to react at 37°C for 2 hours. The reaction solution passed through phenol-chloroform extraction and ethanol precipitation, and was then dissolved in 50 µl a buffer containing 50 mM potassium acetate, 20 mM Tris-HCl (pH 7.9), 10 mM magnesium chloride, and 1 mM DTT, and 30 units of *MscI* was added to react at 37°C for 2 hours.

The reaction solution was fractionated by agarose gel electrophoresis, and a 1.9 kb *Bam*HI-*MscI* fragment of pNKH106 was cut out from the gel and then purified by the glass powder method to recover about 0.5 µg.

To 50 µl of Tris B buffer, 5 µg of the plasmid pVL1393 contained in the BaculoGold Starter Kit manufactured by Pharmingen Co. was added, and 30 units of *Eco*RI were added to react at 37°C for 4 hours.

Phenol-chloroform extraction and ethanol precipitation were carried out using the reaction solution to recover DNA fragments. The DNA was subjected to blunt end treatment using a DNA blunting kit (manufactured by Takara Shuzo Co., Ltd.), followed by phenol-chloroform extraction and ethanol precipitation. The resulting DNA was dissolved in 50 µl of a buffer containing 20 mM Tris-HCl (pH 8.5), 10 mM magnesium chloride, 1 mM DTT and 100 mM potassium chloride, and 20 units of *Bam*HI were added to the solution to react at 37°C for 2 hours.

The resulting reaction solution was fractionated by agarose gel electrophoresis, and a 9.6 kb (*EcoRI* blunt ended)-*Bam*HI fragment of pVL1393 was cut out from the gel and then purified by the glass powder method to recover about 1 μ g.

In 20 μ l of T4 DNA ligase, 200 ng of the (*EcoRI* blunt ended)-*Bam*HI fragment of the pVL1393 and 50 ng of the *Bam*HI-*MscI* treated fragment of the pNKH106 were dissolved, one unit of T4 DNA ligase was added thereto, and a ligation was carried out at 16°C for 18 hours.

Escherichia coli JM109 was transformed using the recombinant DNA obtained through the reaction to obtain plasmid pYS150 (Fig. 27).

The recombinant virus was prepared using 1 μ g of pYS150, introducing the plasmid, together with 20 ng of linear baculovirus, into Sf21 cells by lipofection method and then culturing the cells at 27°C for 3 days. The culture supernatant containing the recombinant virus was collected at a volume of 1.0 ml from the culture.

Example 19

Expression of human secretory aging-suppressing polypeptide in insect cell:

(Process 1) Proliferation of recombinant virus

In 10 ml of Sf900-II medium, 2×10^7 cells of Sf21 cells were suspended, which was then placed in a 175 cm² flask (manufactured by Gliner Co.) and allowed to stand at room temperature for one hour to attach the cells onto the flask. After allowing the cells to stand, the supernatant was removed, and 15 ml of TMN-FH insect medium and 1 ml of the culture supernatant containing the recombinant virus obtained in Example 17 were added thereto, followed by culturing at 27°C for 3 days.

After culturing, the supernatant was centrifuged at $1,500 \times g$ for 10 minutes to obtain a recombinant virus solution from which the Sf21 cells had been removed.

The virus titer of the recombinant virus solution was calculated by the method described in Example 13, and it was indicated that the recombinant virus solution contained about 2×10^8 plaque forming units (PFU)/ml virus.

(Process 2) Expression of aging-suppressing polypeptide in insect cell

According to the manual attached to BaculoGold Starter Kit manufactured by Pharmingen Co., the murine aging-suppressing polypeptide was expressed by the following procedures.

In 45 ml of Grace's Insect Medium, manufactured by GIBCO, CO., containing 10% FCS in a 225 cm³ flask, 6×10^6 cells of Sf21 cells were suspended, followed by culturing at 27°C for 3 to 4 days.

After culturing, the culture supernatant was removed, 30 ml of the Grace's Insect Medium containing 10% FCS and 0.5 ml of a solution containing the recombinant virus derived from pSY150 as obtained in the above Process 1 at a concentration of about 2×10^8 PFU/ml were further added, followed by culturing at 27°C for one day.

After culturing, the supernatant was removed, and 45 ml of Sf900-II medium was further added, followed by culturing for 2 to 3 days.

After culturing, the culture was centrifuged at $1500 \times g$ for 5 minutes to obtain the culture supernatant. The culture supernatant can be stored at -20°C, and was used after thawing, if necessary.

(Process 3) Verification of expression

By a method similar to that in Example 17, 0.5 ml of the culture supernatant was used, followed by concentration in acetone, and the resulting culture supernatant was electrophoresed by SDS-PAGE and was then Western blotted.

The results are shown in Fig. 28. By Western blotting, a specific band having cross reactivity with the anti-aging-suppressing polypeptide antibody was confirmed.

It was thus indicated that a marked amount of the human secretory aging-suppressing polypeptide having cross reactivity with the anti-aging-suppressing polypeptide antibody could be expressed using insect cells.

Additionally, the human secretory aging-suppressing polypeptide was obtained from the culture supernatant of the insect cells according to the method in Example 8(1).

Example 20

Construction of plasmid pYS112 for expressing murine secretory aging-suppressing polypeptide in animal cell:

By ligating together the *Hind*III-*Bam*HI fragment of pAGE210 obtained in Example 10 (Process 1) and the

*Hind*III-*Bam*HI fragment of pNKM112, the fragment containing DNA encoding the aging-suppressing polypeptide, as described in Example 4, vector pYS112 expressing the murine secretory aging-suppressing polypeptide was constructed as follows (Fig. 29).

To 30 μ l of a buffer containing 20 mM Tris-HCl (pH 8.5), 10 mM magnesium chloride, 1 mM DTT and 100 mM potassium phosphate, 5 μ g of pAGE210 was added, and 20 units of *Bam*HI and 20 units of *Hind*III were added to the buffer to react at 37°C for 2 hours.

The reaction solution was fractionated by agarose gel electrophoresis, and a 9.0 kb *Hind*III-*Bam*HI fragment of pAGE210 was cut out from the gel and then purified by glass powder method to recover about 1 μ g.

To 50 μ l of a buffer containing 20 mM Tris-HCl (pH 8.5), 10 mM magnesium chloride, 1 mM DTT, and 100 mM potassium chloride, 10 μ g of pNKM112 was added, and 30 units of *Bam*HI and 30 units of *Hind*III were added to the buffer to react at 37°C for 2 hours.

The reaction solution was fractionated by agarose gel electrophoresis to recover about 0.5 μ g of a 1.6 kb *Hind*III-*Bam*HI fragment of pNKM112.

In 20 μ l of a T4 DNA ligase buffer, 100 ng of the *Hind*III-*Bam*HI fragment of the pNKM112 and 100 ng of the *Hind*III-*Bam*HI fragment of the pAGE210 were dissolved,

one unit of T4 DNA ligase was added, and a ligation was carried out at 16°C for 18 hours.

Escherichia coli JM109 was transformed using the recombinant plasmid DNA obtained through the reaction to obtain plasmid pYS112 shown in Fig. 29.

Example 21

Expression of murine secretory aging-suppressing polypeptide in animal cell:

The introduction of plasmid into animal cells was carried out using electroporation according to the method by Miyaji et al [*Cytotechnology*, 3: 133 (1990)].

pYS112 obtained in Example 20 was introduced at a ratio of 4 µg per 4×10^6 cells into CHO cells with deletion of dhfr gene [*Proc. Natl. Acad. Sci.*, 77: 4216 (1980)], and was then suspended in 10 ml of MEMa2000-dFCS (5) [MEMa2000 medium (manufactured by GIBCO, CO.) containing dFCS at 5%, 7.5% NaHCO₃ at a volume of 1/40, 200 mM L-glutamine solution (manufactured by GIBCO, CO.) at 3%, and penicillin-streptomycin solution (manufactured by GIBCO, Co; containing 5000 units/ml penicillin and 5000 µg/ml streptomycin) at 0.5%], and was then placed in a 10 cm plate (manufactured by Iwaki Glass Co.).

The following procedures were carried out by a method similar to that in Example 11 to induce 500 nM MTX resistant clone.

After suspending the 500 nM MTX resistant clone in an MEMa2000-dFCS (5) medium containing MTX of 500 nM to a final concentration of 1×10^5 to 2×10^5 cells/ml and dividing then 15 ml of the suspension in an F75 flask, and culturing the clone in a CO₂ incubator at 37°C for 5 to 7 days, until the resistant clone reached 80 to 100% confluency, the medium was just then exchanged to 15 ml of a serum-free medium for CHO cells, namely CHO-S-SFMII medium (manufactured by GIBCO, CO.), followed by culturing for 3 days.

The culture supernatant can be stored at -20°C, and the supernatant may be used after thawing, if necessary.

The product was concentrated using 1 ml of the culture supernatant by immunoprecipitation described below in Example 25, and was analyzed by Western method.

The results are shown in Fig. 30. It was confirmed that a band having cross reactivity with the anti-aging-suppressing polypeptide antibody was confirmed, and it was indicated that a marked amount of the murine secretory aging-suppressing polypeptide was expressed using the animal cells.

By the method described in Example 15, the N-terminal amino acid sequence of the murine secretory aging-suppressing polypeptide which was prepared through concentration from 45 ml of the culture supernatant of the animal cells by immunoprecipitation was determined. The resulting amino acid sequence corresponded to the sequence of the 13 amino acid residues starting from the N-terminal 36th residue of the amino acid sequence represented by SEQ ID NO:4.

The murine secretory aging-suppressing polypeptide was obtained from the culture supernatant of animal cells according to the method in Example 8(1).

Example 22

Preparation of recombinant virus for expressing murine secretory aging-suppressing polypeptide in insect cell:

Preparation of a recombinant virus for expressing the murine secretory aging-suppressing polypeptide in insect cells followed the method described in Example 12.

More specifically, 10 μ g of the aging-suppressing polypeptide encoding DNA of pNKM112 was dissolved in 50 μ l of a buffer containing 20 mM Tris-HCl (pH 8.5), 10 mM magnesium chloride, 1 mM DTT and 100 mM potassium chloride, 30 units of *Hind*III were added to react at 37°C for 2 hours.

Phenol-chloroform extraction and ethanol precipitation were carried out using the reaction solution to recover DNA fragments. The DNA was subjected to blunt end treatment using a DNA blunting kit (manufactured by Takara Shuzo Co., Ltd.), followed by phenol-chloroform extraction and ethanol precipitation. The resulting precipitate was dissolved in 50 μ l of a buffer containing 20 mM Tris-HCl (pH 8.5), 10 mM magnesium chloride, 1 mM DTT and 100 mM potassium chloride, and 20 units of *Bam*HI were added to the solution to react at 37°C for 2 hours.

The reaction solution was fractionated by agarose electrophoresis, and a 1.6 kb (*Hind*III blunt ended)-*Bam*HI fragment was cut out from the gel and then purified by glass powder method to obtain about 0.5 μ g.

To 50 μ l of Tris B buffer, 5 μ g of plasmid pVL1392 contained in BaculoGold Starter Kit manufactured by Pharmingen Co. was added, and 30 units of *Eco*RI were added to react at 37°C for 4 hours.

Phenol-chloroform extraction and ethanol precipitation were carried out using the reaction solution to recover DNA fragments. The DNA was subjected to blunt end treatment using a DNA blunting kit, followed by phenol-chloroform extraction and ethanol precipitation. The resulting precipitate was

dissolved in 50 μ l of a buffer containing 20 mM Tris-HCl (pH 8.5), 10 mM magnesium chloride, 1 mM DTT and 100 mM potassium chloride, and 20 units of *Bam*HI were added to the solution to react at 37°C for 2 hours.

The reaction solution was fractionated by agarose electrophoresis, and a 9.6 kb (*Eco*RI blunt ended)-*Bam*HI fragment of pVL1393 was cut out from the gel and then purified by glass powder method to obtain about 1 μ g.

In 20 μ l of a T4 DNA ligase buffer, 100 ng of the (*Eco*RI blunt ended)-*Bam*HI fragment of the pVL1392 and 100 ng of the (*Hind*III blunt ended)-*Bam*HI fragment of the pNKM112 were dissolved, one unit of T4 DNA ligase was added thereto, and a ligation was carried out at 16°C for 18 hours.

Escherichia coli JM109 was transformed using the recombinant plasmid DNA thus obtained through the reaction to obtain plasmid pYS151 (Fig. 31).

A recombinant virus was prepared using 1 μ g of pYS151 and introducing the plasmid together with 20 ng of linear baculovirus into Sf21 cells by lipofection method, followed by culturing at 27°C for 3 days. From the culture, the supernatant of 1.0 ml containing the recombinant virus was collected.

Example 23

Expression of murine secretory aging-suppressing polypeptide in insect cell:

(Process 1) Proliferation of recombinant virus

In 10 ml of Sf900-II medium, 2×10^7 cells of Sf21 cells were suspended, and the resulting suspension was placed in a 175 cm³ flask (manufactured by Gliner Co.) and was then allowed to stand at room temperature to attach the cells on the flask.

After allowing the cells to stand, the supernatant was removed, 15 ml of TMN-FH insect medium and 1 ml of the culture supernatant containing the recombinant virus obtained in Example 12 were added to the flask, followed by culturing at 27°C for 3 days.

After culturing, the supernatant was centrifuged at $1,500 \times g$ for 10 minutes to obtain a recombinant virus solution from which the Sf21 cells had been removed.

The virus titer of the recombinant virus solution was calculated by the method described in Example 13, and it was indicated that the recombinant virus solution contained about 1×10^8 plaque forming units (PFU)/ml virus.

(Process 2) Expression of murine secretory aging-suppressing polypeptide in insect cell

According to the manual attached to BaculoGold Starter Kit manufactured by Pharmingen Co., the murine aging-suppressing polypeptide was expressed by the following procedures.

In 45 ml of Grace's insect medium (manufactured by GIBCO, CO.) containing 10% FCS in a 225 cm² flask, 6×10⁶ cells of Sf21 cells were suspended, followed by culturing at 27°C for 3 to 4 days.

After culturing, the culture supernatant was removed, and 30 ml of the Grace's insect medium containing 10% FCS and 1 ml of a solution containing the recombinant virus derived from pSY151 at a concentration of about 1×10⁸ PFU/ml as obtained in the above Process 1 were further added, followed by culturing at 27°C for one day.

After culturing, the culture supernatant was removed, 45 ml of SF900-II medium was further added, followed by culturing for 2 to 3 days.

After culturing, the mixture was centrifuged at 1,500 × g for 5 minutes, the culture supernatant was obtained. The culture supernatant could be stored at -20°C, and was used after thawing, if necessary.

(Process 3) Confirmation of expression

By a method similar to that in Example 21, 1 ml of the culture supernatant was used for immunoprecipitation, and the resulting product was analyzed by Western method.

The results are shown in Fig. 32.

A specific band having cross reactivity with the anti-aging-suppressing polypeptide antibody was confirmed by the Western method.

It was thus indicated that the murine secretory aging-suppressing polypeptide having cross reactivity with the anti-aging-suppressing polypeptide antibody could be exerted at a prominent level using the insect cells.

The murine secretory aging-suppressing polypeptide was obtained from the culture supernatant of the insect cells according to the method in Example 8(1).

Example 24

Staining of immune cell using monoclonal antibody:

The aging-suppressing polypeptide-expressing CHO cells (CHO dhfr⁻/pYT103) prepared in Example 11 was suspended in a buffer for immune cell staining at a final concentration of 5×10^6 cells/ml, and the resulting

suspension was divided at 100 μ l/well into a 96-well round bottom plate.

As a control, the CHO cells used as host in Example 11 was subjected to the same procedures.

The plate was centrifuged at 4°C and 350 $\times$ g for one minute to remove the supernatant.

A 5 ml portion of the culture supernatant of the anti-aging-suppressing polypeptide monoclonal antibody producing hybridoma KM1902 obtained in Example 9(3) was concentrated by 20-fold using MabTrapGII (manufactured by Pharmacia Biotech Co.), and then added at 50 μ l/ well into the plate, and the plate was allowed to stand at 4°C for 30 minutes.

After allowing the plate to stand, a buffer for immune cell staining was added at 200 μ l/well into the plate, and then centrifuged at 4°C and 350 $\times$ g for one minute to remove the supernatant and, and the cells were washed.

After additionally carrying out the rinse procedure twice, a buffer for immune cell staining containing FITC-labeled anti-rat immunoglobulin antibody (manufactured by Wako Pure Chemical Co.), after 30-fold dilution, was added at 50 μ l/well into the plate, and then allowed to stand in darkness under ice cooling for 30 minutes. After allowing the plate to stand and

subsequently carrying out the same rinse procedure three times, analysis with FLOW CYTOMETER (manufactured by Coulter Co.) was carried out.

The results are shown in Fig. 33.

The monoclonal antibody KM1902 did not react with the CHO cells; however, it specifically recognized the aging-suppressing polypeptide expressing CHO cells.

Example 25

Immunoprecipitation of aging-suppressing polypeptide:

As a sample of the aging-suppressing polypeptide for immunoprecipitation, the aging-suppressing polypeptide expressing CHO cells (CHO dhfr⁻/pYT103) described in Example 11 was used.

PBS was added to a 6 cm Petri dish where the CHO cells grew until confluency, and the CHO cells were washed once.

To the Petri dish, 360 μ l of ice-cold Buffer 1 was added, and allowed to stand in ice for 30 minutes, and then the dish was gently shaken at an interval of 5 minutes for solubilization treatment.

The treated solution was recovered into a 1.5-ml centrifugation tube, and centrifuged at 14,000 rpm for 30 minutes.

To the culture supernatant, 25 μ l of protein G-Sepharose (50% v/v) equilibrated with Buffer 1 was added and shaken at 4°C for one hour, and the mixture was centrifuged at 5,000 rpm for 2 minutes to recover the supernatant.

The purified monoclonal antibody obtained in Example 9(4) was added to the supernatant at a final concentration of 10 μ g/ml, followed by shaking at 4°C for one hour.

To the shaken solution, 25 μ l of protein G-Sepharose (50% v/v) was added, followed by shaking at 4°C for one hour, and the mixture was centrifuged at 5,000 rpm for 2 minutes.

To the resulting precipitate fraction, 200 μ l of Buffer 1 was added to suspend the precipitate. The same procedure was repeated three times to rinse the precipitate fraction.

To the precipitate, 15 μ l of a sample buffer for SDS-polyacrylamide gel electrophoresis [buffer containing 6 mM Tris-HCl (pH 6.8), 2% SDS, 10% glycerol, and 5% 2-mercaptoethanol] was added, and the mixture was heated using a heat block and electrophoresed using a commercially available gradient gel for SDS-PAGE (manufactured by Atoh Co.). After the electrophoresis,

the polypeptide in the resulting gel was transferred onto a PVDF membrane (manufactured by Millipore Co.).

According to the method of Example 8, Western blotting was carried out using a PVDF membrane and the anti-aging-suppressing partial fragment peptide polyclonal antibody to detect an aging-suppressing polypeptide at the position of about 140 kDa.

The results are shown in Fig. 34.

The monoclonal antibody KM1902 immunologically precipitated the aging-suppressing polypeptide.

Example 26

Production of murine showing ameliorated syndrome resembling premature aging from mice showing a syndrome resembling premature aging using aging-suppressing gene derived from mouse:

(1) Construction of aging-suppressing DNA for introduction

As a DNA fragment containing a promoter, a *Hind*III fragment of pEF321CAT, containing human elongation factor 1 α [Gene, 91: 217 (1990)] was utilized. In the *Hind*III fragment of about 2.5 kb, parts of the first exon and second exon of the 5'-non-translation region of the human elongation factor 1 α , a promoter, a

*Hind*III linker at the 5' terminus and *Eco*RI and *Hind*III linkers at the 3' terminus were present.

By ligating a *Not*I fragment (4.2 kb) of pNKM101 containing the aging-suppressing gene and the cassette of SV40 early splicing region & polyadenylation signal [nucleotide number 1551-2427 in plasmid pMAMneo (Clontech Co.)] to the downstream of the *Hind*III fragment, the resulting product was used as aging-suppressing DNA for introduction.

The construction method of the aging-suppressing DNA for introduction is shown in Figs. 35 and 36.

More specifically, as follows.

(i) By cleaving pEF321CAT with *Hind*III, the resulting 2.5 kb *Hind*III fragment was blunt ended using a DNA Blunting Kit (manufactured by Takara Shuzo Co., Ltd.). An *Xba*I linker (4693P, manufactured by Takara Shuzo Co., Ltd.) was added to the blunt ended fragment using a DNA ligation kit (manufactured by Takara Shuzo Co., Ltd.), and the fragment was cleaved with *Xba*I to obtain an *Xba*I cleaved linker.

(ii) By cleaving pMAMneo (manufactured by Clontech Co.) with *Bam*HI and *Sma*I, the resulting 870-bp *Bam*HI/*Sma*I fragment containing the poly(A) cassette was subcloned into the *Bam*HI/*Eco*RV site of pBluescript II SK(-) (manufactured by STRATAGENE Co.).

After subcloning, the product was cleaved with *Bam*HI, an *Xho*I linker (4694 bp, manufactured by Takara Shuzo Co., Ltd.) was added, and cleaved with *Xho*I and *Hind*III to cut out a poly(A) cassette (both the termini work as the ends for *Xho*I and *Hind*III).

(iii) The poly(A) cassette obtained in (ii) was subcloned into the *Hind*III/*Xho*I site of pBluescript II SK(-) to obtain a plasmid containing the poly(A) cassette.

(iv) The *Xba*I cleavage fragment obtained in (i) was subcloned into the *Xba*I site of the plasmid obtained in (iii). The resulting plasmid is referred to as "pEFSA" hereinafter.

(v) pNKM101 was cleaved with *Not*I, and the resulting 4.2 kb *Not*I fragment was blunt ended and was then subcloned into the *Eco*RV site of pBluescript II SK(-).

After subcloning, the product was cleaved with *Eco*RI and *Hind*III to cut out a 4.2 kb *Eco*RI/*Hind*III fragment.

(vi) The fragment obtained in (v) was subcloned into the *Eco*RI/*Hind*III site of pEFSA to obtain plasmid pRES.

The pRES was cleaved with *Not*I, linearized, and dissolved in PBS at a final concentration of 5.7 ng/ml (about 500 copies/ml) to prepare a DNA solution for micro-injection.

(2) Production of transgenic mouse

A transgenic mouse was produced by a common microinjection method (*Developmental Engineering Experimental Manual-Preparation of Transgenic Mouse*, Tatsuji Nomura as responsible editor, Motoya Katsuki as editor, Kodansha Scientific, 1987).

More specifically, as follows.

(i) Into a F1 (BCF1) female (age 8 to 16 weeks) of C57BL/6 and C3H, 7 units of Serotropin (manufactured by Teikoku Zoki Co.) were intraperitoneally administered. After 48 hours of the administration, 7 units of gonadotropin (manufactured by Teikoku Hormone Mfg. Co., Ltd.) were administered into the female, and mated with a C3H male.

(ii) On the next day, a fertilized egg was collected from the oviduct ampulla of the female after copulation. The DNA solution for micro-injection as prepared in (1) was injected into the male pronucleus of the fertilized egg using a micro-manipulator under an erect microscope.

(iii) On the day before the practice of (i), the fertilized egg prepared in (i) was transplanted into the oviduct of a female (ICR, age 8 to 16 weeks) who had been mated with a vasoligated male (ICR) so that the female had been fallen into false pregnancy.

(iv) The tail of a litter mouse on birth on the 20th day after the transplantation was cut at the age 4 to 5 weeks to extract the chromosomal DNA, and the genotype was analyzed using PCR according to the method described in (3).

(3) Analysis of genotype

(i) To the murine tail obtained above, 2 ml of a lysis buffer was added, and the resulting mixture was allowed to stand at 50°C overnight.

(ii) An equal volume of phenol was added to the solution standing alone described in (i) for phenol extraction, and the resulting supernatant of 1 ml was used as a PCR template.

As the primers of PCR, 5 types of DNAs, represented by SEQ ID NOS:25 to 29, were used.

Since the DNAs having SEQ ID NOS:25 and 26 were synthesized on the basis of the nucleotide sequence of the cDNA of pNKM101, a fragment of 339 bp can be amplified if the cDNA is present. Because an intron is present between both the primers of DNA from chromosome, any DNA fragment from chromosomal DNA cannot be amplified.

The DNA having the nucleotide sequence represented by SEQ ID NO:27 was synthesized from a

region present in common to the mutant allele (pg) and wild-type allele (+); the DNA having the nucleotide sequence represented by SEQ ID NO:28 was synthesized from a region present in the mutant allele alone; and the DNA having the nucleotide sequence represented by SEQ ID NO:29 was synthesized from a region present in the wild-type allele alone.

Therefore, a 920 bp fragment amplified between the DNA having the nucleotide sequence represented by SEQ ID NO:27 and the DNA having the nucleotide sequence represented by SEQ ID NO:28 was produced from pg/pg; and a 458 bp fragment amplified between the DNA having the nucleotide sequence represented by SEQ ID NO:27 and the DNA having the nucleotide sequence represented by SEQ ID NO:29 was produced from +/+; and both the fragments were produced from pg/+.

PCR was carried out in a system in a total volume of 50 μ l [1 $\times$ LA PCR buffer II (Mg plus), a mixture solution of 400 mM each component of dNTP, 0.2 mM each component of primers, TaKaRa LATaq of 2.5 U] using LA PCR kit (manufactured by Takara Shuzo Co., Ltd.) under the following conditions.

That is, the system was heated at 94°C for 1.5 minutes, and then, the system was subjected to 30 cycles of heating, each cycle consisting of heating at 94°C for

30 seconds, 56°C for 30 seconds, and 72°C for 1.5 minutes, followed by further heating at 72°C for 10 minutes.

(4) Mating of transgenic mouse with mouse showing pg/+

As a result that screening according to the method in (3) was carried out for 161 litter mice obtained in (2), 37 animals were transgenic mice having the aging-suppressing gene.

A transgenic mouse of the genotype of pg/+ and having the aging-suppressing gene was obtained at F1 by mating the transgenic mouse with a mouse showing pg/+.

The anti-aging gene for introduction to the F1 could be transmitted by 31 lines.

By mating between pg/+ animals both having the aging-suppressing gene or mating between pg/+ and pg/+ having the aging-suppressing gene, 3 lines of pg/pg animals having the aging-suppressing gene were obtained at F2.

The results are shown in Table 1.

Table 1

Individual No.	Sex	Genotype	Aging-suppressing gene	Phenotype ^{*1}
1	male	pg/+	-	-
2	male	+/+	-	-
3	male	pg/+	-	-
4	male	pg/+	-	-
5	female	+/+	+	-
6	male	pg/pg	+	- ^{*2}
7	male	pg/+	+	-
8	male	pg/pg	+	- ^{*2}
9	male	pg/pg	+	- ^{*2}
10	female	pg/+	+	-
11	female	pg/+	+	-
12	female	pg/pg	-	+

*1: + showing a syndrome resembling premature aging;
 - showing no syndrome resembling premature aging.
 *2: mouse from which a syndrome resembling premature aging was eliminated.

Table 2

Individual No.	Sex	Genotype	Aging-suppressing gene	Phenotype ^{*1}
13	male	+/+	+	-
14	male	+/+	+	-
15	female	pg/+	+	-
16	female	+/+	+	-
17	male	pg/pg	+	- ^{*2}
18	female	pg/+	-	-

*1: + showing a syndrome resembling premature aging;
 - showing no syndrome resembling premature aging.

*2: mouse from which a syndrome resembling premature aging is eliminated.

It was confirmed that the pg/pg mouse showing a syndrome resembling premature aging did not show the syndrome if the mouse acquired the aging-suppressing gene.

Therefore, it was demonstrated that the gene is the causative gene of a syndrome resembling premature aging in a premature aging mouse, and it was thus indicated that the expression of the gene in individuals showing a syndrome resembling premature aging could suppress the syndrome resembling premature aging.

Example 27

Preparation of mouse showing ameliorated syndrome resembling premature aging from mice showing a syndrome resembling premature aging using recombinant adenovirus containing aging-suppressing gene derived from mouse:

A recombinant virus containing a mouse-derived aging-suppressing gene was prepared according to the method by Miyake et al. [Proc. Natl. Acad. Sci. USA, 93: 1320 (1996)].

More specifically, plasmid pNKM101 containing a mouse-derived aging-suppressing gene was cleaved with *NotI* and *XbaI* to obtain a 3.1 kb fragment containing the gene, and the fragment was blunt ended using a DNA blunting kit (manufactured by Takara Shuzo Co., Ltd.).

In 20 μ l of a T4 DNA ligase buffer, 3 μ g of the fragment and 1 μ g of a *Swa*I fragment of cosmid pAxCawt containing Type 5 adenovirus genome from which E3, E1A and E1B were deleted, a cytomegarovirus enhancer, and a chimera promoter of a chicken β -actin promoter (CAG promoter) [Kanegae et al., *Nucl. Acids. Res.*, 23: 3816 (1995)] were dissolved, one unit of T4 DNA ligase was added to the solution, and a ligation was carried out at 16°C for 18 hours.

In vitro packaging was carried out using the ligase reaction solution and Gigapack II XL Packaging Extract (manufactured by Stratagene Co.), and then the resulting phage was infected into *Escherichia coli* DH5 α to obtain a recombinant cosmid.

The orientation of the mouse-derived aging-suppressing gene toward the promoter in the recombinant cosmid was confirmed by cleaving the cosmid with *Bam*HI to detect a 1.6 kb fragment.

A 8 μ g portion of the cosmid thus obtained and 1 μ g of Type 5 adenovirus Ad5dIX DNA [*J. Virology*, 54: 711 (1985)] from which E3, E1A and E1B were deleted by cleavage of *Eco*T22I were mixed together, and the resulting mixture was transfected into the 293 cells in a 6 cm Petri dish by a calcium phosphate method using CellPfect Transfection Kit (Pharmacia Biotech Co.).

According to the method by Kanegae et al. [*BioManual Series*, 4: 43-58, Yodosha (1994)], the following procedures were carried out to obtain a recombinant virus.

According to the method by Kanegae et al. [*Jpn. J. Med. Sci. Biol.*, 47: 157 (1994)], the recombinant virus was purified twice by a cesium chloride density gradient, suspended in PBS containing 10% glycerol, and stored at -80°C for appropriate use.

The titer of the virus in the recombinant virus solution was calculated according to the method by Kanegae et al. [*Jpn. J. Med. Sci. Biol.*, 47: 157 (1994)], and it was found that the solution contained 1×10^{10} pfu/ml virus.

To the caudal vein of a mouse aged 4 weeks showing a syndrome resembling premature aging, 5×10^8 pfu of the recombinant virus thus obtained were inoculated, and the course was observed.

The results are shown in Fig. 37.

The mouse inoculated having the virus had body weight gain and prolonged life expectancy, and it was found that the syndrome resembling premature aging is eliminated.

Example 28

Construction of plasmid pYS201 for expressing N-terminal region of human aging-suppressing polypeptide in *Escherichia coli*:

By ligating together the (KpnI blunt ended)-EcoRV fragment of pSupex prepared in Example 6 and a 623 bp SacII fragment containing DNA encoding the human-derived aging-suppressing polypeptide of pNKM103 obtained in Example 5, vector pYS201 for expressing the N-terminal region of the human aging-suppressing polypeptide was constructed as follows (Fig. 38).

To 30 μ l of a buffer containing 33 mM Tris-acetic acid (pH 7.9), 10 mM magnesium acetate, 66 mM potassium acetate, 0.01% BSA and 0.5 mM DTT, 10 μ g of pNKM103 obtained in Example 5 was added, and 20 units of SacII were added to the buffer to react at 37°C for 4 hours. Phenol-chloroform extraction and ethanol precipitation were carried out using the reaction solution to recover DNA fragments, and the DNA fragments were blunt ended using a DNA blunting kit (manufactured by Takara Shuzo Co., Ltd.).

The treated DNA fragments in the reaction solution were fractionated by agarose gel electrophoresis to recover about 0.3 μ g of a blunt ended SacII fragment of about 0.6 kb containing DNA encoding a

fragment containing the amino acid residues from Gly⁵⁵ to Pro²⁶¹ in the aging-suppressing polypeptide represented by SEQ ID NO:1.

To 30 µl of a buffer containing Tris-HCl (pH 7.5), 10 mM magnesium chloride and 1 mM DTT, 3 µg of expression vector pSupex for *Escherichia coli* obtained in Example 6, Process 5 was added, and 10 units of KpnI were added thereto at 37°C for 4 hours. Phenol-chloroform extraction and ethanol precipitation were carried out using the reaction solution to recover DNA fragments, and they were subjected to blunt end treatment using a DNA blunting kit (manufactured by Takara Shuzo Co., Ltd.).

Additionally, phenol-chloroform extraction and ethanol precipitation were carried out, and the DNA was added to 30 µl of a buffer containing 50 mM Tris-HCl (pH 7.5), 10 mM magnesium chloride, 100 mM sodium chloride and 1 mM DTT, and 10 units of *EcoRV* were added to the buffer to react at 37°C for 4 hours.

The treated DNA fragments in the reaction solution were fractionated by agarose gel electrophoresis to recover about 2 µg of an about 3.8 kb (blunt ended KpnI)-*EcoRV* treated fragment of pSupex.

The resulting fragment was dissolved in 44 µl of H₂O, and 5 µl of a solution containing 0.5 M Tris-HCl

(pH 8.5), 1 mM EDTA and one unit of alkali phosphatase (manufactured by Boehringer Mannheim Co.) was added thereto, and allowed to stand at 37°C for 30 minutes.

Phenol-chloroform extraction and ethanol precipitation were carried out using the reaction solution to recover DNA fragments.

In 20 µl of a T4 DNA ligase buffer, 50 ng of the blunt ended SacII fragment of pNKM103 and 100 ng of (blunt ended KpnI)-EcoRV treated fragment of pSupex after alkali phosphatase treatment were dissolved, 100 units of T4 DNA ligase (manufactured by Takara Shuzo Co., Ltd.) were added thereto, and a ligation was carried out at 16°C for 18 hours.

Escherichia coli JM109 was transformed to obtain plasmid pYS201 (Fig. 38) using the recombinant plasmid obtained through the reaction.

Example 29

Expression of N-terminal region of human-derived aging-suppressing polypeptide in *Escherichia coli*:

pYS201 obtained in Example 28 was introduced into *Escherichia coli* NY49. The N-terminal region of a human-derived aging-suppressing polypeptide was expressed using *Escherichia coli* by a method similar to that in Example 7.

That is, the above *Escherichia coli* was cultured in 400 ml of an M9 minimal medium to which 75 µg/ml ampicillin and 2 mg/ml casaminoic acid were added (the medium described in *Molecular Cloning, A laboratory manual*) at 37°C for 2 hours, and 50 µg/ml indole acrylic acid was added thereto, followed by further culturing at 37°C for 18 hours.

A 400 ml portion of the resulting culture was centrifuged at 3,000 × g for 15 minutes, and the precipitate containing the *Escherichia coli* was suspended in 7 ml of Buffer 1 [buffer containing 10 mM Tris-HCl (pH 8.0), 1 mM EDTA and 150 mM sodium chloride], and the *Escherichia coli* was disrupted by ultrasonic treatment.

The treated solution was centrifuged at 10,000 × g for 30 minutes, and the resulting precipitate was dissolved in a sample buffer for SDS-polyacrylamide gel electrophoresis [buffer containing 6 mM Tris-HCl (pH 6.8), 2% SDS, 10% glycerol, and 5% 2-mercaptoethanol].

The solution was fractionated by SDS-polyacrylamide gel electrophoresis, and the gel was then stained with Coomassie Brilliant Blue.

The results are shown in Fig. 39.

It was confirmed that the N-terminal region of human-derived aging-suppressing polypeptide (hereinafter

referred to as "peptide SUHN") having a molecular weight of about 26 kDa was produced. In the electrophoresis, phosphorylase b (94,000), bovine serum albumin (67,000), ovalbumin (43,000), carbonic anhydrase (30,000), soybean trypsin inhibitor (20,000) and lysozyme (14,400) were used as molecular markers.

Example 30

Construction of vector pYS202 for expressing C-terminal region of human aging-suppressing polypeptide:

By ligating together the (*Kpn*I blunt ended)-*Eco*RV fragment of pSupex prepared in Example 28 and a 467 bp *Kpn*I-*Apa*I fragment containing DNA encoding the human-derived aging-suppressing polypeptide of pNKM103 described in Example 5, vector pYS202 for expressing the C-terminal region of the human aging-suppressing polypeptide was constructed as follows (Fig. 40).

To 30 μ l of a buffer containing 10 mM Tris-HCl (pH 7.5), 10 mM magnesium chloride and 1 mM DTT, 10 μ g of the pNKM103 obtained in Example 5 was added, and 20 units each of *Apa*I and *Kpn*I were added to the buffer to react at 37°C for 4 hours.

Phenol-chloroform extraction and ethanol precipitation were carried out using the reaction solution to recover DNA fragments, and they were

subjected to blunt end treatment using a DNA blunting kit (manufactured by Takara Shuzo Co., Ltd.).

The treated DNA fragments in the reaction solution were fractionated by agarose gel electrophoresis to recover about 0.3 µg of a blunt ended *ApaI*-*KpnI* fragment of about 0.5 kb of pNKM103 containing DNA encoding a fragment containing the amino acid residues from Phe⁸⁰¹ to Pro⁹⁵⁴ in the aging-suppressing polypeptide represented by SEQ ID NO:1.

In 20 µl of a T4 DNA ligase buffer, 50 ng of the blunt ended *ApaI*-*KpnI* fragment of pNKM103 and 100 ng of (blunt ended *KpnI*)-*EcoRV* treated fragment of pSupex after alkali phosphatase treatment described in Example 28 were dissolved, 100 units of T4 DNA ligase (manufactured by Takara Shuzo Co., Ltd.) were added thereto, and a ligation was carried out at 16°C for 18 hours.

Escherichia coli JM109 was transformed using the recombinant plasmid DNA obtained by the reaction to obtain plasmid pYS202 (Fig. 40).

Example 31

Expression of C-terminal region of human-derived aging-suppressing polypeptide in *Escherichia coli*:

pYS202 obtained in Example 30 was introduced into *Escherichia coli* NY49. The C-terminal region of human-derived aging-suppressing polypeptide was expressed using the *Escherichia coli* by a method similar to that in Example 7.

That is, the *Escherichia coli* was cultured in 400 ml of an M9 minimal medium to which 75 µg/ml ampicillin and 2 mg/ml casaminoic acid were added at 37°C for 2 hours, and 50 µg/ml indole acrylic acid was added thereto, followed by culturing at 37°C for 18 hours.

A 400 ml portion of the resulting culture was centrifuged at 3,000 × g for 15 minutes, the precipitate containing the *Escherichia coli* was suspended in 7 ml of Buffer 1, and the *Escherichia coli* was disrupted by ultrasonic treatment.

The treated solution was centrifuged at 10,000 × g for 30 minutes, and the resulting precipitate was dissolved in a sample buffer for SDS-polyacrylamide gel electrophoresis. The resulting solution was fractionated by SDS-polyacrylamide gel electrophoresis, and the gel was then stained with Coomassie Brilliant Blue.

The results are shown in Fig. 41.

It was confirmed that the C-terminal region of human-derived aging-suppressing polypeptide (hereinafter referred to as "peptide SUHC") having a molecular weight of about 18 kDa was produced. In the electrophoresis, the molecular weight markers the same as those in Example 29.

Example 32

Generation of monoclonal antibody reacting with partial fragment of human aging-suppressing polypeptide:

Peptides SUHN and SUHC produced in host *Escherichia coli* in Examples 29 and 31, respectively, were purified by a method similar to that in Example 8.

The molecular weights of the purified peptides SUHN and SUHC were about 26 kDa and about 18 kDa, respectively.

According to the method described in Example 8, rats were immunized, and monoclonal antibodies were prepared by a method similar to that in Example 9.

A list of the monoclonal antibodies produced is shown in Table 3.

Hybridoma KM2070, hybridoma KM2076, hybridoma KM 2105, hybridoma KM 2116, and hybridoma KM 2119 were deposited as FERM BP-6196, FERM BP-6197, FERM BP-6198,

FERM BP-6199 and FERM BP-6200, respectively, on December 9, 1997 at National Instituted of Bioscience and Human Technology, Agency of Industrial Science and Technology, 1-3, Higashi 1 chome, Tsukuba-shi, Ibaraki-ken, Japan (Zip code 305).

Table 3

Immunogen	Monoclonal antibody	Animal species	Subclass
Human N-terminal region (SUHN)	KM2070	rat	IgM
Human N-terminal region (SUHN)	KM2076	rat	IgG2a
Human extra-membrane C-terminal region (SUHN)	KM2105	rat	IgG1
Human extra-membrane C-terminal region (SUHN)	KM2116	rat	IgG2b
Human extra-membrane C-terminal region (SUHN)	KM2119	rat	IgG2b

Example 33

Detection of aging-suppressing polypeptide using monoclonal antibody reacting with partial fragment of human aging-suppressing polypeptide:

(1) Western blotting of murine complete length protein expressed by CHO and murine tissue

The kidney and liver of a wild-type ICR mouse and the kidney and liver of a homozygote ICR mouse (aged mouse) were ground in a homogenizing buffer [20 mM Tris-

HCl (pH 7.5), 0.25 M Sucrose, 1 mM EDTA, 10 mM EGTA, 10 mM 2-mercaptoethanol], and ultra-centrifugation (100,000 $\times$ g, 4°C, one hour) was carried out to separate and recover the membrane fraction (precipitate) and the cytoplasm fraction (supernatant).

The resulting membrane fraction was dissolved in a dissolution buffer [1% Triton-X100, 20 mM Tris-HCl (pH 7.5), 150 mM NaCl]. Additionally, the murine membrane type complete length-expressing CHO cells as described in Example 11 were washed with PBS, and then solubilized in a dissolution buffer. SDS-polyacrylamide gel electrophoresis was carried out using the membrane fraction and cytoplasm fraction (20 μ g) of each tissue and the cell lysate (2 μ g) of the murine membrane type complete length-expressing CHO cells, and the culture supernatant (15 μ l) of the murine membrane type complete length-expressing CHO cells to transfer the protein from the gel onto a PVDF membrane.

After the transfer, blocking was carried out in PBS-Tween containing 5% skim milk for 20 minutes, and the culture supernatant of each of hybridoma KM2076, hybridoma KM2116 and hybridoma KM2119 was allowed to react at room temperature for one hour. After washing in PBS-Tween for one hour, a peroxidase-labeled anti-rat immunoglobulin antibody (Amersham Co., 4000-fold

dilution) was allowed to react as the second antibody at room temperature for 30 minutes.

After the reaction, the membrane was washed with PBS-Tween for one hour, an ECL Western blotting detection reagent (Amersham Co.) was allowed to react, and the membrane was exposed to an X-ray film to detect bands.

The results are shown in Figs. 42 and 43.

KM2076 recognized a band of about 130 kDa specifically to the wild-type in the kidney membrane fraction. Because the band of about 130 kDa is close to the molecular weight estimated on the basis of the amino acid sequence and is almost equal to the size of the murine membrane type complete length protein expressed in CHO cells, the band would be derived from the membrane type complete length protein. Additionally, KM2076 recognized a band of about 70 kDa in the culture supernatant of the murine membrane type complete length-expressing CHO cells.

In the kidney membrane fraction, KM2119 recognized a band of about 130 kDa of the membrane type complete length and a band of about 60 kDa in a manner specific to the wild-type. Because the band of about 60 kDa was not detected with KM2076 (human N-terminal recognizing antibody) but detected only with KM2119

(human C-terminal recognizing antibody), it is suggested that the band would be a fragment on the side of the C terminus of the complete length protein remaining after cleavage of the side of the N-terminus. Then, the band of about 70 kDa in the culture supernatant of the murine membrane type complete length-expressing CHO cells as recognized with KM2076 would be a cleavage fragment on the side of the N-terminus. Additionally, KM2119 recognized a non-specific band of about 66 kDa, which reacted with the cytoplasm fractions of kidney and liver from the wild-type and homozygote. Alternatively, KM2116 recognized the complete length protein in the kidney membrane fraction in a manner specific to the wild-type, and also detected the non-specific band of about 70 kDa.

(2) Immunoprecipitation of murine complete length protein expressed by CHO and human secretory protein expressed by CHO

The murine membrane type complete length protein-expressing CHO cells described in Example 11 and CHO cells were solubilized in a dissolution buffer [1% Triton-X100, 20 mM Tris-HCl (pH 7.5), 150 mM NaCl]. An immunoprecipitation buffer [20 mM Tris-HCl (pH 7.5), 150 mM NaCl] of 800 μ l was added to 200 μ l of the resulting

solution to a final total volume of 1 ml, 25 μ l of Protein G-Sepharose 4FF (Pharmacia Co.) was added to react at 4°C for one hour. The culture supernatant was recovered by centrifugation (1000 $\times$ g, 4°C, 5 minutes), 1 μ g each of purified KM2076 and KM2119 antibodies was added thereto prior to reaction at 4°C for one hour. Furthermore, 25 μ l of Protein G-Sepharose 4FF was added to the resulting mixture to react at 4°C for one hour. Still furthermore, 1 ml of the culture supernatant of the human secretory protein-expressing CHO cells was allowed to react with KM2076 preliminarily bound to Protein G-Sepharose at 4°C for one hour in the same manner as described above. After washing these reaction products in a buffer for immunoprecipitation, the precipitate was recovered by centrifugation (10,000 $\times$ g, 4°C, 5 minutes), and then separated by SDS-polyacrylamide gel electrophoresis to transfer the protein from the gel onto a PVDF membrane. Blocking was carried out in PBS-Tween containing 5% skim milk, and Western blotting was carried out using KM2076 and KM2119. Consequently, as shown in Fig. 44, the membrane type complete length protein was recovered by immunoprecipitation using KM2076, and the membrane type complete length protein and the C-terminal fragment protein were recovered by immunoprecipitation using

KM2119. As shown in Fig. 45, similarly, the human secretory protein was recovered by immunoprecipitation using KM2076.

(3) Immune tissue staining using human tissue section

Formalin-immobilized paraffin-embedded tissues of two samples of human kidney and two samples of human liver were thinly cut to 4 mm, and fixed on a slide glass. The sections were deparaffinated with xylene, the hydrophilicity of the sections was increased with alcohol-water, and the sections were treated with methanol containing an aqueous 1% hydrogen peroxide solution for 15 minutes to block the endogenous peroxidase. The sections were washed with PBS and were blocked with diluted normal horse serum for 20 minutes, and were allowed to react with either KM2070 or KM2116 (10 mg/ml) at room temperature for 30 minutes. After thorough washing, a biotin-labeled anti-rat immunoglobulin antibody (Vector Co., 200-fold dilution) was allowed to react as the second antibody at room temperature for 30 minutes. After washing, ABC reagent (manufactured by Vector Co.) was allowed to react at room temperature for 30 minutes. After washing with PBS, color development was carried out in a diaminobenzidine substrate solution [produced by dissolving 50 mg of

diaminobenzidine in 150 ml of a 0.1 M Tris-HCl buffer (pH 7.2), followed by filtration, and 50 ml of hydrogen peroxide was added thereto] for about one minute, and then the reaction was terminated under ice cooling. The nucleus was stained with hematoxyline, the sections were dehydrated with alcohol-water and xylene and sealed with Enteran New for microscopic observation. As a result, as shown in Table 4, KM2070 was allowed to react with the renal uriniferous tubule and vascular smooth muscle of the human kidney, and KM2116 was allowed to specifically react with the distal uriniferous tubule of the human kidney. As to human liver, both KM2070 and KM2116 were allowed to react with liver cells. It is demonstrated that KM2116 is useful for the analysis of human pathological sections, additionally because a band was detected in the kidney membrane fraction of wild-type ICR mouse but not detected in the kidney membrane fraction of homozygote mouse (aged mouse) by Western blotting with KM2116 (Fig. 43).

(4) Immune tissue staining using murine tissue section

Formalin-immobilized paraffin-embedded tissues of two samples of kidney and liver of wild-type ICR mouse and two samples of kidney and liver of homozygote ICR mouse (aged mouse) were thinly cut to 4 mm, and fixed on

a slide glass. In the same manner as for KM2070 and KM2116 in (1), immune tissues were stained with KM2070 and KM2105 (10 mg/ml). Consequently, as shown in Table 4, both KM2070 and KM2105 were allowed to react with renal uriniferous tubule in a manner specific to the wild-type. However, KM2070 was allowed to react with vascular smooth muscle from both wild-type and homozygote. Furthermore, KM2070 and KM2105 were allowed to react with the liver cells from both wild-type and homozygote.

Table 4

Monoclonal antibody	KM2070	KM2105	KM2116
Human kidney	uriniferous tubule, vascular smooth muscle	-	distal uriniferous tubule
Human liver	liver cell	-	liver cell
Wild-type murine kidney	uriniferous tubule, vascular smooth muscle	uriniferous tubule	-
Wild-type murine liver	liver cell	liver cell	-
Homozygote murine kidney	uriniferous tubule		-
Homozygote murine liver	liver cell	liver cell	-

INDUSTRIAL APPLICABILITY

The present invention can provide a polypeptide having an activity of suppressing aging; a therapeutic agent for a syndrome resembling premature aging, a therapeutic agent for adult diseases or an aging-suppressing agent, each comprising the polypeptide; DNA encoding the polypeptide; a therapeutic agent for a syndrome resembling premature aging, a therapeutic agent for adult diseases or an aging-suppressing agent, each comprising the DNA; a method for improving livestock by using the DNA; a recombinant DNA prepared by incorporating the DNA into a vector; a transformant harboring the recombinant; a method for producing the polypeptide of the present invention using the transformant; an antibody recognizing the polypeptide; a method for assaying the polypeptide of the present invention or a method for diagnosing aging, using the antibody; a method for screening a ligand for the polypeptide of the present invention; the ligand; a method for screening a compound inhibiting the specific binding between the polypeptide and ligand of the present invention; a compound obtained by the screening method; a method for screening a compound enhancing the expression of the aging-suppressing gene encoding the

aging-suppressing polypeptide of the present invention;
and a compound obtained by the screening method.

SEQUENCE LISTING

SEQ ID NO:1

SEQUENCE LENGTH: 1,012

SEQUENCE TYPE: amino acid

STRANDEDNESS: single

TOPOLOGY: linear

MOLECULE TYPE: peptide

ORIGINAL SOURCE:

Organism: human

Organization: kidney

SEQUENCE:

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Leu Ser Leu Leu Leu Val Leu Leu Gly Leu Gly Gly Arg Arg Leu Arg
 20           25           30
Ala Glu Pro Gly Asp Gly Ala Gln Thr Trp Ala Arg Phe Ser Arg Pro
 35           40           45
Pro Ala Pro Glu Ala Ala Gly Leu Phe Gln Gly Thr Phe Pro Asp Gly
 50           55           60
Phe Leu Trp Ala Val Gly Ser Ala Ala Tyr Gln Thr Glu Gly Gly Trp
 65           70           75           80
Gln Gln His Gly Lys Gly Ala Ser Ile Trp Asp Thr Phe Thr His His
 85           90           95
Pro Leu Ala Pro Pro Gly Asp Ser Arg Asn Ala Ser Leu Pro Leu Gly
100           105           110
Ala Pro Ser Pro Leu Gln Pro Ala Thr Gly Asp Val Ala Ser Asp Ser
115           120           125
Tyr Asn Asn Val Phe Arg Asp Thr Glu Ala Leu Arg Glu Leu Gly Val
130           135           140
Thr His Tyr Arg Phe Ser Ile Ser Trp Ala Arg Val Leu Pro Asn Gly
145           150           155           160
Ser Ala Gly Val Pro Asn Arg Glu Gly Leu Arg Tyr Tyr Arg Arg Leu
165           170           175
Leu Glu Arg Leu Arg Glu Leu Gly Val Gln Pro Val Val Thr Leu Tyr
180           185           190
His Trp Asp Leu Pro Gln Arg Leu Gln Asp Ala Tyr Gly Gly Trp Ala
195           200           205
Asn Arg Ala Leu Ala Asp His Phe Arg Asp Tyr Ala Glu Leu Cys Phe
210           215           220
Arg His Phe Gly Gly Gln Val Lys Tyr Trp Ile Thr Ile Asp Asn Pro
225           230           235           240
Tyr Val Val Ala Trp His Gly Tyr Ala Thr Gly Arg Leu Ala Pro Gly
245           250           255
Ile Arg Gly Ser Pro Arg Leu Gly Tyr Leu Val Ala His Asn Leu Leu
260           265           270
Leu Ala His Ala Lys Val Trp His Leu Tyr Asn Thr Ser Phe Arg Pro
275           280           285
Thr Gln Gly Gly Gln Val Ser Ile Ala Leu Ser Ser His Trp Ile Asn
290           295           300
Pro Arg Arg Met Thr Asp His Ser Ile Lys Glu Cys Gln Lys Ser Leu

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305					310					315				320	
Asp	Phe	Val	Leu	Gly	Trp	Phe	Ala	Lys	Pro	Val	Phe	Ile	Asp	Gly	Asp
				325					330					335	
Tyr	Pro	Glu	Ser	Met	Lys	Asn	Asn	Leu	Ser	Ser	Ile	Leu	Pro	Asp	Phe
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Thr	Glu	Ser	Glu	Lys	Lys	Phe	Ile	Lys	Gly	Thr	Ala	Asp	Phe	Phe	Ala
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Leu	Cys	Phe	Gly	Pro	Thr	Leu	Ser	Phe	Gln	Leu	Leu	Asp	Pro	His	Met
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Lys	Phe	Arg	Gln	Leu	Glu	Ser	Pro	Asn	Leu	Arg	Gln	Leu	Leu	Ser	Trp
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Ile	Asp	Leu	Glu	Phe	Asn	His	Pro	Gln	Ile	Phe	Ile	Val	Glu	Asn	Gly
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Trp	Phe	Val	Ser	Gly	Thr	Thr	Lys	Arg	Asp	Asp	Ala	Lys	Tyr	Met	Tyr
				420				425						430	
Tyr	Leu	Lys	Lys	Phe	Ile	Met	Glu	Thr	Leu	Lys	Ala	Ile	Lys	Leu	Asp
				435				440					445		
Gly	Val	Asp	Val	Ile	Gly	Tyr	Thr	Ala	Trp	Ser	Leu	Met	Asp	Gly	Phe
								455					460		
Glu	Trp	His	Arg	Gly	Tyr	Ser	Ile	Arg	Arg	Gly	Leu	Phe	Tyr	Val	Asp
465								470					475		480
Phe	Leu	Ser	Gln	Asp	Lys	Met	Leu	Leu	Pro	Lys	Ser	Ser	Ala	Leu	Phe
				485					490					495	
Tyr	Gln	Lys	Leu	Ile	Glu	Lys	Asn	Gly	Phe	Pro	Pro	Leu	Pro	Glu	Asn
				500				505						510	
Gln	Pro	Leu	Glu	Gly	Thr	Phe	Pro	Cys	Asp	Phe	Ala	Trp	Gly	Val	Val
				515				520					525		
Asp	Asn	Tyr	Ile	Gln	Val	Asp	Thr	Thr	Leu	Ser	Gln	Phe	Thr	Asp	Leu
								535					540		
Asn	Val	Tyr	Leu	Trp	Asp	Val	His	His	Ser	Lys	Arg	Leu	Ile	Lys	Val
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Asp	Gly	Val	Val	Thr	Lys	Lys	Arg	Lys	Ser	Tyr	Cys	Val	Asp	Phe	Ala
				565					570					575	
Ala	Ile	Gln	Pro	Gln	Ile	Ala	Leu	Leu	Gln	Glu	Met	His	Val	Thr	His
				580				585						590	
Phe	Arg	Phe	Ser	Leu	Asp	Trp	Ala	Leu	Ile	Leu	Pro	Leu	Gly	Asn	Gln
				595				600					605		
Ser	Gln	Val	Asn	His	Thr	Ile	Leu	Gln	Tyr	Tyr	Arg	Cys	Met	Ala	Ser
								615					620		
Glu	Leu	Val	Arg	Val	Asn	Ile	Thr	Pro	Val	Val	Ala	Leu	Trp	Gln	Pro
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Met	Ala	Pro	Asn	Gln	Gly	Leu	Pro	Arg	Leu	Leu	Ala	Arg	Gln	Gly	Ala
				645					650					655	
Trp	Glu	Asn	Pro	Tyr	Thr	Ala	Leu	Ala	Phe	Ala	Glu	Tyr	Ala	Arg	Leu
				660				665						670	
Cys	Phe	Gln	Glu	Leu	Gly	His	His	Val	Lys	Leu	Trp	Ile	Thr	Met	Asn
				675				680						685	
Glu	Pro	Tyr	Thr	Arg	Asn	Met	Thr	Tyr	Ser	Ala	Gly	His	Asn	Leu	Leu
				690				695						700	
Lys	Ala	His	Ala	Leu	Ala	Trp	His	Val	Tyr	Asn	Glu	Lys	Phe	Arg	His
705								710						715	720

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 Pro Ala Cys Pro Phe Ser Gln Lys Asp Lys Glu Val Ala Glu Arg Val
 740 745 750
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 770 775 780
 Leu Leu Pro Tyr Phe Thr Glu Asp Glu Lys Lys Leu Ile Gln Gly Thr
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 805 810 815
 Glu Lys Glu Asp Pro Ile Lys Tyr Asn Asp Tyr Leu Glu Val Gln Glu
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 Met Thr Asp Ile Thr Trp Leu Asn Ser Pro Ser Gln Val Ala Val Val
 835 840 845
 Pro Trp Gly Leu Arg Lys Val Leu Asn Trp Leu Lys Phe Lys Tyr Gly
 850 855 860
 Asp Leu Pro Met Tyr Ile Ile Ser Asn Gly Ile Asp Asp Gly Leu His
 865 870 875 880
 Ala Glu Asp Asp Gln Leu Arg Val Tyr Tyr Met Gln Asn Tyr Ile Asn
 885 890 895
 Glu Ala Leu Lys Ala His Ile Leu Asp Gly Ile Asn Leu Cys Gly Tyr
 900 905 910
 Phe Ala Tyr Ser Phe Asn Asp Arg Thr Ala Pro Arg Phe Gly Leu Tyr
 915 920 925
 Arg Tyr Ala Ala Asp Gln Phe Glu Pro Lys Ala Ser Met Lys His Tyr
 930 935 940
 Arg Lys Ile Ile Asp Ser Asn Gly Phe Pro Gly Pro Glu Thr Leu Glu
 945 950 955 960
 Arg Phe Cys Pro Glu Glu Phe Thr Val Cys Thr Glu Cys Ser Phe Phe
 965 970 975
 His Thr Arg Lys Ser Leu Leu Ala Phe Ile Ala Phe Leu Phe Phe Ala
 980 985 990
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 995 1000 1005
 Arg Ser Tyr Lys
 1010

SEQ ID NO:2

SEQUENCE LENGTH: 549

SEQUENCE TYPE: amino acid

STRANDEDNESS: single

TOPOLGY: linear

MOLECULE TYPE: protein

ORIGINAL SOURCE:

Organism: human

Organization: kidney

SEQUENCE:

Met Pro Ala Ser Ala Pro Pro Arg Arg Pro Arg Pro Pro Pro Ser
 1 5 10 15

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

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          450          455          460
Glu Trp His Arg Gly Tyr Ser Ile Arg Arg Gly Leu Phe Tyr Val Asp
465          470          475          480
Phe Leu Ser Gln Asp Lys Met Leu Leu Pro Lys Ser Ser Ala Leu Phe
          485          490          495
Tyr Gln Lys Leu Ile Glu Lys Asn Gly Phe Pro Pro Leu Pro Glu Asn
          500          505          510
Gln Pro Leu Glu Gly Thr Phe Pro Cys Asp Phe Ala Trp Gly Val Val
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Thr Lys Pro Tyr His
545

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SEQ ID NO:3

SEQUENCE LENGTH: 1,014

SEQUENCE TYPE: amino acid

STRANDEDNESS: single

TOPOLGY: linear

MOLECULE TYPE: protein

ORIGINAL SOURCE:

ORGANISM: mouse

Organization: kidney

SEQUENCE:

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Leu Ser Ala Glu Pro Gly Gln Gly Ala Gln Thr Trp Ala Arg Phe Ala
          35          40          45
Arg Ala Pro Ala Pro Glu Ala Ala Gly Leu Leu His Asp Thr Phe Pro
          50          55          60
Asp Gly Phe Leu Trp Ala Val Gly Ser Ala Ala Tyr Gln Thr Glu Gly
65          70          75          80
Gly Trp Arg Gln His Gly Lys Gly Ala Ser Ile Trp Asp Thr Phe Thr
          85          90          95
His His Ser Gly Ala Ala Pro Ser Asp Ser Pro Ile Val Val Ala Pro
          100          105          110
Ser Gly Ala Pro Ser Pro Pro Leu Ser Ser Thr Gly Asp Val Ala Ser
          115          120          125
Asp Ser Tyr Asn Asn Val Tyr Arg Asp Thr Glu Gly Leu Arg Glu Leu
          130          135          140
Gly Val Thr His Tyr Arg Phe Ser Ile Ser Trp Ala Arg Val Leu Pro
          145          150          155          160
Asn Gly Thr Ala Gly Thr Pro Asn Arg Glu Gly Leu Arg Tyr Tyr Arg
          165          170          175
Arg Leu Leu Glu Arg Leu Arg Glu Leu Gly Val Gln Pro Val Val Thr

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Trp	Ala	Asn	Arg	Ala	Leu	Ala	Asp	His	Phe	Arg	Asp	Tyr	Ala	Glu	Leu		
	210					215					220						
Cys	Phe	Arg	His	Phe	Gly	Gly	Gln	Val	Lys	Tyr	Trp	Ile	Thr	Ile	Asp		
225					230					235					240		
Asn	Pro	Tyr	Val	Val	Ala	Trp	His	Gly	Tyr	Ala	Thr	Gly	Arg	Leu	Ala		
				245					250					255			
Pro	Gly	Val	Arg	Gly	Ser	Ser	Arg	Leu	Gly	Tyr	Leu	Val	Ala	His	Asn		
			260				265						270				
Leu	Leu	Leu	Ala	His	Ala	Lys	Val	Trp	His	Leu	Tyr	Asn	Thr	Ser	Phe		
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Arg	Pro	Thr	Gln	Gly	Gly	Arg	Val	Ser	Ile	Ala	Leu	Ser	Ser	His	Trp		
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Ile	Asn	Pro	Arg	Arg	Met	Thr	Asp	Tyr	Asn	Ile	Arg	Glu	Cys	Gln	Lys		
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Ser	Leu	Asp	Phe	Val	Leu	Gly	Trp	Phe	Ala	Lys	Pro	Ile	Phe	Ile	Asp		
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Gly	Asp	Tyr	Pro	Glu	Ser	Met	Lys	Asn	Asn	Leu	Ser	Ser	Leu	Leu	Pro		
			340				345						350				
Asp	Phe	Thr	Glu	Ser	Glu	Lys	Arg	Leu	Ile	Arg	Gly	Thr	Ala	Asp	Phe		
	355						360					365					
Phe	Ala	Leu	Ser	Phe	Gly	Pro	Thr	Leu	Ser	Phe	Gln	Leu	Leu	Asp	Pro		
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Asn	Met	Lys	Phe	Arg	Gln	Leu	Glu	Ser	Pro	Asn	Leu	Arg	Gln	Leu	Leu		
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Ser	Trp	Ile	Asp	Leu	Glu	Tyr	Asn	His	Pro	Pro	Ile	Phe	Ile	Val	Glu		
			405						410					415			
Asn	Gly	Trp	Phe	Val	Ser	Gly	Thr	Thr	Lys	Arg	Asp	Asp	Ala	Lys	Tyr		
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Met	Tyr	Tyr	Leu	Lys	Lys	Phe	Ile	Met	Glu	Thr	Leu	Lys	Ala	Ile	Arg		
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Leu	Asp	Gly	Val	Asp	Val	Ile	Gly	Tyr	Thr	Ala	Trp	Ser	Leu	Met	Asp		
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465					470					475					480		
Val	Asp	Phe	Leu	Ser	Gln	Asp	Lys	Glu	Leu	Leu	Pro	Lys	Ser	Ser	Ala		
				485				490						495			
Leu	Phe	Tyr	Gln	Lys	Leu	Ile	Glu	Asp	Asn	Gly	Phe	Pro	Pro	Leu	Pro		
			500				505						510				
Glu	Asn	Gln	Pro	Leu	Glu	Gly	Thr	Phe	Pro	Cys	Asp	Phe	Ala	Trp	Gly		
	515						520					525					
Val	Val	Asp	Asn	Tyr	Val	Gln	Val	Asp	Thr	Thr	Leu	Ser	Gln	Phe	Thr		
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Asp	Pro	Asn	Val	Tyr	Leu	Trp	Asp	Val	His	His	Ser	Lys	Arg	Leu	Ile		
545					550					555					560		
Lys	Val	Asp	Gly	Val	Val	Ala	Lys	Lys	Arg	Lys	Pro	Tyr	Cys	Val	Asp		
			565					570						575			
Phe	Ser	Ala	Ile	Arg	Pro	Gln	Ile	Thr	Leu	Leu	Arg	Glu	Met	Arg	Val		
			580					585					590				

Thr His Phe Arg Phe Ser Leu Asp Trp Ala Leu Ile Leu Pro Leu Gly
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 610 615 620
 Ile Ser Glu Leu Val His Ala Asn Ile Thr Pro Val Val Ala Leu Trp
 625 630 635 640
 Gln Pro Ala Ala Pro His Gln Gly Leu Pro His Ala Leu Ala Lys His
 645 650 655
 Gly Ala Trp Glu Asn Pro His Thr Ala Leu Ala Phe Ala Asp Tyr Ala
 660 665 670
 Asn Leu Cys Phe Lys Glu Leu Gly His Trp Val Asn Leu Trp Ile Thr
 675 680 685
 Met Asn Glu Pro Asn Thr Arg Asn Met Thr Tyr Arg Ala Gly His His
 690 695 700
 Leu Leu Arg Ala His Ala Leu Ala Trp His Leu Tyr Asp Asp Lys Phe
 705 710 715 720
 Arg Ala Ala Gln Lys Gly Lys Ile Ser Ile Ala Leu Gln Ala Asp Trp
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 Ser Gly Asp Tyr Pro Arg Val Met Arg Asp Trp Leu Asn Gln Lys Asn
 770 775 780
 Asn Phe Leu Leu Pro Tyr Phe Thr Glu Asp Glu Lys Lys Leu Val Arg
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 Gly Ser Phe Asp Phe Leu Ala Val Ser His Tyr Thr Thr Ile Leu Val
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 Gln Glu Met Thr Asp Ile Thr Trp Leu Asn Ser Pro Ser Gln Val Ala
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 Val Val Pro Trp Gly Leu Arg Lys Val Leu Asn Trp Leu Arg Phe Lys
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 Pro His Ala Glu Gln Asp Ser Leu Arg Ile Tyr Tyr Ile Lys Asn Tyr
 885 890 895
 Val Asn Glu Ala Leu Lys Ala Tyr Val Leu Asp Asp Ile Asn Leu Cys
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 Gly Tyr Phe Ala Tyr Ser Leu Ser Asp Arg Ser Ala Pro Lys Ser Gly
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 His Tyr Arg Arg Ile Ile Asp Ser Asn Gly Phe Leu Gly Ser Gly Thr
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 Leu Gly Arg Phe Cys Pro Glu Glu Tyr Thr Val Cys Thr Glu Cys Gly
 965 970 975
 Phe Phe Gln Thr Arg Lys Ser Leu Leu Val Phe Ile Ser Phe Leu Val
 980 985 990
 Phe Thr Phe Ile Ile Ser Leu Ala Leu Ile Phe His Tyr Ser Lys Lys

995
Gly Gln Arg Ser Tyr Lys
1010

1000

1005

SEQ ID NO:4
SEQUENCE LENGTH: 550
SEQUENCE TYPE: amino acid
STRANDEDNESS: single
TOPOLYGY: linear
MOLECULE TYPE: protein
ORIGINAL SOURCE:
ORGANISM: mouse
Organization: kidney

SEQUENCE:

Met	Leu	Ala	Arg	Ala	Pro	Pro	Arg	Arg	Pro	Pro	Arg	Leu	Val	Leu	Leu	1	5	10	15
Arg	Leu	Leu	Leu	Leu	His	Leu	Leu	Leu	Leu	Ala	Leu	Arg	Ala	Arg	Cys	20	25	30	
Leu	Ser	Ala	Glu	Pro	Gly	Gln	Gly	Ala	Gln	Thr	Trp	Ala	Arg	Phe	Ala	35	40	45	
Arg	Ala	Pro	Ala	Pro	Glu	Ala	Ala	Gly	Leu	Leu	His	Asp	Thr	Phe	Pro	50	55	60	
Asp	Gly	Phe	Leu	Trp	Ala	Val	Gly	Ser	Ala	Ala	Tyr	Gln	Thr	Glu	Gly	65	70	75	80
Gly	Trp	Arg	Gln	His	Gly	Lys	Gly	Ala	Ser	Ile	Trp	Asp	Thr	Phe	Thr	85	90	95	
His	His	Ser	Gly	Ala	Ala	Pro	Ser	Asp	Ser	Pro	Ile	Val	Val	Ala	Pro	100	105	110	
Ser	Gly	Ala	Pro	Ser	Pro	Pro	Leu	Ser	Ser	Thr	Gly	Asp	Val	Ala	Ser	115	120	125	
Asp	Ser	Tyr	Asn	Asn	Val	Tyr	Arg	Asp	Thr	Glu	Gly	Leu	Arg	Glu	Leu	130	135	140	
Gly	Val	Thr	His	Tyr	Arg	Phe	Ser	Ile	Ser	Trp	Ala	Arg	Val	Leu	Pro	145	150	155	160
Asn	Gly	Thr	Ala	Gly	Thr	Pro	Asn	Arg	Glu	Gly	Leu	Arg	Tyr	Tyr	Arg	165	170	175	
Arg	Leu	Leu	Glu	Arg	Leu	Arg	Glu	Leu	Gly	Val	Gln	Pro	Val	Val	Thr	180	185	190	
Leu	Tyr	His	Trp	Asp	Leu	Pro	Gln	Arg	Leu	Gln	Asp	Thr	Tyr	Gly	Gly	195	200	205	
Trp	Ala	Asn	Arg	Ala	Leu	Ala	Asp	His	Phe	Arg	Asp	Tyr	Ala	Glu	Leu	210	215	220	
Cys	Phe	Arg	His	Phe	Gly	Gly	Gln	Val	Lys	Tyr	Trp	Ile	Thr	Ile	Asp	225	230	235	240
Asn	Pro	Tyr	Val	Val	Ala	Trp	His	Gly	Tyr	Ala	Thr	Gly	Arg	Leu	Ala	245	250	255	
Pro	Gly	Val	Arg	Gly	Ser	Ser	Arg	Leu	Gly	Tyr	Leu	Val	Ala	His	Asn	260	265	270	
Leu	Leu	Leu	Ala	His	Ala	Lys	Val	Trp	His	Leu	Tyr	Asn	Thr	Ser	Phe	275	280	285	
Arg	Pro	Thr	Gln	Gly	Gly	Arg	Val	Ser	Ile	Ala	Leu	Ser	Ser	His	Trp				

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      290              295              300
Ile Asn Pro Arg Arg Met Thr Asp Tyr Asn Ile Arg Glu Cys Gln Lys
305              310              315              320
Ser Leu Asp Phe Val Leu Gly Trp Phe Ala Lys Pro Ile Phe Ile Asp
      325              330              335
Gly Asp Tyr Pro Glu Ser Met Lys Asn Asn Leu Ser Ser Leu Leu Pro
      340              345              350
Asp Phe Thr Glu Ser Glu Lys Arg Leu Ile Arg Gly Thr Ala Asp Phe
      355              360              365
Phe Ala Leu Cys Phe Gly Pro Thr Leu Ser Phe Gln Leu Leu Asp Pro
      370              375              380
Asn Met Lys Phe Arg Gln Leu Glu Ser Pro Asn Leu Arg Gln Leu Leu
385              390              395              400
Ser Trp Ile Asp Leu Glu Tyr Asn His Pro Pro Ile Phe Ile Val Glu
      405              410              415
Asn Gly Trp Phe Val Ser Gly Thr Thr Lys Arg Asp Asp Ala Lys Tyr
      420              425              430
Met Tyr Tyr Leu Lys Lys Phe Ile Met Glu Thr Leu Lys Ala Ile Arg
      435              440              445
Leu Asp Gly Val Asp Val Ile Gly Tyr Thr Ala Trp Ser Leu Met Asp
      450              455              460
Gly Phe Glu Trp His Arg Gly Tyr Ser Ile Arg Arg Gly Leu Phe Tyr
465              470              475              480
Val Asp Phe Leu Ser Gln Asp Lys Glu Leu Leu Pro Lys Ser Ser Ala
      485              490              495
Leu Phe Tyr Gln Lys Leu Ile Glu Asp Asn Gly Phe Pro Pro Leu Pro
      500              505              510
Glu Asn Gln Pro Leu Glu Gly Thr Phe Pro Cys Asp Phe Ala Trp Gly
      515              520              525
Val Val Asp Asn Tyr Val Gln Val Ser Pro Leu Thr Lys Pro Ser Val
      530              535              540
Gly Leu Leu Leu Pro His
545              550

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SEQ ID NO:5

SEQUENCE LENGTH: 1,015

SEQUENCE TYPE: amino acid

STRANDEDNESS: single

TOPOLGY: linear

MOLECULE TYPE: protein

ORIGINAL SOURCE:

ORGANISM: human

ORGANIZATION: pancreas

SEQUENCE:

```

Met Ser Asn Gly Gly Leu Gln Arg Ser Val Ile Leu Ser Ala Leu Ile
 1              5              10              15
Leu Leu Arg Ala Val Thr Gly Phe Ser Gly Asp Gly Arg Ala Ile Trp
      20              25              30
Ser Lys Asn Pro Asn Phe Thr Pro Val Asn Glu Ser Gln Leu Phe Leu
      35              40              45
Tyr Gly Thr Phe Pro Lys Asn Phe Phe Trp Gly Ile Gly Thr Gly Ala

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50	55	60
Leu Gln Val Glu Gly Ser Trp Lys Lys Asp Gly Lys Gly Pro Ser Ile		
65	70	75
Trp Asp His Phe Ile His Thr His Leu Lys Asn Val Ser Ser Thr Asn		
	85	90
Gly Ser Ser Asp Ser Tyr Ile Phe Leu Glu Lys Asp Leu Ser Ala Leu		
	100	105
Asp Phe Ile Gly Val Ser Phe Tyr Gln Phe Ser Ile Ser Trp Pro Arg		
	115	120
Leu Phe Pro Asp Gly Ile Val Thr Val Ala Asn Ala Lys Gly Leu Gln		
	130	135
Tyr Tyr Ser Thr Leu Leu Asp Ala Leu Val Leu Arg Asn Ile Glu Pro		
145	150	155
Ile Val Thr Leu Tyr His Trp Asp Leu Pro Leu Ala Leu Gln Glu Lys		
	165	170
Tyr Gly Gly Trp Lys Asn Asp Thr Ile Ile Asp Ile Phe Asn Asp Tyr		
	180	185
Ala Thr Tyr Cys Phe Gln Met Phe Gly Asp Arg Val Lys Tyr Trp Ile		
	195	200
Thr Ile His Asn Pro Tyr Leu Val Ala Trp His Gly Tyr Gly Thr Gly		
	210	215
Met His Ala Pro Gly Glu Lys Gly Asn Leu Ala Ala Val Tyr Thr Val		
225	230	235
Gly His Asn Leu Ile Lys Ala His Ser Lys Val Trp His Asn Tyr Asn		
	245	250
Thr His Phe Arg Pro His Gln Lys Gly Trp Leu Ser Ile Thr Leu Gly		
	260	265
Ser His Trp Ile Glu Pro Asn Arg Ser Glu Asn Thr Met Asp Ile Phe		
	275	280
Lys Cys Gln Gln Ser Met Val Ser Val Leu Gly Trp Phe Ala Asn Pro		
	290	295
Ile His Gly Asp Gly Asp Tyr Pro Glu Gly Met Arg Lys Lys Leu Phe		
305	310	315
Ser Val Leu Pro Ile Phe Ser Glu Ala Glu Lys His Glu Met Arg Gly		
	325	330
Thr Ala Asp Phe Phe Ala Phe Ser Phe Gly Pro Asn Asn Phe Lys Pro		
	340	345
Leu Asn Thr Met Ala Lys Met Gly Gln Asn Val Ser Leu Asn Leu Arg		
	355	360
Glu Ala Leu Asn Trp Ile Lys Leu Glu Tyr Asn Asn Pro Arg Ile Leu		
	370	375
Ile Ala Glu Asn Gly Trp Phe Thr Asp Ser Arg Val Lys Thr Glu Asp		
385	390	395
Thr Thr Ala Ile Tyr Met Met Lys Asn Phe Leu Ser Gln Val Leu Gln		
	405	410
Ala Ile Arg Leu Asp Glu Ile Arg Val Phe Gly Tyr Thr Ala Trp Ser		
	420	425
Leu Leu Asp Gly Phe Glu Trp Gln Asp Ala Tyr Thr Ile Arg Arg Gly		
	435	440
Leu Phe Tyr Val Asp Phe Asn Ser Lys Gln Lys Glu Arg Lys Pro Lys		
450	455	460

Ser Ser Ala His Tyr Tyr Lys Gln Ile Ile Arg Glu Asn Gly Phe Ser
 465 470 475 480
 Leu Lys Glu Ser Thr Pro Asp Val Gln Gly Gln Phe Pro Cys Asp Phe
 485 490 495
 Ser Trp Gly Val Thr Glu Ser Val Leu Lys Pro Glu Ser Val Ala Ser
 500 505 510
 Ser Pro Gln Phe Ser Asp Pro His Leu Tyr Val Trp Asn Ala Thr Gly
 515 520 525
 Asn Arg Leu Leu His Arg Val Glu Gly Val Arg Leu Lys Thr Arg Pro
 530 535 540
 Ala Gln Cys Thr Asp Phe Val Asn Ile Lys Lys Gln Leu Glu Met Leu
 545 550 555 560
 Ala Arg Met Lys Val Thr His Tyr Arg Phe Ala Leu Asp Trp Ala Ser
 565 570 575
 Val Leu Pro Thr Gly Asn Leu Ser Ala Val Asn Arg Gln Ala Leu Arg
 580 585 590
 Tyr Tyr Arg Cys Val Val Ser Glu Gly Leu Lys Leu Gly Ile Ser Ala
 595 600 605
 Met Val Thr Leu Tyr Tyr Pro Thr His Ala His Leu Gly Leu Pro Glu
 610 615 620
 Pro Leu Leu His Ala Asp Gly Trp Leu Asn Pro Ser Thr Ala Glu Ala
 625 630 635 640
 Phe Gln Ala Tyr Ala Gly Leu Cys Phe Gln Glu Leu Gly Asp Leu Val
 645 650 655
 Lys Leu Trp Ile Thr Ile Asn Glu Pro Asn Arg Leu Ser Asp Ile Tyr
 660 665 670
 Asn Arg Ser Gly Asn Asp Thr Tyr Gly Ala Ala His Asn Leu Leu Val
 675 680 685
 Ala His Ala Leu Ala Trp Arg Leu Tyr Asp Gln Gln Phe Arg Pro Ser
 690 695 700
 Gln Arg Gly Ala Val Ser Leu Ser Leu His Ala Asp Trp Ala Glu Pro
 705 710 715 720
 Ala Asn Pro Tyr Ala Asp Ser His Trp Arg Ala Ala Glu Arg Phe Leu
 725 730 735
 Gln Phe Glu Ile Ala Trp Phe Ala Glu Pro Leu Phe Lys Thr Gly Asp
 740 745 750
 Tyr Pro Ala Ala Met Arg Glu Tyr Ile Ala Ser Lys His Arg Arg Gly
 755 760 765
 Leu Ser Ser Ser Ala Leu Pro Arg Leu Thr Glu Ala Glu Arg Arg Leu
 770 775 780
 Leu Lys Gly Thr Val Asp Phe Cys Ala Leu Asn His Phe Thr Thr Arg
 785 790 795 800
 Phe Val Met His Glu Gln Leu Ala Gly Ser Arg Tyr Asp Ser Asp Arg
 805 810 815
 Asp Ile Gln Phe Leu Gln Asp Ile Thr Arg Leu Ser Ser Pro Thr Arg
 820 825 830
 Leu Ala Val Ile Pro Trp Gly Val Arg Lys Leu Leu Arg Trp Val Arg
 835 840 845
 Arg Asn Tyr Gly Asp Met Asp Ile Tyr Ile Thr Ala Ser Gly Ile Asp
 850 855 860
 Asp Gln Ala Leu Glu Asp Asp Arg Leu Arg Lys Tyr Tyr Leu Gly Lys

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865          870          875          880
Tyr Leu Gln Glu Val Leu Lys Ala Tyr Leu Ile Asp Lys Val Arg Ile
          885          890          895
Lys Gly Tyr Tyr Ala Phe Lys Leu Ala Glu Glu Lys Ser Lys Pro Arg
          900          905          910
Phe Gly Phe Phe Thr Ser Asp Phe Lys Ala Lys Ser Ser Ile Gln Phe
          915          920          925
Tyr Asn Lys Val Ile Ser Ser Arg Gly Phe Pro Phe Glu Asn Ser Ser
          930          935          940
Ser Arg Cys Ser Gln Thr Gln Glu Asn Thr Glu Cys Thr Val Cys Leu
945          950          955          960
Phe Leu Val Gln Lys Lys Pro Leu Ile Phe Leu Gly Cys Cys Phe Phe
          965          970          975
Ser Thr Leu Val Leu Leu Leu Ser Ile Ala Ile Phe Gln Arg Gln Lys
          980          985          990
Arg Arg Lys Phe Trp Lys Ala Lys Asn Leu Gln His Ile Pro Leu Lys
          995          1000          1005
Lys Gly Lys Arg Val Val Ser
1010          1015

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SEQ ID NO:6

SEQUENCE LENGTH: 3,163

SEQUENCE TYPE: nucleic acid

STRANDEDNESS: double

TOPOLGY: linear

MOLECULAR TYPE: cDNA to mRNA

ORIGINAL SOURCE:

ORGANISM: human

Organization: kidney

FEATURE

NAME/KEY: CDS

LOCATION: 9..3047

IDENTIFICATION METHOD: E

SEQUENCE:

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CGCGCAGC ATG CCC GCC AGC GCC CCG CCG CGC CGC CCG CGG CCG CCG CCG      50
      Met Pro Ala Ser Ala Pro Pro Arg Arg Pro Arg Pro Pro Pro
          1          5          10
CCG TCG CTG TCG CTG CTG CTG GTG CTG CTG GGC CTG GGC GGC CGC CGC      98
Pro Ser Leu Ser Leu Leu Leu Val Leu Leu Gly Leu Gly Gly Arg Arg
15          20          25          30
CTG CGT GCG GAG CCG GGC GAC GGC GCG CAG ACC TGG GCC CGT GTC TCG      146
Leu Arg Ala Glu Pro Gly Asp Gly Ala Gln Thr Trp Ala Arg Val Ser
          35          40          45
CGG CCT CCT GCC CCC GAG GCC GCG GGC CTC TTC CAG GGC ACC TTC CCC      194
Arg Pro Pro Ala Pro Glu Ala Ala Gly Leu Phe Gln Gly Thr Phe Pro
          50          55          60
GAC GGC TTC CTC TGG GCC GTG GGC AGC GCC GCC TAC CAG ACC GAG GGC      242
Asp Gly Phe Leu Trp Ala Val Gly Ser Ala Ala Tyr Gln Thr Glu Gly
          65          70          75
GGC TGG CAG CAG CAC GGC AAG GGT GCG TCC ATC TGG GAC ACG TTC ACC      290
Gly Trp Gln Gln His Gly Lys Gly Ala Ser Ile Trp Asp Thr Phe Thr

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80	85	90	
CAC CAC CCC CTG GCA CCC CCG GGA GAC TCC CGG AAC GCC AGT CTG CCG			338
His His Pro Leu Ala Pro Pro Gly Asp Ser Arg Asn Ala Ser Leu Pro			
95	100	105	110
TTG GGC GCC CCG TCG CCG CTG CAG CCC GCC ACC GGG GAC GTA GCC AGC			386
Leu Gly Ala Pro Ser Pro Leu Gln Pro Ala Thr Gly Asp Val Ala Ser			
115	120	125	
GAC AGC TAC AAC AAC GTC TTC CGC GAC ACG GAG GCG CTG CGC GAG CTC			434
Asp Ser Tyr Asn Asn Val Phe Arg Asp Thr Glu Ala Leu Arg Glu Leu			
130	135	140	
GGG GTC ACT CAC TAC CGC TTC TCC ATC TCG TGG GCG CGA GTG CTC CCC			482
Gly Val Thr His Tyr Arg Phe Ser Ile Ser Trp Ala Arg Val Leu Pro			
145	150	155	
AAT GGC AGC GCG GGC GTC CCC AAC CGC GAG GGG CTG CGC TAC TAC CGG			530
Asn Gly Ser Ala Gly Val Pro Asn Arg Glu Gly Leu Arg Tyr Tyr Arg			
160	165	170	
CGC CTG CTG GAG CGG CTG CGG GAG CTG GGC GTG CAG CCC GTG GTC ACC			578
Arg Leu Leu Glu Arg Leu Arg Glu Leu Gly Val Gln Pro Val Val Thr			
175	180	185	190
CTG TAC CAC TGG GAC CTG CCC CAG CGC CTG CAG GAC GCC TAC GGC GGC			626
Leu Tyr His Trp Asp Leu Pro Gln Arg Leu Gln Asp Ala Tyr Gly Gly			
195	200	205	
TGG GCC AAC CGC GCC CTG GCC GAC CAC TTC AGG GAT TAC GCG GAG CTC			674
Trp Ala Asn Arg Ala Leu Ala Asp His Phe Arg Asp Tyr Ala Glu Leu			
210	215	220	
TGC TTC CGC CAC TTC GGC GGT CAG GTC AAG TAC TGG ATC ACC ATC GAC			722
Cys Phe Arg His Phe Gly Gly Gln Val Lys Tyr Trp Ile Thr Ile Asp			
225	230	235	
AAC CCC TAC GTG GTG GCC TGG CAC GGC TAC GCC ACC GGG CGC CTG GCC			770
Asn Pro Tyr Val Val Ala Trp His Gly Tyr Ala Thr Gly Arg Leu Ala			
240	245	250	
CCC GGC ATC CGG GGC AGC CCG CGG CTC GGG TAC CTG GTG GCG CAC AAC			818
Pro Gly Ile Arg Gly Ser Pro Arg Leu Gly Tyr Leu Val Ala His Asn			
255	260	265	270
CTC CTC CTG GCT CAT GCC AAA GTC TGG CAT CTC TAC AAT ACT TCT TTC			866
Leu Leu Leu Ala His Ala Lys Val Trp His Leu Tyr Asn Thr Ser Phe			
275	280	285	
CGT CCC ACT CAG GGA GGT CAG GTG TCC ATT GCC CTA AGC TCT CAC TGG			914
Arg Pro Thr Gln Gly Gly Gln Val Ser Ile Ala Leu Ser Ser His Trp			
290	295	300	
ATC AAT CCT CGA AGA ATG ACC GAC CAC AGC ATC AAA GAA TGT CAA AAA			962
Ile Asn Pro Arg Arg Met Thr Asp His Ser Ile Lys Glu Cys Gln Lys			
305	310	315	
TCT CTG GAC TTT GTA CTA GGT TGG TTT GCC AAA CCC GTA TTT ATT GAT			1010
Ser Leu Asp Phe Val Leu Gly Trp Phe Ala Lys Pro Val Phe Ile Asp			
320	325	330	
GGT GAC TAT CCC GAG AGC ATG AAG AAT AAC CTT TCA TCT ATT CTG CCT			1058
Gly Asp Tyr Pro Glu Ser Met Lys Asn Asn Leu Ser Ser Ile Leu Pro			
335	340	345	350
GAT TTT ACT GAA TCT GAG AAA AAG TTC ATC AAA GGA ACT GCT GAC TTT			1106
Asp Phe Thr Glu Ser Glu Lys Lys Phe Ile Lys Gly Thr Ala Asp Phe			

				355				360				365				
TTT	GCT	CTT	TGC	TTT	GGA	CCC	ACC	TTG	AGT	TTT	CAA	CTT	TTG	GAC	CCT	1154
Phe	Ala	Leu	Cys	Phe	Gly	Pro	Thr	Leu	Ser	Phe	Gln	Leu	Leu	Asp	Pro	
			370					375				380				
CAC	ATG	AAG	TTC	CGC	CAA	TTG	GAA	TCT	CCC	AAC	CTG	AGG	CAA	CTG	CTT	1202
His	Met	Lys	Phe	Arg	Gln	Leu	Glu	Ser	Pro	Asn	Leu	Arg	Gln	Leu	Leu	
		385					390				395					
TCC	TGG	ATT	GAC	CTT	GAA	TTT	AAC	CAT	CCT	CAA	ATA	TTT	ATT	GTG	GAA	1250
Ser	Trp	Ile	Asp	Leu	Glu	Phe	Asn	His	Pro	Gln	Ile	Phe	Ile	Val	Glu	
	400					405				410						
AAT	GGC	TGG	TTT	GTC	TCA	GGG	ACC	ACC	AAG	AGA	GAT	GAT	GCC	AAA	TAT	1298
Asn	Gly	Trp	Phe	Val	Ser	Gly	Thr	Thr	Lys	Arg	Asp	Asp	Ala	Lys	Tyr	
415					420				425					430		
ATG	TAT	TAC	CTC	AAA	AAG	TTC	ATC	ATG	GAA	ACC	TTA	AAA	GCC	ATC	AAG	1346
Met	Tyr	Tyr	Leu	Lys	Lys	Phe	Ile	Met	Glu	Thr	Leu	Lys	Ala	Ile	Lys	
			435					440			445					
CTG	GAT	GGG	GTG	GAT	GTC	ATC	GGG	TAT	ACC	GCA	TGG	TCC	CTC	ATG	GAT	1394
Leu	Asp	Gly	Val	Asp	Val	Ile	Gly	Tyr	Thr	Ala	Trp	Ser	Leu	Met	Asp	
		450					455				460					
GGT	TTC	GAG	TGG	CAC	AGA	GGT	TAC	AGC	ATC	AGG	CGT	GGA	CTC	TTC	TAT	1442
Gly	Phe	Glu	Trp	His	Arg	Gly	Tyr	Ser	Ile	Arg	Arg	Gly	Leu	Phe	Tyr	
	465					470				475						
GTT	GAC	TTT	CTA	AGC	CAG	GAC	AAG	ATG	TTG	TTG	CCA	AAG	TCT	TCA	GCC	1490
Val	Asp	Phe	Leu	Ser	Gln	Asp	Lys	Met	Leu	Leu	Pro	Lys	Ser	Ser	Ala	
	480				485				490							
TTG	TTC	TAC	CAA	AAG	CTG	ATA	GAG	AAA	AAT	GGC	TTC	CCT	CCT	TTA	CCT	1538
Leu	Phe	Tyr	Gln	Lys	Leu	Ile	Glu	Lys	Asn	Gly	Phe	Pro	Pro	Leu	Pro	
495					500				505					510		
GAA	AAT	CAG	CCC	CTA	GAA	GGG	ACA	TTT	CCC	TGT	GAC	TTT	GCT	TGG	GGA	1586
Glu	Asn	Gln	Pro	Leu	Glu	Gly	Thr	Phe	Pro	Cys	Asp	Phe	Ala	Trp	Gly	
		515				520			525							
GTT	GTT	GAC	AAC	TAC	ATT	CAA	GTA	GAT	ACC	ACT	CTG	TCT	CAG	TTT	ACC	1634
Val	Val	Asp	Asn	Tyr	Ile	Gln	Val	Asp	Thr	Thr	Leu	Ser	Gln	Phe	Thr	
		530				535					540					
GAC	CTG	AAT	GTT	TAC	CTG	TGG	GAT	GTC	CAC	CAC	AGT	AAA	AGG	CTT	ATT	1682
Asp	Leu	Asn	Val	Tyr	Leu	Trp	Asp	Val	His	His	Ser	Lys	Arg	Leu	Ile	
		545				550					555					
AAA	GTG	GAT	GGG	GTT	GTG	ACC	AAG	AAG	AGG	AAA	TCC	TAC	TGT	GTT	GAC	1730
Lys	Val	Asp	Gly	Val	Val	Thr	Lys	Lys	Arg	Lys	Ser	Tyr	Cys	Val	Asp	
	560				565				570							
TTT	GCT	GCC	ATC	CAG	CCC	CAG	ATC	GCT	TTA	CTC	CAG	GAA	ATG	CAC	GTT	1778
Phe	Ala	Ala	Ile	Gln	Pro	Gln	Ile	Ala	Leu	Leu	Gln	Glu	Met	His	Val	
575					580				585					590		
ACA	CAT	TTT	CGC	TTC	TCC	CTG	GAC	TGG	GCC	CTG	ATT	CTC	CCT	CTG	GGT	1826
Thr	His	Phe	Arg	Phe	Ser	Leu	Asp	Trp	Ala	Leu	Ile	Leu	Pro	Leu	Gly	
		595				600			605							
AAC	CAG	TCC	CAG	GTG	AAC	CAC	ACC	ATC	CTG	CAG	TAC	TAT	CGC	TGC	ATG	1874
Asn	Gln	Ser	Gln	Val	Asn	His	Thr	Ile	Leu	Gln	Tyr	Tyr	Arg	Cys	Met	
		610				615			620							
GCC	AGC	GAG	CTT	GTC	CGT	GTC	AAC	ATC	ACC	CCA	GTG	GTG	GCC	CTG	TGG	1922
Ala	Ser	Glu	Leu	Val	Arg	Val	Asn	Ile	Thr	Pro	Val	Val	Ala	Leu	Trp	

	625		630		635												
CAG	CCT	ATG	GCC	CCG	AAC	CAA	GGA	CTG	CCG	CGC	CTC	CTG	GCC	AGG	CAG	1970	
Gln	Pro	Met	Ala	Pro	Asn	Gln	Gly	Leu	Pro	Arg	Leu	Leu	Ala	Arg	Gln		
	640						645					650					
GGC	GCC	TGG	GAG	AAC	CCC	TAC	ACT	GCC	CTG	GCC	TTT	GCA	GAG	TAT	GCC	2018	
Gly	Ala	Trp	Glu	Asn	Pro	Tyr	Thr	Ala	Leu	Ala	Phe	Ala	Glu	Tyr	Ala		
	655					660					665				670		
CGA	CTG	TGC	TTT	CAA	GAG	CTC	GGC	CAT	CAC	GTC	AAG	CTT	TGG	ATA	ACG	2066	
Arg	Leu	Cys	Phe	Gln	Glu	Leu	Gly	His	His	Val	Lys	Leu	Trp	Ile	Thr		
				675					680					685			
ATG	AAT	GAG	CCG	TAT	ACA	AGG	AAT	ATG	ACA	TAC	AGT	GCT	GGC	CAC	AAC	2114	
Met	Asn	Glu	Pro	Tyr	Thr	Arg	Asn	Met	Thr	Tyr	Ser	Ala	Gly	His	Asn		
			690					695					700				
CTT	CTG	AAG	GCC	CAT	GCC	CTG	GCT	TGG	CAT	GTG	TAC	AAT	GAA	AAG	TTT	2162	
Leu	Leu	Lys	Ala	His	Ala	Leu	Ala	Trp	His	Val	Tyr	Asn	Glu	Lys	Phe		
		705					710					715					
AGG	CAT	GCT	CAG	AAT	GGG	AAA	ATA	TCC	ATA	GCC	TTG	CAG	GCT	GAT	TGG	2210	
Arg	His	Ala	Gln	Asn	Gly	Lys	Ile	Ser	Ile	Ala	Leu	Gln	Ala	Asp	Trp		
		720				725					730						
ATA	GAA	CCT	GCC	TGC	CCT	TTC	TCC	CAA	AAG	GAC	AAA	GAG	GTG	GCC	GAG	2258	
Ile	Glu	Pro	Ala	Cys	Pro	Phe	Ser	Gln	Lys	Asp	Lys	Glu	Val	Ala	Glu		
	735					740					745				750		
AGA	GTT	TTG	GAA	TTT	GAC	ATT	GGC	TGG	CTG	GCT	GAG	CCC	ATT	TTC	GGC	2306	
Arg	Val	Leu	Glu	Phe	Asp	Ile	Gly	Trp	Leu	Ala	Glu	Pro	Ile	Phe	Gly		
				755					760				765				
TCT	GGA	GAT	TAT	CCA	TGG	GTG	ATG	AGG	GAC	TGG	CTG	AAC	CAA	AGA	AAC	2354	
Ser	Gly	Asp	Tyr	Pro	Trp	Val	Met	Arg	Asp	Trp	Leu	Asn	Gln	Arg	Asn		
			770					775					780				
AAT	TTT	CTT	CTT	CCT	TAT	TTC	ACT	GAA	GAT	GAA	AAA	AAG	CTA	ATC	CAG	2402	
Asn	Phe	Leu	Leu	Pro	Tyr	Phe	Thr	Glu	Asp	Glu	Lys	Lys	Leu	Ile	Gln		
		785					790					795					
GGT	ACC	TTT	GAC	TTT	TTG	GCT	TTA	AGC	CAT	TAT	ACC	ACC	ATC	CTT	GTA	2450	
Gly	Thr	Phe	Asp	Phe	Leu	Ala	Leu	Ser	His	Tyr	Thr	Thr	Ile	Leu	Val		
	800					805						810					
GAC	TCA	GAA	AAA	GAA	GAT	CCA	ATA	AAA	TAC	AAT	GAT	TAC	CTA	GAA	GTG	2498	
Asp	Ser	Glu	Lys	Glu	Asp	Pro	Ile	Lys	Tyr	Asn	Asp	Tyr	Leu	Glu	Val		
	815					820					825				830		
CAA	GAA	ATG	ACC	GAC	ATC	ACG	TGG	CTC	AAC	TCC	CCC	AGT	CAG	GTG	GCG	2546	
Gln	Glu	Met	Thr	Asp	Ile	Thr	Trp	Leu	Asn	Ser	Pro	Ser	Gln	Val	Ala		
				835					840				845				
GTA	GTG	CCC	TGG	GGG	TTG	CGC	AAA	GTG	CTG	AAC	TGG	CTG	AAG	TTC	AAG	2594	
Val	Val	Pro	Trp	Gly	Leu	Arg	Lys	Val	Leu	Asn	Trp	Leu	Lys	Phe	Lys		
		850					855					860					
TAC	GGA	GAC	CTC	CCC	ATG	TAC	ATA	ATA	TCC	AAC	GGA	ATC	GAT	GAC	GGG	2642	
Tyr	Gly	Asp	Leu	Pro	Met	Tyr	Ile	Ile	Ser	Asn	Gly	Ile	Asp	Asp	Gly		
		865					870					875					
CTG	CAT	GCT	GAG	GAC	GAC	CAG	CTG	AGG	GTG	TAT	TAT	ATG	CAG	AAT	TAC	2690	
Leu	His	Ala	Glu	Asp	Asp	Gln	Leu	Arg	Val	Tyr	Tyr	Met	Gln	Asn	Tyr		
		880				885						890					
ATA	AAC	GAA	GCT	CTC	AAA	GCC	CAC	ATA	CTG	GAT	GGT	ATC	AAT	CTT	TGC	2738	
Ile	Asn	Glu	Ala	Leu	Lys	Ala	His	Ile	Leu	Asp	Gly	Ile	Asn	Leu	Cys		

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895          900          905          910
GGA TAC TTT GCT TAT TCG TTT AAC GAC CGC ACA GCT CCG AGG TTT GGC 2786
Gly Tyr Phe Ala Tyr Ser Phe Asn Asp Arg Thr Ala Pro Arg Phe Gly
          915          920          925
CTC TAT CGT TAT GCT GCA GAT CAG TTT GAG CCC AAG GCA TCC ATG AAA 2834
Leu Tyr Arg Tyr Ala Ala Asp Gln Phe Glu Pro Lys Ala Ser Met Lys
          930          935          940
CAT TAC AGG AAA ATT ATT GAC AGC AAT GGT TTC CCG GGC CCA GAA ACT 2882
His Tyr Arg Lys Ile Ile Asp Ser Asn Gly Phe Pro Gly Pro Glu Thr
          945          950          955
CTG GAA AGA TTT TGT CCA GAA GAA TTC ACC GTG TGT ACT GAG TGC AGT 2930
Leu Glu Arg Phe Cys Pro Glu Glu Phe Thr Val Cys Thr Glu Cys Ser
          960          965          970
TTT TTT CAC ACC CGA AAG TCT TTA CTG GCT TTC ATA GCT TTT CTA TTT 2978
Phe Phe His Thr Arg Lys Ser Leu Leu Ala Phe Ile Ala Phe Leu Phe
975          980          985          990
TTT GCT TCT ATT ATT TCT CTC TCC CTT ATA TTT TAC TAC TCG AAG AAA 3026
Phe Ala Ser Ile Ile Ser Leu Ser Leu Ile Phe Tyr Tyr Ser Lys Lys
          995          1000          1005
GGC AGA AGA AGT TAC AAA TAGTTCTGAA CATTTTCTA TTCATTCATT 3074
Gly Arg Arg Ser Tyr Lys
          1010
TTGAAATAAT TATGCAGACA CATCAGCTGT TAACCATTTG CACCTCTAAG TGTGTGAAA 3134
CTGTAAATTT CATACATTTG ACTTCTAGA 3163

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SEQ ID NO:7

SEQUENCE LENGTH: 3,435

SEQUENCE TYPE: nucleic acid

STRANDEDNESS: double

TOPOLYGY: linear

MOLECULAR TYPE: cDNA to mRNA

ORIGINAL SOURCE:

ORGANISM: human

Organization: kidney

FEATURE

NAME/KEY: CDS

LOCATION: 9..1655

IDENTIFICATION METHOD: E

SEQUENCE:

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CGCGCAGC ATG CCC GCC AGC GCC CCG CCG CGC CGC CCG CGG CCG CCG CCG 50
Met Pro Ala Ser Ala Pro Pro Arg Arg Pro Arg Pro Pro Pro
          1          5          10
CCG TCG CTG TCG CTG CTG CTG GTG CTG CTG GGC CTG GGC GGC CGC CGC 98
Pro Ser Leu Ser Leu Leu Leu Val Leu Leu Gly Leu Gly Gly Arg Arg
          15          20          25          30
CTG CGT GCG GAG CCG GGC GAC GGC GCG CAG ACC TGG GCC CGT GTC TCG 146
Leu Arg Ala Glu Pro Gly Asp Gly Ala Gln Thr Trp Ala Arg Val Ser
          35          40          45
CGG CCT CCT GCC CCC GAG GCC GCG GGC CTC TTC CAG GGC ACC TTC CCC 194
Arg Pro Pro Ala Pro Glu Ala Ala Gly Leu Phe Gln Gly Thr Phe Pro
          50          55          60

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GAC GGC TTC CTC TGG GCC GTG GGC AGC GCC GCC TAC CAG ACC GAG GGC	242
Asp Gly Phe Leu Trp Ala Val Gly Ser Ala Ala Tyr Gln Thr Glu Gly	
65 70 75	
GGC TGG CAG CAG CAC GGC AAG GGT GCG TCC ATC TGG GAC ACG TTC ACC	290
Gly Trp Gln Gln His Gly Lys Gly Ala Ser Ile Trp Asp Thr Phe Thr	
80 85 90	
CAC CAC CCC CTG GCA CCC CCG GGA GAC TCC CGG AAC GCC AGT CTG CCG	338
His His Pro Leu Ala Pro Pro Gly Asp Ser Arg Asn Ala Ser Leu Pro	
95 100 105 110	
TTG GGC GCC CCG TCG CCG CTG CAG CCC GCC ACC GGG GAC GTA GCC AGC	386
Leu Gly Ala Pro Ser Pro Leu Gln Pro Ala Thr Gly Asp Val Ala Ser	
115 120 125	
GAC AGC TAC AAC AAC GTC TTC CGC GAC ACG GAG GCG CTG CGC GAG CTC	434
Asp Ser Tyr Asn Asn Val Phe Arg Asp Thr Glu Ala Leu Arg Glu Leu	
130 135 140	
GGG GTC ACT CAC TAC CGC TTC TCC ATC TCG TGG GCG CGA GTG CTC CCC	482
Gly Val Thr His Tyr Arg Phe Ser Ile Ser Trp Ala Arg Val Leu Pro	
145 150 155	
AAT GGC AGC GCG GGC GTC CCC AAC CGC GAG GGG CTG CGC TAC TAC CCG	530
Asn Gly Ser Ala Gly Val Pro Asn Arg Glu Gly Leu Arg Tyr Tyr Arg	
160 165 170	
CGC CTG CTG GAG CGG CTG CCG GAG CTG GGC GTG CAG CCC GTG GTC ACC	578
Arg Leu Leu Glu Arg Leu Arg Glu Leu Gly Val Gln Pro Val Val Thr	
175 180 185 190	
CTG TAC CAC TGG GAC CTG CCC CAG CGC CTG CAG GAC GCC TAC GGC GGC	626
Leu Tyr His Trp Asp Leu Pro Gln Arg Leu Gln Asp Ala Tyr Gly Gly	
195 200 205	
TGG GCC AAC CGC GCC CTG GCC GAC CAC TTC AGG GAT TAC GCG GAG CTC	674
Trp Ala Asn Arg Ala Leu Ala Asp His Phe Arg Asp Tyr Ala Glu Leu	
210 215 220	
TGC TTC CGC CAC TTC GGC GGT CAG GTC AAG TAC TGG ATC ACC ATC GAC	722
Cys Phe Arg His Phe Gly Gly Gln Val Lys Tyr Trp Ile Thr Ile Asp	
225 230 235	
AAC CCC TAC GTG GTG GCC TGG CAC GGC TAC GCC ACC GGG CGC CTG GCC	770
Asn Pro Tyr Val Val Ala Trp His Gly Tyr Ala Thr Gly Arg Leu Ala	
240 245 250	
CCC GGC ATC CGG GGC AGC CCG CGG CTC GGG TAC CTG GTG GCG CAC AAC	818
Pro Gly Ile Arg Gly Ser Pro Arg Leu Gly Tyr Leu Val Ala His Asn	
255 260 265 270	
CTC CTC CTG GCT CAT GCC AAA GTC TGG CAT CTC TAC AAT ACT TCT TTC	866
Leu Leu Leu Ala His Ala Lys Val Trp His Leu Tyr Asn Thr Ser Phe	
275 280 285	
CGT CCC ACT CAG GGA GGT CAG GTG TCC ATT GCC CTA AGC TCT CAC TGG	914
Arg Pro Thr Gln Gly Gly Gln Val Ser Ile Ala Leu Ser Ser His Trp	
290 295 300	
ATC AAT CCT CGA AGA ATG ACC GAC CAC AGC ATC AAA GAA TGT CAA AAA	962
Ile Asn Pro Arg Arg Met Thr Asp His Ser Ile Lys Glu Cys Gln Lys	
305 310 315	
TCT CTG GAC TTT GTA CTA GGT TGG TTT GCC AAA CCC GTA TTT ATT GAT	1010
Ser Leu Asp Phe Val Leu Gly Trp Phe Ala Lys Pro Val Phe Ile Asp	
320 325 330	

GGT GAC TAT CCC GAG AGC ATG AAG AAT AAC CTT TCA TCT ATT CTG CCT 1058
Gly Asp Tyr Pro Glu Ser Met Lys Asn Asn Leu Ser Ser Ile Leu Pro
335 340 345 350
GAT TTT ACT GAA TCT GAG AAA AAG TTC ATC AAA GGA ACT GCT GAC TTT 1106
Asp Phe Thr Glu Ser Glu Lys Lys Phe Ile Lys Gly Thr Ala Asp Phe
355 360 365
TTT GCT CTT TGC TTT GGA CCC ACC TTG AGT TTT CAA CTT TTG GAC CCT 1154
Phe Ala Leu Cys Phe Gly Pro Thr Leu Ser Phe Gln Leu Leu Asp Pro
370 375 380
CAC ATG AAG TTC CGC CAA TTG GAA TCT CCC AAC CTG AGG CAA CTG CTT 1202
His Met Lys Phe Arg Gln Leu Glu Ser Pro Asn Leu Arg Gln Leu Leu
385 390 395
TCC TGG ATT GAC CTT GAA TTT AAC CAT CCT CAA ATA TTT ATT GTG GAA 1250
Ser Trp Ile Asp Leu Glu Phe Asn His Pro Gln Ile Phe Ile Val Glu
400 405 410
AAT GGC TGG TTT GTC TCA GGG ACC ACC AAG AGA GAT GAT GCC AAA TAT 1298
Asn Gly Trp Phe Val Ser Gly Thr Thr Lys Arg Asp Asp Ala Lys Tyr
415 420 425 430
ATG TAT TAC CTC AAA AAG TTC ATC ATG GAA ACC TTA AAA GCC ATC AAG 1346
Met Tyr Tyr Leu Lys Lys Phe Ile Met Glu Thr Leu Lys Ala Ile Lys
435 440 445
CTG GAT GGG GTG GAT GTC ATC GGG TAT ACC GCA TGG TCC CTC ATG GAT 1394
Leu Asp Gly Val Asp Val Ile Gly Tyr Thr Ala Trp Ser Leu Met Asp
450 455 460
GGT TTC GAG TGG CAC AGA GGT TAC AGC ATC AGG CGT GGA CTC TTC TAT 1442
Gly Phe Glu Trp His Arg Gly Tyr Ser Ile Arg Arg Gly Leu Phe Tyr
465 470 475
GTT GAC TTT CTA AGC CAG GAC AAG ATG TTG TTG CCA AAG TCT TCA GCC 1490
Val Asp Phe Leu Ser Gln Asp Lys Met Leu Leu Pro Lys Ser Ser Ala
480 485 490
TTG TTC TAC CAA AAG CTG ATA GAG AAA AAT GGC TTC CCT CCT TTA CCT 1538
Leu Phe Tyr Gln Lys Leu Ile Glu Lys Asn Gly Phe Pro Pro Leu Pro
495 500 505 510
GAA AAT CAG CCC CTA GAA GGG ACA TTT CCC TGT GAC TTT GCT TGG GGA 1586
Glu Asn Gln Pro Leu Glu Gly Thr Phe Pro Cys Asp Phe Ala Trp Gly
515 520 525
GTT GTT GAC AAC TAC ATT CAA GTA AGT CAG CTG ACA AAA CCA ATC AGC 1634
Val Val Asp Asn Tyr Ile Gln Val Ser Gln Leu Thr Lys Pro Ile Ser
530 535 540
AGT CTC ACC AAG CCC TAT CAC TAGTAGATAC CACTCTGTCT CAGTTTACCG 1685
Ser Leu Thr Lys Pro Tyr His
545
ACCTGAATGT TTACCTGTGG GATGTCCACC ACAGTAAAAG GCTTATTAAA GTGGATGGGG 1745
TTGTGACCAA GAAGAGGAAA TCCTACTGTG TTGACTTTGC TGCCATCCAG CCCAGATCG 1805
CTTTACTCCA GGAAATGCAC GTTACACATT TTCGCTTCTC CCTGGACTGG GCCCTGATTC 1865
TCCCTCTGGG TAACCAGTCC CAGGTGAACC ACACCATCCT GCAGTACTAT CGCTGCATGG 1925
CCAGCGAGCT TGTCCGTGTC AACATCACCC CAGTGGTGGC CCTGTGGCAG CCTATGGCCC 1985
CGAACCAAGG ACTGCCGCGC CTCCTGGCCA GGCAGGGCGC CTGGGAGAAC CCCTACACTG 2045
CCCTGGCCTT TGCAGAGTAT GCCCGACTGT GCTTTCAAGA GCTCGGCCAT CACGTCAAGC 2105
TTTGATAAC GATGAATGAG CCGTATACAA GGAATATGAC ATACAGTGCT GGCCACAACC 2165
TTCTGAAGGC CCATGCCCTG GCTTGGCATG TGTACAATGA AAAGTTTAGG CATGCTCAGA 2225

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ATGGGAAAAT ATCCATAGCC TTGCAGGCTG ATTGGATAGA ACCTGCCTGC CCTTTCTCCC 2285
AAAAGGACAA AGAGGTGGCC GAGAGAGTTT TGGAATTTGA CATTGGCTGG CTGGCTGAGC 2345
CCATTTTCGG CTCTGGAGAT TATCCATGGG TGATGAGGGA CTGGCTGAAC CAAAGAAACA 2405
ATTTTCTTCT TCCTTATTTT ACTGAAGATG AAAAAAAGCT AATCCAGGGT ACCTTTGACT 2465
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AATACAATGA TTACCTAGAA GTGCAAGAAA TGACCGACAT CACGTGGCTC AACTCCCCCA 2585
GTCAGGTGGC GGTAGTGCCC TGGGGGTTGC GCAAAGTGCT GAACTGGCTG AAGTTCAAGT 2645
ACGGAGACCT CCCCATGTAC ATAATATCCA ACGGAATCGA TGACGGGCTG CATGCTGAGG 2705
ACGACCAGCT GAGGGTGTAT TATATGCAGA ATTACATAAA CGAAGCTCTC AAAGCCCACA 2765
TACTGGATGG TATCAATCTT TGC GGATACT TTGCTTATTC GTTTAACGAC CGCACAGCTC 2825
CGAGGTTTGG CCTCTATCGT TATGCTGCAG ATCAGTTTGA GCCCAAGGCA TCCATGAAAC 2885
ATTACAGGAA AATTATTGAC AGCAATGGTT TCCCGGGGCC AGAACTCTG GAAAGATTTT 2945
GTCCAGAAGA ATTCACCGTG TGTACTGAGT GCAGTTTTTT TCACACCCGA AAGTCTTTAC 3005
TGGCTTTCAT AGCTTTTCTA TTTTTTGCTT CTATTATTTT TCTCTCCCTT ATATTTTACT 3065
ACTCGAAGAA AGGCAGAAGA AGTTACAAAT AGTTCTGAAC ATTTTCTAT TCATTCAATT 3125
TGAAATAATT ATGCAGACAC ATCAGCTGTT AACCATTGTC ACCTCTAAGT GTTGTGAAAC 3185
TGTAATTTTC ATACATTTGA CTTCTAGAAA ACATTTTGTG GGCTTATGAC AGAGGTTTTG 3245
AAATGGGCAT AGGTGATCGT AAAATATTGA ATAATGCGAA TAGTGCCTGA ATTTGTTCTC 3305
TTTTTGGGTG ATTA AAAAAC TGACAGGCAC TATAATTTCT GTAACACACT AACAAAAGCA 3365
TGAAAAATAG GAACCACACC AATGCAACAT TTGTGCAGAA ATTTGAATGA CAAGATTAGG 3425
AATATTTTCT                                     3435

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SEQ ID NO:8

SEQUENCE LENGTH: 5,032

SEQUENCE TYPE: nucleic acid

STRANDEDNESS: double

TOPOLYGY: linear

MOLECULAR TYPE: cDNA to mRNA

ORIGINAL SOURCE:

ORGANISM: mouse

Organization: kidney

FEATURE

NAME/KEY: CDS

LOCATION: 19..3060

IDENTIFICATION METHOD: E

SEQUENCE:

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CCTCCCGGCT CCCGCAGC ATG CTA GCC CGC GCC CCT CCT CGC CGC CCG CCG      51
      Met Leu Ala Arg Ala Pro Pro Arg Arg Pro Pro
      1              5              10
CGG CTG GTG CTG CTC CGT TTG CTG TTG CTG CAT CTG CTG CTG CTC GCC      99
Arg Leu Val Leu Leu Arg Leu Leu Leu Leu His Leu Leu Leu Leu Ala
      15              20              25
CTG CGC GCC CGC TGC CTG AGC GCT GAG CCG GGT CAG GGC GCG CAG ACC     147
Leu Arg Ala Arg Cys Leu Ser Ala Glu Pro Gly Gln Gly Ala Gln Thr
      30              35              40
TGG GCT CGC TTC GCG CGC GCT CCT GCC CCA GAG GCC GCT GGC CTC CTC     195
Trp Ala Arg Phe Ala Arg Ala Pro Ala Pro Glu Ala Ala Gly Leu Leu
      45              50              55
CAC GAC ACC TTC CCC GAC GGT TTC CTC TGG GCG GTA GGC AGC GCC GCC     243
His Asp Thr Phe Pro Asp Gly Phe Leu Trp Ala Val Gly Ser Ala Ala
      60              65              70              75

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TAT	CAG	ACC	GAG	GGC	GGC	TGG	CGA	CAG	CAC	GGC	AAA	GGC	GCG	TCC	ATC	291
Tyr	Gln	Thr	Glu	Gly	Gly	Trp	Arg	Gln	His	Gly	Lys	Gly	Ala	Ser	Ile	
			80						85					90		
TGG	GAC	ACT	TTC	ACC	CAT	CAC	TCT	GGG	GCG	GCC	CCG	TCC	GAC	TCC	CCG	339
Trp	Asp	Thr	Phe	Thr	His	His	Ser	Gly	Ala	Ala	Pro	Ser	Asp	Ser	Pro	
			95					100					105			
ATC	GTC	GTG	GCG	CCG	TCG	GGT	GCC	CCG	TCG	CCT	CCC	CTG	TCC	TCC	ACT	387
Ile	Val	Val	Ala	Pro	Ser	Gly	Ala	Pro	Ser	Pro	Pro	Leu	Ser	Ser	Thr	
		110				115						120				
GGA	GAT	GTG	GCC	AGC	GAT	AGT	TAC	AAC	AAC	GTG	TAC	CGC	GAC	ACA	GAG	435
Gly	Asp	Val	Ala	Ser	Asp	Ser	Tyr	Asn	Asn	Val	Tyr	Arg	Asp	Thr	Glu	
	125					130					135					
GGG	CTG	CGC	GAA	CTG	GGG	GTC	ACC	CAC	TAC	CGC	TTC	TCC	ATA	TCG	TGG	483
Gly	Leu	Arg	Glu	Leu	Gly	Val	Thr	His	Tyr	Arg	Phe	Ser	Ile	Ser	Trp	
	140				145					150					155	
GCG	CGG	GTG	CTC	CCC	AAT	GGC	ACC	GCG	GGC	ACT	CCC	AAC	CGC	GAG	GGG	531
Ala	Arg	Val	Leu	Pro	Asn	Gly	Thr	Ala	Gly	Thr	Pro	Asn	Arg	Glu	Gly	
			160					165					170			
CTG	CGC	TAC	TAC	CGG	CGG	CTG	CTG	GAG	CGG	CTG	CGG	GAG	CTG	GGC	GTG	579
Leu	Arg	Tyr	Tyr	Arg	Arg	Leu	Leu	Glu	Arg	Leu	Arg	Glu	Leu	Gly	Val	
			175					180					185			
CAG	CCG	GTG	GTT	ACC	CTG	TAC	CAT	TGG	GAC	CTG	CCA	CAG	CGC	CTG	CAG	627
Gln	Pro	Val	Val	Thr	Leu	Tyr	His	Trp	Asp	Leu	Pro	Gln	Arg	Leu	Gln	
		190				195						200				
GAC	ACC	TAT	GGC	GGA	TGG	GCC	AAT	CGC	GCC	CTG	GCC	GAC	CAT	TTC	AGG	675
Asp	Thr	Tyr	Gly	Gly	Trp	Ala	Asn	Arg	Ala	Leu	Ala	Asp	His	Phe	Arg	
	205					210					215					
GAT	TAT	GCC	GAG	CTC	TGC	TTC	CGC	CAC	TTC	GGT	GGT	CAG	GTC	AAG	TAC	723
Asp	Tyr	Ala	Glu	Leu	Cys	Phe	Arg	His	Phe	Gly	Gly	Gln	Val	Lys	Tyr	
	220				225					230				235		
TGG	ATC	ACC	ATT	GAC	AAC	CCC	TAC	GTG	GTG	GCC	TGG	CAC	GGG	TAT	GCC	771
Trp	Ile	Thr	Ile	Asp	Asn	Pro	Tyr	Val	Val	Ala	Trp	His	Gly	Tyr	Ala	
			240					245					250			
ACC	GGG	CGC	CTG	GCC	CCG	GGC	GTG	AGG	GGC	AGC	TCC	AGG	CTC	GGG	TAC	819
Thr	Gly	Arg	Leu	Ala	Pro	Gly	Val	Arg	Gly	Ser	Ser	Arg	Leu	Gly	Tyr	
			255					260					265			
CTG	GTT	GCC	CAC	AAC	CTA	CTT	TTG	GCT	CAT	GCC	AAA	GTC	TGG	CAT	CTC	867
Leu	Val	Ala	His	Asn	Leu	Leu	Leu	Ala	His	Ala	Lys	Val	Trp	His	Leu	
		270				275						280				
TAC	AAC	ACC	TCT	TTC	CGC	CCC	ACA	CAG	GGA	GGC	CGG	GTG	TCT	ATC	GCC	915
Tyr	Asn	Thr	Ser	Phe	Arg	Pro	Thr	Gln	Gly	Gly	Arg	Val	Ser	Ile	Ala	
	285					290					295					
TTA	AGC	TCC	CAT	TGG	ATC	AAT	CCT	CGA	AGA	ATG	ACT	GAC	TAT	AAT	ATC	963
Leu	Ser	Ser	His	Trp	Ile	Asn	Pro	Arg	Arg	Met	Thr	Asp	Tyr	Asn	Ile	
	300				305					310				315		
AGA	GAA	TGC	CAG	AAG	TCT	CTT	GAC	TTT	GTG	CTA	GGC	TGG	TTT	GCC	AAA	1011
Arg	Glu	Cys	Gln	Lys	Ser	Leu	Asp	Phe	Val	Leu	Gly	Trp	Phe	Ala	Lys	
			320					325					330			
CCC	ATA	TTT	ATT	GAT	GGC	GAC	TAC	CCA	GAG	AGT	ATG	AAG	AAC	AAC	CTC	1059
Pro	Ile	Phe	Ile	Asp	Gly	Asp	Tyr	Pro	Glu	Ser	Met	Lys	Asn	Asn	Leu	
		335						340					345			

TCG	TCT	CTT	CTG	CCT	GAT	TTT	ACT	GAA	TCT	GAG	AAG	AGG	CTC	ATC	AGA	1107
Ser	Ser	Leu	Leu	Pro	Asp	Phe	Thr	Glu	Ser	Glu	Lys	Arg	Leu	Ile	Arg	
		350					355				360					
GGA	ACT	GCT	GAC	TTT	TTT	GCT	CTC	TCC	TTC	GGA	CCA	ACC	TTG	AGC	TTT	1155
Gly	Thr	Ala	Asp	Phe	Phe	Ala	Leu	Ser	Phe	Gly	Pro	Thr	Leu	Ser	Phe	
	365					370				375						
CAG	CTA	TTG	GAC	CCT	AAC	ATG	AAG	TTC	CGC	CAA	TTG	GAG	TCT	CCC	AAC	1203
Gln	Leu	Leu	Asp	Pro	Asn	Met	Lys	Phe	Arg	Gln	Leu	Glu	Ser	Pro	Asn	
	380				385					390					395	
CTG	AGG	CAG	CTT	CTG	TCT	TGG	ATA	GAT	CTG	GAA	TAT	AAC	CAC	CCT	CCA	1251
Leu	Arg	Gln	Leu	Leu	Ser	Trp	Ile	Asp	Leu	Glu	Tyr	Asn	His	Pro	Pro	
			400						405					410		
ATA	TTT	ATT	GTG	GAA	AAT	GGC	TGG	TTT	GTC	TCG	GGA	ACC	ACC	AAA	AGG	1299
Ile	Phe	Ile	Val	Glu	Asn	Gly	Trp	Phe	Val	Ser	Gly	Thr	Thr	Lys	Arg	
		415					420						425			
GAT	GAT	GCC	AAA	TAT	ATG	TAT	TAT	CTC	AAG	AAG	TTC	ATA	ATG	GAA	ACC	1347
Asp	Asp	Ala	Lys	Tyr	Met	Tyr	Tyr	Leu	Lys	Lys	Phe	Ile	Met	Glu	Thr	
		430				435					440					
TTA	AAA	GCA	ATC	AGA	CTG	GAT	GGG	GTC	GAC	GTC	ATT	GGG	TAC	ACC	GCG	1395
Leu	Lys	Ala	Ile	Arg	Leu	Asp	Gly	Val	Asp	Val	Ile	Gly	Tyr	Thr	Ala	
	445					450				455						
TGG	TCG	CTC	ATG	GAC	GGT	TTC	GAG	TGG	CAT	AGG	GGC	TAC	AGC	ATC	CGG	1443
Trp	Ser	Leu	Met	Asp	Gly	Phe	Glu	Trp	His	Arg	Gly	Tyr	Ser	Ile	Arg	
	460			465						470					475	
CGA	GGA	CTC	TTC	TAC	GTT	GAC	TTT	CTG	AGT	CAG	GAC	AAG	GAG	CTG	TTG	1491
Arg	Gly	Leu	Phe	Tyr	Val	Asp	Phe	Leu	Ser	Gln	Asp	Lys	Glu	Leu	Leu	
			480						485				490			
CCA	AAG	TCT	TCG	GCC	TTG	TTC	TAC	CAA	AAG	CTG	ATA	GAG	GAC	AAT	GGC	1539
Pro	Lys	Ser	Ser	Ala	Leu	Phe	Tyr	Gln	Lys	Leu	Ile	Glu	Asp	Asn	Gly	
		495						500					505			
TTT	CCT	CCT	TTA	CCT	GAA	AAC	CAG	CCC	CTT	GAA	GGG	ACA	TTT	CCC	TGT	1587
Phe	Pro	Pro	Leu	Pro	Glu	Asn	Gln	Pro	Leu	Glu	Gly	Thr	Phe	Pro	Cys	
	510						515					520				
GAC	TTT	GCT	TGG	GGA	GTT	GTT	GAC	AAC	TAC	GTT	CAA	GTG	GAC	ACT	ACT	1635
Asp	Phe	Ala	Trp	Gly	Val	Val	Asp	Asn	Tyr	Val	Gln	Val	Asp	Thr	Thr	
	525					530				535						
CTC	TCT	CAG	TTT	ACT	GAC	CCG	AAT	GTC	TAT	CTG	TGG	GAT	GTG	CAT	CAC	1683
Leu	Ser	Gln	Phe	Thr	Asp	Pro	Asn	Val	Tyr	Leu	Trp	Asp	Val	His	His	
	540				545					550					555	
AGT	AAG	AGG	CTT	ATT	AAA	GTA	GAC	GGG	GTT	GTA	GCC	AAG	AAG	AGA	AAA	1731
Ser	Lys	Arg	Leu	Ile	Lys	Val	Asp	Gly	Val	Val	Ala	Lys	Lys	Arg	Lys	
			560					565					570			
CCT	TAC	TGT	GTT	GAT	TTC	TCT	GCC	ATC	CGG	CCT	CAG	ATA	ACC	TTA	CTT	1779
Pro	Tyr	Cys	Val	Asp	Phe	Ser	Ala	Ile	Arg	Pro	Gln	Ile	Thr	Leu	Leu	
		575						580					585			
CGA	GAA	ATG	CGG	GTC	ACC	CAC	TTT	CGC	TTC	TCC	CTG	GAC	TGG	GCC	CTG	1827
Arg	Glu	Met	Arg	Val	Thr	His	Phe	Arg	Phe	Ser	Leu	Asp	Trp	Ala	Leu	
	590						595					600				
ATC	TTG	CCT	CTG	GGT	AAC	CAG	ACC	CAA	GTG	AAC	CAC	ACG	GTT	CTG	CAC	1875
Ile	Leu	Pro	Leu	Gly	Asn	Gln	Thr	Gln	Val	Asn	His	Thr	Val	Leu	His	
	605					610					615					

TTC	TAC	CGC	TGC	ATG	ATC	AGC	GAG	CTG	GTG	CAC	GCC	AAC	ATC	ACT	CCA	1923
Phe	Tyr	Arg	Cys	Met	Ile	Ser	Glu	Leu	Val	His	Ala	Asn	Ile	Thr	Pro	
620					625					630					635	
GTG	GTG	GCC	CTG	TGG	CAG	CCA	GCA	GCC	CCG	CAC	CAA	GGC	CTG	CCA	CAT	1971
Val	Val	Ala	Leu	Trp	Gln	Pro	Ala	Ala	Pro	His	Gln	Gly	Leu	Pro	His	
				640						645					650	
GCC	CTT	GCA	AAA	CAT	GGG	GCC	TGG	GAG	AAC	CCG	CAC	ACT	GCT	CTG	GCG	2019
Ala	Leu	Ala	Lys	His	Gly	Ala	Trp	Glu	Asn	Pro	His	Thr	Ala	Leu	Ala	
			655						660						665	
TTT	GCA	GAC	TAC	GCA	AAC	CTG	TGT	TTT	AAA	GAG	TTG	GGT	CAC	TGG	GTC	2067
Phe	Ala	Asp	Tyr	Ala	Asn	Leu	Cys	Phe	Lys	Glu	Leu	Gly	His	Trp	Val	
		670					675								680	
AAT	CTC	TGG	ATC	ACC	ATG	AAC	GAG	CCA	AAC	ACA	CGG	AAC	ATG	ACC	TAT	2115
Asn	Leu	Trp	Ile	Thr	Met	Asn	Glu	Pro	Asn	Thr	Arg	Asn	Met	Thr	Tyr	
		685					690								695	
CGT	GCC	GGG	CAC	CAC	CTC	CTG	AGA	GCC	CAT	GCC	TTG	GCT	TGG	CAT	CTG	2163
Arg	Ala	Gly	His	His	Leu	Leu	Arg	Ala	His	Ala	Leu	Ala	Trp	His	Leu	
700					705					710					715	
TAC	GAT	GAC	AAG	TTT	AGG	GCG	GCT	CAG	AAA	GGC	AAA	ATA	TCC	ATC	GCC	2211
Tyr	Asp	Asp	Lys	Phe	Arg	Ala	Ala	Gln	Lys	Gly	Lys	Ile	Ser	Ile	Ala	
				720						725					730	
TTG	CAG	GCT	GAC	TGG	ATA	GAA	CCG	GCC	TGC	CCT	TTC	TCT	CAA	AAT	GAC	2259
Leu	Gln	Ala	Asp	Trp	Ile	Glu	Pro	Ala	Cys	Pro	Phe	Ser	Gln	Asn	Asp	
			735						740						745	
AAA	GAA	GTG	GCC	GAG	AGA	GTT	TTG	GAA	TTT	GAT	ATA	GGC	TGG	CTG	GCA	2307
Lys	Glu	Val	Ala	Glu	Arg	Val	Leu	Glu	Phe	Asp	Ile	Gly	Trp	Leu	Ala	
		750							755						760	
GAG	CCT	ATT	TTT	GGT	TCC	GGA	GAT	TAT	CCA	CGT	GTG	ATG	AGG	GAC	TGG	2355
Glu	Pro	Ile	Phe	Gly	Ser	Gly	Asp	Tyr	Pro	Arg	Val	Met	Arg	Asp	Trp	
		765					770								775	
CTG	AAC	CAA	AAA	AAC	AAT	TTT	CTT	TTG	CCC	TAT	TTC	ACC	GAA	GAT	GAA	2403
Leu	Asn	Gln	Lys	Asn	Asn	Phe	Leu	Leu	Pro	Tyr	Phe	Thr	Glu	Asp	Glu	
780					785					790					795	
AAA	AAG	CTA	GTC	CGG	GGT	TCC	TTT	GAC	TTC	CTG	GCG	GTG	AGT	CAT	TAC	2451
Lys	Lys	Leu	Val	Arg	Gly	Ser	Phe	Asp	Phe	Leu	Ala	Val	Ser	His	Tyr	
				800						805					810	
ACC	ACC	ATT	CTG	GTA	GAC	TGG	GAA	AAG	GAG	GAT	CCG	ATG	AAA	TAC	AAC	2499
Thr	Thr	Ile	Leu	Val	Asp	Trp	Glu	Lys	Glu	Asp	Pro	Met	Lys	Tyr	Asn	
			815						820						825	
GAT	TAC	TTG	GAG	GTA	CAG	GAG	ATG	ACT	GAC	ATC	ACA	TGG	CTC	AAC	TCT	2547
Asp	Tyr	Leu	Glu	Val	Gln	Glu	Met	Thr	Asp	Ile	Thr	Trp	Leu	Asn	Ser	
		830					835								840	
CCC	AGT	CAG	GTG	GCA	GTG	GTG	CCT	TGG	GGG	CTG	CGC	AAA	GTG	CTC	AAC	2595
Pro	Ser	Gln	Val	Ala	Val	Val	Pro	Trp	Gly	Leu	Arg	Lys	Val	Leu	Asn	
		845					850								855	
TGG	CTA	AGG	TTC	AAG	TAC	GGA	GAC	CTC	CCG	ATG	TAT	GTG	ACA	GCC	AAT	2643
Trp	Leu	Arg	Phe	Lys	Tyr	Gly	Asp	Leu	Pro	Met	Tyr	Val	Thr	Ala	Asn	
860					865					870					875	
GGA	ATC	GAT	GAT	GAC	CCC	CAC	GCC	GAG	CAA	GAC	TCA	CTG	AGG	ATC	TAT	2691
Gly	Ile	Asp	Asp	Asp	Pro	His	Ala	Glu	Gln	Asp	Ser	Leu	Arg	Ile	Tyr	
				880						885					890	

TAT ATT AAG AAT TAT GTG AAT GAG GCT CTG AAA GCC TAC GTG TTG GAC 2739
 Tyr Ile Lys Asn Tyr Val Asn Glu Ala Leu Lys Ala Tyr Val Leu Asp
 895 900 905
 GAC ATC AAC CTT TGT GGC TAC TTT GCG TAT TCA CTT AGT GAT CGC TCA 2787
 Asp Ile Asn Leu Cys Gly Tyr Phe Ala Tyr Ser Leu Ser Asp Arg Ser
 910 915 920
 GCT CCC AAG TCT GGC TTT TAT CGA TAT GCT GCG AAT CAG TTT GAG CCC 2835
 Ala Pro Lys Ser Gly Phe Tyr Arg Tyr Ala Ala Asn Gln Phe Glu Pro
 925 930 935
 AAA CCA TCT ATG AAA CAT TAC AGG AGA ATT ATT GAC AGC AAT GGC TTC 2883
 Lys Pro Ser Met Lys His Tyr Arg Arg Ile Ile Asp Ser Asn Gly Phe
 940 945 950 955
 CTG GGT TCT GGA ACA CTG GGA AGG TTT TGT CCA GAA GAA TAC ACT GTG 2931
 Leu Gly Ser Gly Thr Leu Gly Arg Phe Cys Pro Glu Glu Tyr Thr Val
 960 965 970
 TGC ACC GAA TGT GGA TTT TTT CAA ACC CGG AAG TCT TTG CTG GTC TTC 2979
 Cys Thr Glu Cys Gly Phe Phe Gln Thr Arg Lys Ser Leu Leu Val Phe
 975 980 985
 ATC TCG TTT CTT GTT TTT ACT TTT ATT ATT TCT CTT GCT CTC ATT TTT 3027
 Ile Ser Phe Leu Val Phe Thr Phe Ile Ile Ser Leu Ala Leu Ile Phe
 990 995 1000
 CAC TAC TCC AAG AAA GGC CAG AGA AGT TAT AAG TAATGTGAAC GTCTGCCTGG 3080
 His Tyr Ser Lys Lys Gly Gln Arg Ser Tyr Lys
 1005 1010
 CCATTCGCTT TGGGATCAAG ATGTACACGC CGTCAGCCGT TTGCACCTCT CTGTGTTGTG 3140
 AGCCGCATTC CACACATTTT GATTCTAGAA AACCCTTTTT GTCATGGGTG GTAGAGGTTT 3200
 TAAACAGGAA TTGGTGAGAA TAAATATTG CAGGGTGAAT GGTATCTGAA TCTGCTCTCT 3260
 TTGGTGGCAA TTACGGAATT ATACTACCA CAGTTTCTAC AGTGCCCCGG AATGGAAGGC 3320
 ATAGAATACG GTAGGGATAA CAGTGCCAAG CAGACAGAAG TTAAAGAAGC AACTTTAGGG 3380
 ACTTGTTTAT CCATGGCCAT TTTTAAATTC ACTCCTGTTG GGGAGTAACA CTCTCTCAAT 3440
 TACCATCTTA ACACCTGGAC TTTACCTGAT CCAGTTTAC AAGGTGAAGT AGAAAAATAT 3500
 CCAGTAAAGG TGGCCAAGAG CCCTGAGTCC AGAGCAGCCC ATTAAGAAGC ACTATTCCTA 3560
 CCAATGCTG CTAATGTCAA TTTACAAATA TACTTAGAAA GCACATTATG GACATTTGTA 3620
 TTCTTGTGAA TGTTTTTGAG GTGTGCCCTA AACCCAGAT CCTTGAGGGC TTTCTCTTAC 3680
 CAACTTTCCT TTCAGAGCCT GCTTGTGGA GATTCTTCCC CAGCCCCCTT CCCCTTTCCC 3740
 TCTTGCTCTG CCCACCTCG CTCCACCCAG CTTGCTCCAG CCCAAAGATT CTTTATTTGT 3800
 TTCTCATTAC CGAAGGTTGT GAGCCACCAT GTGGTTTCTG GGATTTGAAC TCATGACCTC 3860
 CGGAGGAGCT GTCATGCTCT TAACCAGCCC ATGTTGAAGA TTCTTTTGAT AAATATTCAC 3920
 AAAAAATAAA GATGAGCCAT GAGCTGTTGG CCTCTTCGGA AGCGGAAACT GAGTGATTTG 3980
 ATTGAACATC CTTTTATCTT TGACCAGACC TTGGAATGAA TGCAATGACC TTTCCACAG 4040
 GAAGAAGGAG GAGCTCTCAG TCAAAGTGT AAGAATGCCT CTTGAGAATA TGCTGTCAGT 4100
 GCTTGGATGC CATGATGTTT AACTTTCTTA GTCGATCCGG CAGCAATCAC AGTGTGAGCA 4160
 CACTGGGAAC CTGTCCTTGC GGCCGCCGAG ATCTACCGTG TGCTTCTGTG AAGAGGCTTT 4220
 GACGTAGCCC CTCTTTGAGC TCTTACACCA TGCTACTGAC TTCTAGAAAG GCTAATTAGG 4280
 TCTTCTTCTA CACCTAATAC CCTAAGTCTT ACTGACTCTC ACGGGAGAAG TCTCTGTGCT 4340
 ACACCTGAGT GGTCTTATTG ATAACCTGA TACCAGATCA GGCAAGATAA ATCCGTCATA 4400
 GCAGGCATGG CTACCCTTGC TGCCACAGGG TCACAGCACA TAGCTCATCA CCCTGTTATT 4460
 CTTTCATCTG CAATGTGGTA TGGTTTTCTT GGTGAATGAT CAGCTTTTGC TGTGGTATTG 4520
 TTTATACATC TGGACTTATT ATTGAAATCA AATGCTATAG AATCAATAGT TTATTTTATG 4580
 TCTATTTTTC TTGATCGCAG AGTAATATAT ATTAATTGTA AAAAATTTAA GAAACAAAAA 4640
 CTATATGTAA AGAAAAAATT ATAATATAAT ACAGAGATGC TGCTGACAGT TCCTATGTGT 4700

TGTGTTTTGT ATACTGAGAT CATGTGATAC GTAGGCATAC ATCTTCTTGG GTTTTTTTGT 4760
 TTTTGTTTTT TGTGTTTGTGTT TGTGTTTGTGTT TGGTTTTTTG AGATAGGGTT TCTCTGTATA 4820
 GCCCTGGCTG TCCTGGAAC TCACTTTGCAG ACCAGGCTAG CCTCAAACCTC TTATTCATTT 4880
 TTAAGAAGT AATTTTTCTG TCATTAGTCT TCAAGAGCAA AACTTTAATA GTTATGGAGA 4940
 ATATTGCCAG AACAGCTCAA AACTGTTTTA TTTGTTGGTC CAATTTCCCA TTAATTAGTT 5000
 CAATAATAAA TATCATTTAG AAATAAAAAA AA 5032

SEQ ID NO:9

SEQUENCE LENGTH: 1650

SEQUENCE TYPE: nucleic acid

STRANDEDNESS: double

TOPOLYGY: linear

MOLECULAR TYPE: cDNA to mRNA

ORIGINAL SOURCE:

ORGANISM: mouse

Organization: kidney

FEATURE

NAME/KEY: CDS

LOCATION: 1..1650

IDENTIFICATION METHOD: E

SEQUENCE:

ATG CTA GCC CGC GCC CCT CCT CGC CGC CCG CCG CGG CTG GTG CTG CTC	48
Met Leu Ala Arg Ala Pro Pro Arg Arg Pro Pro Arg Leu Val Leu Leu	
1 5 10 15	
CGT TTG CTG TTG CTG CAT CTG CTG CTG CTC GCC CTG CGC GCC CGC TGC	96
Arg Leu Leu Leu Leu His Leu Leu Leu Leu Ala Leu Arg Ala Arg Cys	
20 25 30	
CTG AGC GCT GAG CCG GGT CAG GGC GCG CAG ACC TGG GCT CGC TTC GCG	144
Leu Ser Ala Glu Pro Gly Gln Gly Ala Gln Thr Trp Ala Arg Phe Ala	
35 40 45	
CGC GCT CCT GCC CCA GAG GCC GCT GGC CTC CTC CAC GAC ACC TTC CCC	192
Arg Ala Pro Ala Pro Glu Ala Ala Gly Leu Leu His Asp Thr Phe Pro	
50 55 60	
GAC GGT TTC CTC TGG GCG GTA GGC AGC GCC GCC TAT CAG ACC GAG GGC	240
Asp Gly Phe Leu Trp Ala Val Gly Ser Ala Ala Tyr Gln Thr Glu Gly	
65 70 75 80	
GGC TGG CGA CAG CAC GGC AAA GGC GCG TCC ATC TGG GAC ACT TTC ACC	288
Gly Trp Arg Gln His Gly Lys Gly Ala Ser Ile Trp Asp Thr Phe Thr	
85 90 95	
CAT CAC TCT GGG GCG GCC CCG TCC GAC TCC CCG ATC GTC GTG GCG CCG	336
His His Ser Gly Ala Ala Pro Ser Asp Ser Pro Ile Val Val Ala Pro	
100 105 110	
TCG GGT GCC CCG TCG CCT CCC CTG TCC TCC ACT GGA GAT GTG GCC AGC	384
Ser Gly Ala Pro Ser Pro Pro Leu Ser Ser Thr Gly Asp Val Ala Ser	
115 120 125	
GAT AGT TAC AAC AAC GTC TAC CGC GAC ACA GAG GGG CTG CGC GAA CTG	432
Asp Ser Tyr Asn Asn Val Tyr Arg Asp Thr Glu Gly Leu Arg Glu Leu	
130 135 140	
GGG GTC ACC CAC TAC CGC TTC TCC ATA TCG TGG GCG CGG GTG CTC CCC	480
Gly Val Thr His Tyr Arg Phe Ser Ile Ser Trp Ala Arg Val Leu Pro	
145 150 155 160	

AAT GGC ACC GCG GGC ACT CCC AAC CGC GAG GGG CTG CGC TAC TAC CGG	528
Asn Gly Thr Ala Gly Thr Pro Asn Arg Glu Gly Leu Arg Tyr Tyr Arg	
165 170 175	
CGG CTG CTG GAG CGG CTG CGG GAG CTG GGC GTG CAG CCG GTG GTT ACC	576
Arg Leu Leu Glu Arg Leu Arg Glu Leu Gly Val Gln Pro Val Val Thr	
180 185 190	
CTG TAC CAT TGG GAC CTG CCA CAG CGC CTG CAG GAC ACC TAT GGC GGA	624
Leu Tyr His Trp Asp Leu Pro Gln Arg Leu Gln Asp Thr Tyr Gly Gly	
195 200 205	
TGG GCC AAT CGC GCC CTG GCC GAC CAT TTC AGG GAT TAT GCC GAG CTC	672
Trp Ala Asn Arg Ala Leu Ala Asp His Phe Arg Asp Tyr Ala Glu Leu	
210 215 220	
TGC TTC CGC CAC TTC GGT GGT CAG GTC AAG TAC TGG ATC ACC ATT GAC	720
Cys Phe Arg His Phe Gly Gly Gln Val Lys Tyr Trp Ile Thr Ile Asp	
225 230 235 240	
AAC CCC TAC GTG GTG GCC TGG CAC GGG TAT GCC ACC GGG CGC CTG GCC	768
Asn Pro Tyr Val Val Ala Trp His Gly Tyr Ala Thr Gly Arg Leu Ala	
245 250 255	
CCG GGC GTG AGG GGC AGC TCC AGG CTC GGG TAC CTG GTT GCC CAC AAC	816
Pro Gly Val Arg Gly Ser Ser Arg Leu Gly Tyr Leu Val Ala His Asn	
260 265 270	
CTA CTT TTG GCT CAT GCC AAA GTC TGG CAT CTC TAC AAC ACC TCT TTC	864
Leu Leu Leu Ala His Ala Lys Val Trp His Leu Tyr Asn Thr Ser Phe	
275 280 285	
CGC CCC ACA CAG GGA GGC CGG GTG TCT ATC GCC TTA AGC TCC CAT TGG	912
Arg Pro Thr Gln Gly Gly Arg Val Ser Ile Ala Leu Ser Ser His Trp	
290 295 300	
ATC AAT CCT CGA AGA ATG ACT GAC TAT AAT ATC AGA GAA TGC CAG AAG	960
Ile Asn Pro Arg Arg Met Thr Asp Tyr Asn Ile Arg Glu Cys Gln Lys	
305 310 315 320	
TCT CTT GAC TTT GTG CTA GGC TGG TTT GCC AAA CCC ATA TTT ATT GAT	1008
Ser Leu Asp Phe Val Leu Gly Trp Phe Ala Lys Pro Ile Phe Ile Asp	
325 330 335	
GGC GAC TAC CCA GAG AGT ATG AAG AAC AAC CTC TCG TCT CTT CTG CCT	1056
Gly Asp Tyr Pro Glu Ser Met Lys Asn Asn Leu Ser Ser Leu Leu Pro	
340 345 350	
GAT TTT ACT GAA TCT GAG AAG AGG CTC ATC AGA GGA ACT GCT GAC TTT	1104
Asp Phe Thr Glu Ser Glu Lys Arg Leu Ile Arg Gly Thr Ala Asp Phe	
355 360 365	
TTT GCT CTC TGC TTC GGA CCA ACC TTG AGC TTT CAG CTA TTG GAC CCT	1152
Phe Ala Leu Cys Phe Gly Pro Thr Leu Ser Phe Gln Leu Leu Asp Pro	
370 375 380	
AAC ATG AAG TTC CGC CAA TTG GAG TCT CCC AAC CTG AGG CAG CTT CTs	1200
Asn Met Lys Phe Arg Gln Leu Glu Ser Pro Asn Leu Arg Gln Leu Leu	
385 390 395 400	
TCT TGG ATA GAT CTG GAA TAT AAC CAC CCT CCA ATA TTT ATT GTG GAA	1248
Ser Trp Ile Asp Leu Glu Tyr Asn His Pro Pro Ile Phe Ile Val Glu	
405 410 415	
AAT GGC TGG TTT GTC TCG GGA ACC ACC AAA AGG GAT GAT GCC AAA TAT	1296
Asn Gly Trp Phe Val Ser Gly Thr Thr Lys Arg Asp Asp Ala Lys Tyr	
420 425 430	

ATG TAT TAT CTC AAG AAG TTC ATA ATG GAA ACC TTA AAA GCA ATC AGA	1344
Met Tyr Tyr Leu Lys Lys Phe Ile Met Glu Thr Leu Lys Ala Ile Arg	
435 440 445	
CTG GAT GGG GTC GAC GTC ATT GGG TAC ACC GCG TGG TCG CTC ATG GAC	1392
Leu Asp Gly Val Asp Val Ile Gly Tyr Thr Ala Trp Ser Leu Met Asp	
450 455 460	
GGT TTC GAG TGG CAT AGG GGC TAC AGC ATC CGG CGA GGA CTC TTC TAC	1440
Gly Phe Glu Trp His Arg Gly Tyr Ser Ile Arg Arg Gly Leu Phe Tyr	
465 470 475 480	
GTT GAC TTT CTG AGT CAG GAC AAG GAG CTG TTG CCA AAG TCT TCG GCC	1488
Val Asp Phe Leu Ser Gln Asp Lys Glu Leu Leu Pro Lys Ser Ser Ala	
485 490 495	
TTG TTC TAC CAA AAG CTG ATA GAG GAC AAT GGC TTT CCT CCT TTA CCT	1536
Leu Phe Tyr Gln Lys Leu Ile Glu Asp Asn Gly Phe Pro Pro Leu Pro	
500 505 510	
GAA AAC CAG CCC CTT GAA GGG ACA TTT CCC TGT GAC TTT GCT TGG GGA	1584
Glu Asn Gln Pro Leu Glu Gly Thr Phe Pro Cys Asp Phe Ala Trp Gly	
515 520 525	
GTT GTT GAC AAC TAC GTA CAA GTA AGT CCT TTG ACA AAA CCC AGT GTC	1632
Val Val Asp Asn Tyr Val Gln Val Ser Pro Leu Thr Lys Pro Ser Val	
530 535 540	
GGC CTC TTG CTT CCT CAC	1650
Gly Leu Leu Leu Pro His	
545 550	

SEQ ID NO:10

SEQUENCE LENGTH: 3460

SEQUENCE TYPE: nucleic acid

STRANDEDNESS: double

TOPOLYGY: linear

MOLECULAR TYPE: cDNA to mRNA

ORIGINAL SOURCE:

ORGANISM: human

ORGANIZATION: pancreas

FEATURE

NAME/KEY: CDS

LOCATION: 60..3107

IDENTIFICATION METHOD: E

SEQUENCE:

CAGGGAATGA ATGGATTTTC TTCAGCACTG ATGAAATAAC CACACGCTAT AGGAATACA	59
ATG TCC AAC GGG GGA TTG CAA AGA TCT GTC ATC CTG TCA GCA CTT ATT	107
Met Ser Asn Gly Gly Leu Gln Arg Ser Val Ile Leu Ser Ala Leu Ile	
1 5 10 15	
CTG CTA CGA GCT GTT ACT GGA TTC TCT GGA GAT GGA AGA GCT ATA TGG	155
Leu Leu Arg Ala Val Thr Gly Phe Ser Gly Asp Gly Arg Ala Ile Trp	
20 25 30	
TCT AAA AAT CCT AAT TTT ACT CCG GTA AAT GAA AGT CAG CTG TTT CTC	203
Ser Lys Asn Pro Asn Phe Thr Pro Val Asn Glu Ser Gln Leu Phe Leu	
35 40 45	
TAT GGC ACT TTC CCT AAA AAC TTT TTC TGG GGT ATT GGG ACT GGA GCA	251
Tyr Gly Thr Phe Pro Lys Asn Phe Phe Trp Gly Ile Gly Thr Gly Ala	

50	55	60	
TTG CAA GTG GAA GGG AGT TGG AAG AAG GAT GGA AAA GGA CCT TCT ATA	299		
Leu Gln Val Glu Gly Ser Trp Lys Lys Asp Gly Lys Gly Pro Ser Ile			
65 70 75 80			
TGG GAT CAT TTC ATC CAC ACA CAC CTT AAA AAT GTC AGC AGC ACG AAT	347		
Trp Asp His Phe Ile His Thr His Leu Lys Asn Val Ser Ser Thr Asn			
85 90 95			
GGT TCC AGT GAC AGT TAT ATT TTT CTG GAA AAA GAC TTA TCA GCC CTG	395		
Gly Ser Ser Asp Ser Tyr Ile Phe Leu Glu Lys Asp Leu Ser Ala Leu			
100 105 110			
GAT TTT ATA GGA GTT TCT TTT TAT CAA TTT TCA ATT TCC TGG CCA AGG	443		
Asp Phe Ile Gly Val Ser Phe Tyr Gln Phe Ser Ile Ser Trp Pro Arg			
115 120 125			
CTT TTC CCC GAT GGA ATA GTA ACA GTT GCC AAC GCA AAA GGT CTG CAG	491		
Leu Phe Pro Asp Gly Ile Val Thr Val Ala Asn Ala Lys Gly Leu Gln			
130 135 140			
TAC TAC AGT ACT CTT CTG GAC GCT CTA GTG CTT AGA AAC ATT GAA CCT	539		
Tyr Tyr Ser Thr Leu Leu Asp Ala Leu Val Leu Arg Asn Ile Glu Pro			
145 150 155 160			
ATA GTT ACT TTA TAC CAC TGG GAT TTG CCT TTG GCA CTA CAA GAA AAA	587		
Ile Val Thr Leu Tyr His Trp Asp Leu Pro Leu Ala Leu Gln Glu Lys			
165 170 175			
TAT GGG GGG TGG AAA AAT GAT ACC ATA ATA GAT ATC TTC AAT GAC TAT	635		
Tyr Gly Gly Trp Lys Asn Asp Thr Ile Ile Asp Ile Phe Asn Asp Tyr			
180 185 190			
GCC ACA TAC TGT TTC CAG ATG TTT GGG GAC CGT GTC AAA TAT TGG ATT	683		
Ala Thr Tyr Cys Phe Gln Met Phe Gly Asp Arg Val Lys Tyr Trp Ile			
195 200 205			
ACA ATT CAC AAC CCA TAT CTA GTG GCT TGG CAT GGG TAT GGG ACA GGT	731		
Thr Ile His Asn Pro Tyr Leu Val Ala Trp His Gly Tyr Gly Thr Gly			
210 215 220			
ATG CAT GCC CCT GGA GAG AAG GGA AAT TTA GCA GCT GTC TAC ACT GTG	779		
Met His Ala Pro Gly Glu Lys Gly Asn Leu Ala Ala Val Tyr Thr Val			
225 230 235 240			
GGA CAC AAC TTG ATC AAG GCT CAC TCG AAA GTT TGG CAT AAC TAC AAC	827		
Gly His Asn Leu Ile Lys Ala His Ser Lys Val Trp His Asn Tyr Asn			
245 250 255			
ACA CAT TTC CGC CCA CAT CAG AAG GGT TGG TTA TCG ATC ACG TTG GGA	875		
Thr His Phe Arg Pro His Gln Lys Gly Trp Leu Ser Ile Thr Leu Gly			
260 265 270			
TCT CAT TGG ATC GAG CCA AAC CGG TCG GAA AAC ACG ATG GAT ATA TTC	923		
Ser His Trp Ile Glu Pro Asn Arg Ser Glu Asn Thr Met Asp Ile Phe			
275 280 285			
AAA TGT CAA CAA TCC ATG GTT TCT GTG CTT GGA TGG TTT GCC AAC CCT	971		
Lys Cys Gln Gln Ser Met Val Ser Val Leu Gly Trp Phe Ala Asn Pro			
290 295 300			
ATC CAT GGG GAT GGC GAC TAT CCA GAG GGG ATG AGA AAG AAG TTG TTC	1019		
Ile His Gly Asp Gly Asp Tyr Pro Glu Gly Met Arg Lys Lys Leu Phe			
305 310 315 320			
TCC GTT CTA CCC ATT TTC TCT GAA GCA GAG AAG CAT GAG ATG AGA GGC	1067		
Ser Val Leu Pro Ile Phe Ser Glu Ala Glu Lys His Glu Met Arg Gly			

															325																330																335																																
ACA	GCT	GAT	TTC	TTT	GCC	TTT	TCT	TTT	GGA	CCC	AAC	AAC	TTC	AAG	CCC		1115																																																														
Thr	Ala	Asp	Phe	Phe	Ala	Phe	Ser	Phe	Gly	Pro	Asn	Asn	Phe	Lys	Pro																																																																
															340																345																350																																
CTA	AAC	ACC	ATG	GCT	AAA	ATG	GGA	CAA	AAT	GTT	TCA	CTT	AAT	TTA	AGA		1163																																																														
Leu	Asn	Thr	Met	Ala	Lys	Met	Gly	Gln	Asn	Val	Ser	Leu	Asn	Leu	Arg																																																																
															355																360																365																																
GAA	GCG	CTG	AAC	TGG	ATT	AAA	CTG	GAA	TAC	AAC	AAC	CCT	CGA	ATC	TTG		1211																																																														
Glu	Ala	Leu	Asn	Trp	Ile	Lys	Leu	Glu	Tyr	Asn	Asn	Pro	Arg	Ile	Leu																																																																
															370																375																380																																
ATT	GCT	GAG	AAT	GGC	TGG	TTC	ACA	GAC	AGT	CGT	GTG	AAA	ACA	GAA	GAC		1259																																																														
Ile	Ala	Glu	Asn	Gly	Trp	Phe	Thr	Asp	Ser	Arg	Val	Lys	Thr	Glu	Asp																																																																
															385																390																395																400																
ACC	ACG	GCC	ATC	TAC	ATG	ATG	AAG	AAT	TTC	CTC	AGC	CAG	GTG	CTT	CAA		1307																																																														
Thr	Thr	Ala	Ile	Tyr	Met	Met	Lys	Asn	Phe	Leu	Ser	Gln	Val	Leu	Gln																																																																
															405																410																415																																
GCA	ATA	AGG	TTA	GAT	GAA	ATA	CGA	GTG	TTT	GGT	TAT	ACT	GCC	TGG	TCT		1355																																																														
Ala	Ile	Arg	Leu	Asp	Glu	Ile	Arg	Val	Phe	Gly	Tyr	Thr	Ala	Trp	Ser																																																																
															420																425																430																																
CTC	CTG	GAT	GGC	TTT	GAA	TGG	CAG	GAT	GCT	TAC	ACC	ATC	CGC	CGA	GGA		1403																																																														
Leu	Leu	Asp	Gly	Phe	Glu	Trp	Gln	Asp	Ala	Tyr	Thr	Ile	Arg	Arg	Gly																																																																
															435																440																445																																
TTA	TTT	TAT	GTG	GAT	TTT	AAC	AGT	AAA	CAG	AAA	GAG	CGG	AAA	CCT	AAG		1451																																																														
Leu	Phe	Tyr	Val	Asp	Phe	Asn	Ser	Lys	Gln	Lys	Glu	Arg	Lys	Pro	Lys																																																																
															450																455																460																																
TCT	TCA	GCA	CAC	TAC	TAC	AAA	CAG	ATC	ATA	CGA	GAA	AAT	GGT	TTT	TCT		1499																																																														
Ser	Ser	Ala	His	Tyr	Tyr	Lys	Gln	Ile	Ile	Arg	Glu	Asn	Gly	Phe	Ser																																																																
															465																470																475																480																
TTA	AAA	GAG	TCC	ACG	CCA	GAT	GTG	CAG	GGC	CAG	TTT	CCC	TGT	GAC	TTC		1547																																																														
Leu	Lys	Glu	Ser	Thr	Pro	Asp	Val	Gln	Gly	Gln	Phe	Pro	Cys	Asp	Phe																																																																
															485																490																495																																
TCC	TGG	GGT	GTC	ACT	GAA	TCT	GTT	CTT	AAG	CCC	GAG	TCT	GTG	GCT	TCG		1595																																																														
Ser	Trp	Gly	Val	Thr	Glu	Ser	Val	Leu	Lys	Pro	Glu	Ser	Val	Ala	Ser																																																																
															500																505																510																																
TCC	CCA	CAG	TTC	AGC	GAT	CCT	CAT	CTG	TAC	GTG	TGG	AAC	GCC	ACT	GGC		1643																																																														
Ser	Pro	Gln	Phe	Ser	Asp	Pro	His	Leu	Tyr	Val	Trp	Asn	Ala	Thr	Gly																																																																
															515																520																525																																
AAC	AGA	CTG	TTG	CAC	CGA	GTG	GAA	GGG	GTG	AGG	CTG	AAA	ACA	CGA	CCC		1691																																																														
Asn	Arg	Leu	Leu	His	Arg	Val	Glu	Gly	Val	Arg	Leu	Lys	Thr	Arg	Pro																																																																
															530																535																540																																
GCT	CAA	TGC	ACA	GAT	TTT	GTA	AAC	ATC	AAA	AAA	CAA	CTT	GAG	ATG	TTG		1739																																																														
Ala	Gln	Cys	Thr	Asp	Phe	Val	Asn	Ile	Lys	Lys	Gln	Leu	Glu	Met	Leu																																																																
															545																550																555																560																
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															565																570																575																																
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															580																585																590																																
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Lys Gly Lys Arg Val Val Ser				
1010	1015			
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SEQUENCE TYPE: nucleic acid

STRANDEDNESS: single

TOPOLYGY: linear

MOLECULE TYPE: synthetic DNA

SEQUENCE:

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SEQ ID NO:12

SEQUENCE LENGTH: 20

SEQUENCE TYPE: nucleic acid

STRANDEDNESS: single

TOPOLYGY: linear

MOLECULE TYPE: synthetic DNA

SEQUENCE:

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20

SEQ ID NO:13

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SEQUENCE TYPE: nucleic acid

STRANDEDNESS: single

TOPOLYGY: linear

MOLECULE TYPE: synthetic DNA

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27

SEQ ID NO:14

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SEQUENCE TYPE: nucleic acid

STRANDEDNESS: single

TOPOLYGY: linear

MOLECULE TYPE: synthetic DNA

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STRANDEDNESS: single

TOPOLYGY: linear

MOLECULE TYPE: synthetic DNA

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SEQ ID NO:16

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STRANDEDNESS: single

TOPOLYGY: linear

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SEQUENCE:

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STRANDEDNESS: single

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ORIGINAL SOURCE: synthetic DNA
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TOPOLYGY: linear
MOLECULE TYPE: synthetic DNA

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20

CLAIMS

1. A polypeptide which is selected from the group consisting of the following (a) to (d):

(a) a polypeptide comprising an amino acid sequence selected from amino acid sequences represented by SEQ ID NOS:1, 2, 3, 4 and 5;

(b) a polypeptide comprising an amino acid sequence wherein the 1st to 33rd amino acids are deleted in the amino acid sequence represented by SEQ ID NOS:1 or 2;

(c) a polypeptide comprising an amino acid sequence wherein the 1st to 35th amino acids are deleted in the amino acid sequence represented by SEQ ID NO:3 or 4; and

(d) a polypeptide comprising an amino acid sequence wherein the 1st to 23rd amino acids are deleted in the amino acid sequence represented by SEQ ID NO:5.

2. A DNA which is selected from the group consisting of the following (a) to (c):

(a) a DNA encoding the polypeptide according to claim 1;

(b) a DNA comprising a DNA sequence selected from DNA sequences represented by SEQ ID NOS: 6, 7, 8, 9 and 10; and

(c) a DNA that hybridizes to the complement of the DNA described in (a) or (b) under stringent conditions, wherein the stringent conditions comprise hybridization at

65°C in the presence of 0.7 to 1.0 mol/l NaCl and washing at 65°C using 0.1 to 2 × SSC solution, wherein said DNA encodes a polypeptide having the same biological activity as the polypeptide of claim 1.

3. An antibody which recognizes the polypeptide according to claim 1.

4. A hybridoma which produces the antibody according to claim 3.

5. The hybridoma according to claim 4, which is selected from KM1902 deposited as FERM BP-5983, KM2070 deposited as FERM BP-6196, KM2076 deposited as FERM BP-6197, KM2105 deposited as FERM BP-6198, KM2116 deposited as FERM BP-6199, and KM2119 deposited as FERM BP-6200.

6. A therapeutic agent comprising the polypeptide according to claim 1.

7. A method for immunologically detecting the polypeptide according to claim 1, the method comprising putting the polypeptide into contact with the antibody according to claim 3 and assaying the binding of the polypeptide to the antibody.

8. A vector containing the DNA according to claim 2.

9. A host cell harboring the vector according to claim 8.

10. The host cell according to claim 9, which is selected from *Escherichia coli* ENKM101 deposited as FERM BP-5765, *Escherichia coli* ENKM112 deposited as FERM BP-6184,

Escherichia coli ENKM103 deposited as FERM BP-5942, *Escherichia coli* ENKH106 deposited as FERM BP-5767, and *Escherichia coli* XL1-Blue/pRYHH02 deposited as FERM BP-6193.

11. A method for preparing a polypeptide encoded by the DNA according to claim 2, comprising culturing the host cell according to claim 9 or 10 in a culture to produce and accumulate the polypeptide during the culturing, and recovering the polypeptide from the culture.

12. A method for improving livestock, comprising expressing the DNA according to claim 2 to prolong the life of the livestock.

13. A method of identifying a ligand of the polypeptide according to claim 1, the method comprising providing a first cell which expresses the DNA according to claim 2, providing a second cell which does not express the DNA according to claim 2, contacting the first and second cells with a test sample, and determining cell stimulating activity of the first and second cells in the presence of the test sample, wherein a change in the cell stimulating activity of the first cell relative to the cell stimulating activity of the second cell is indicative that the test sample comprises a ligand of the polypeptide.

14. A method of identifying a compound that enhances expression of the DNA according to claim 2, the method comprising putting a cell expressing the polypeptide according to claim 1 in contact with a test sample, assaying the level of the polypeptide expressed by the cell using the antibody according to claim 3, comparing the level of the

polypeptide with a corresponding level assayed using a corresponding cell expressing the polypeptide of claim 1 that has not been contacted with the test sample, wherein an increase in the level of the polypeptide in the presence relative to in the absence of the test sample is indicative that the test sample comprises a compound that enhances expression of the DNA according to claim 2.

15. A method of identifying a compound that enhances expression of the DNA according to claim 2, the method comprising putting a cell expressing the polypeptide according to claim 1 in contact with a test sample, assaying the level of the transcription product of the DNA according to claim 2, comparing the level of the transcription product with a corresponding level assayed using a corresponding cell expressing the polypeptide of claim 1 that has not been contacted with the test sample, wherein an increase in the level of the transcription product in the presence relative to in the absence of the test sample is indicative that the test sample comprises a compound that enhances expression of the DNA according to claim 2.

16. A method of identifying a compound that enhances expression of the DNA according to claim 2, the method comprising:

(a) contacting a test sample with a cell transformed with a plasmid comprising a reporter gene ligated downstream of a region controlling the transcription of the DNA according to claim 2; and

(b) assaying the expression level of a polypeptide encoded by the reporter gene,

wherein an increase in the expression level relative to a corresponding expression level assayed in a corresponding cell that has not been contacted with the test sample is indicative that the test sample comprises a compound that enhances expression of the DNA according to claim 2.

17. A method for assaying expression level of the DNA according to claim 2, comprising carrying out Northern hybridization or PCR using an oligonucleotide comprising a sequence identical to or complementary to continuous 10 to 50 nucleotides in a nucleotide sequence selected from nucleotide sequences represented by SEQ ID NO:6 to SEQ ID NO:10.

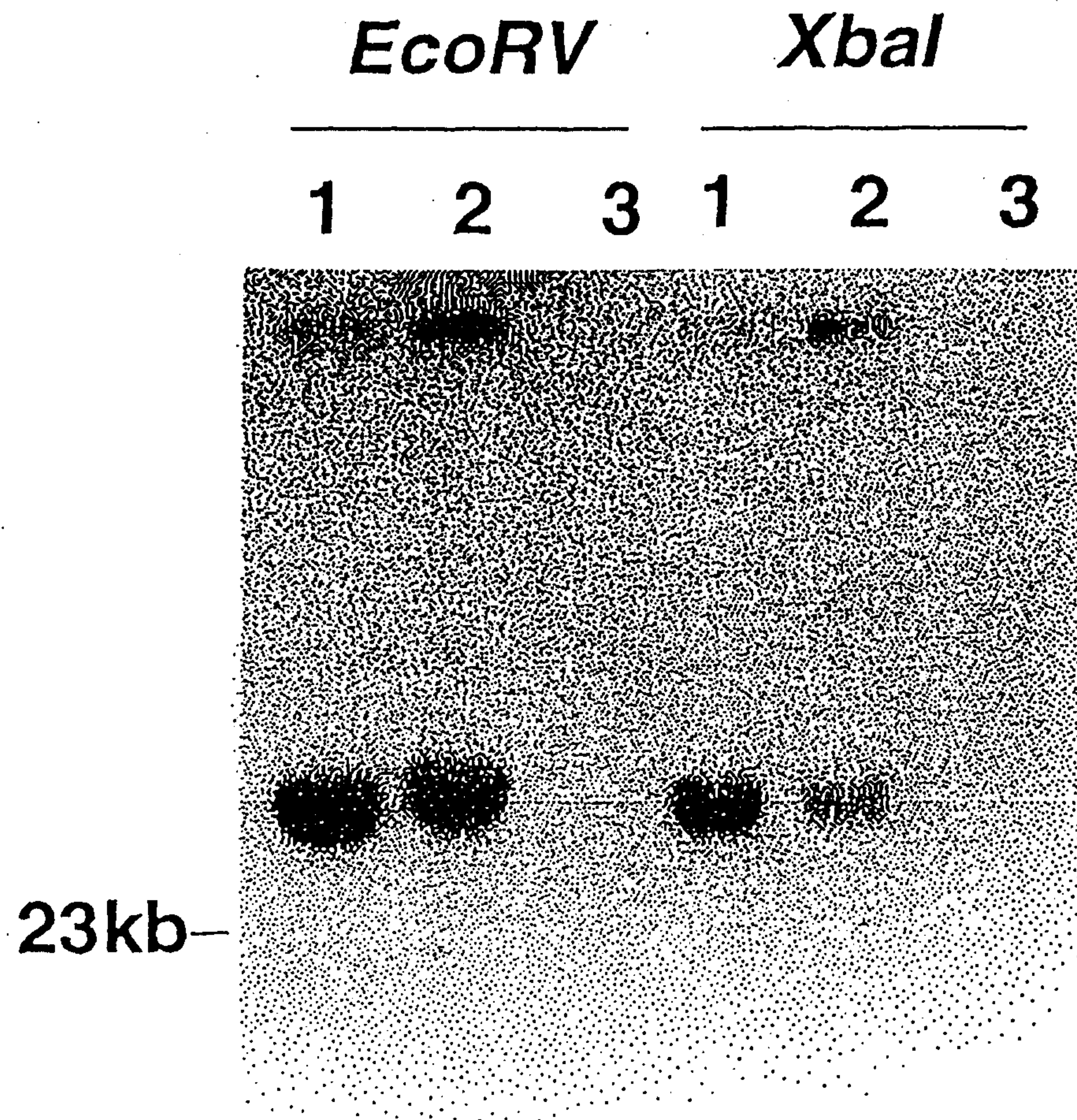
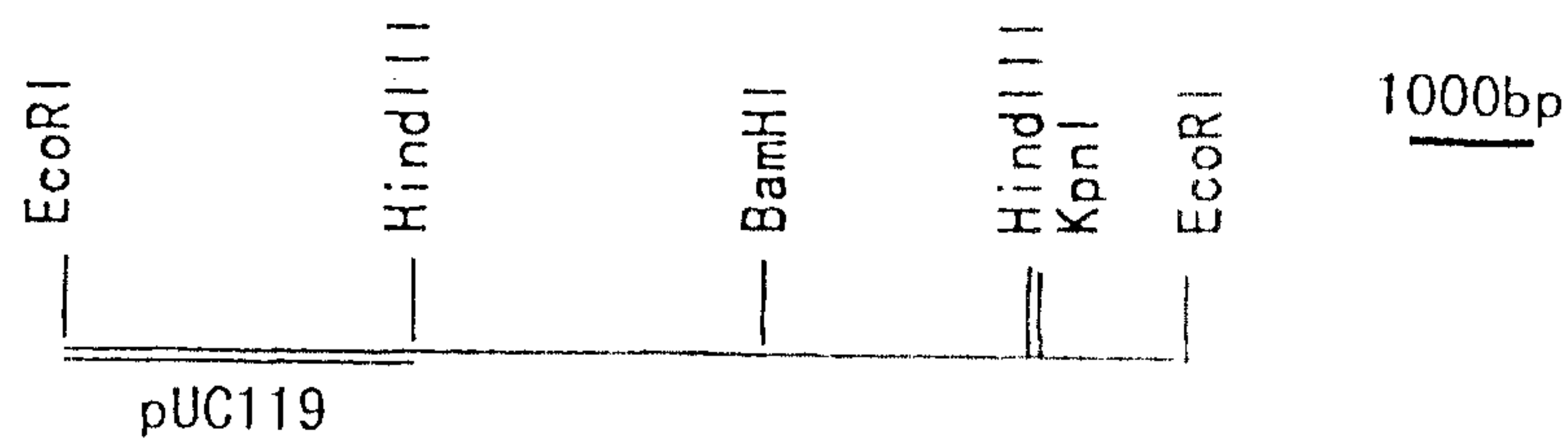
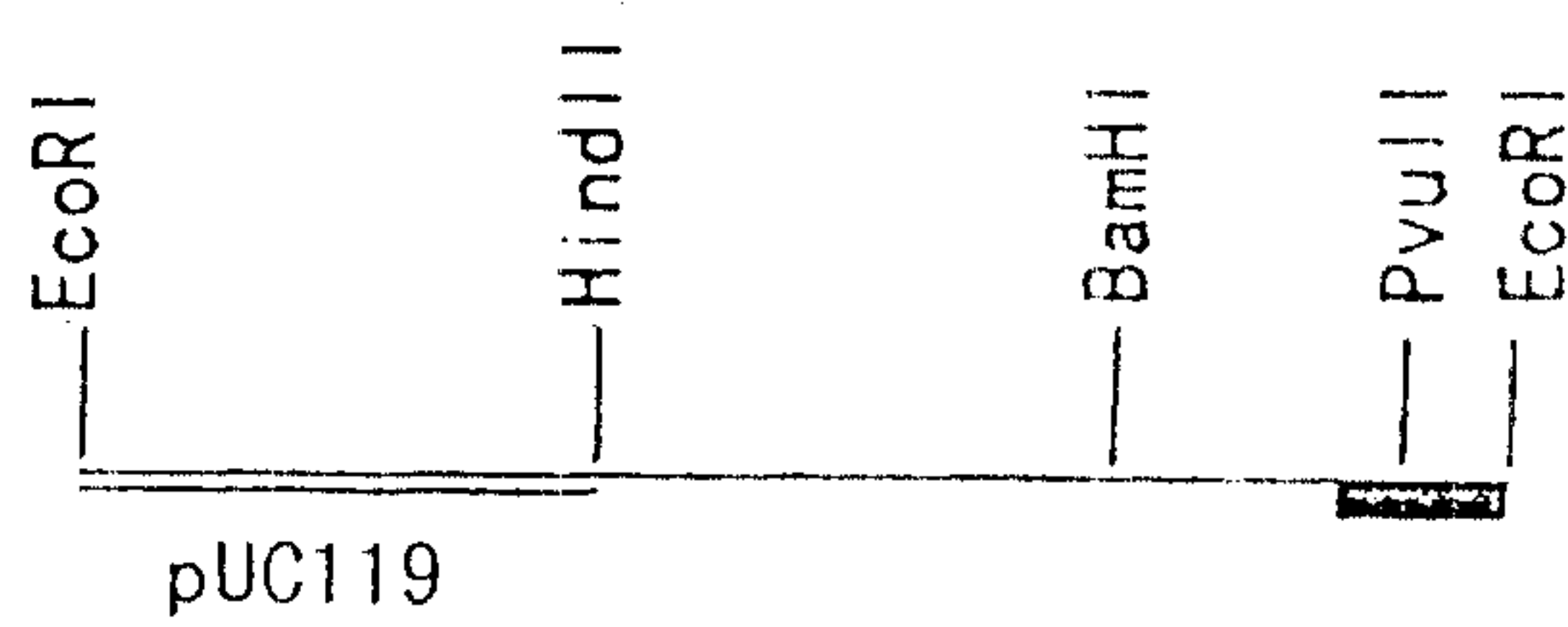


Fig. 1

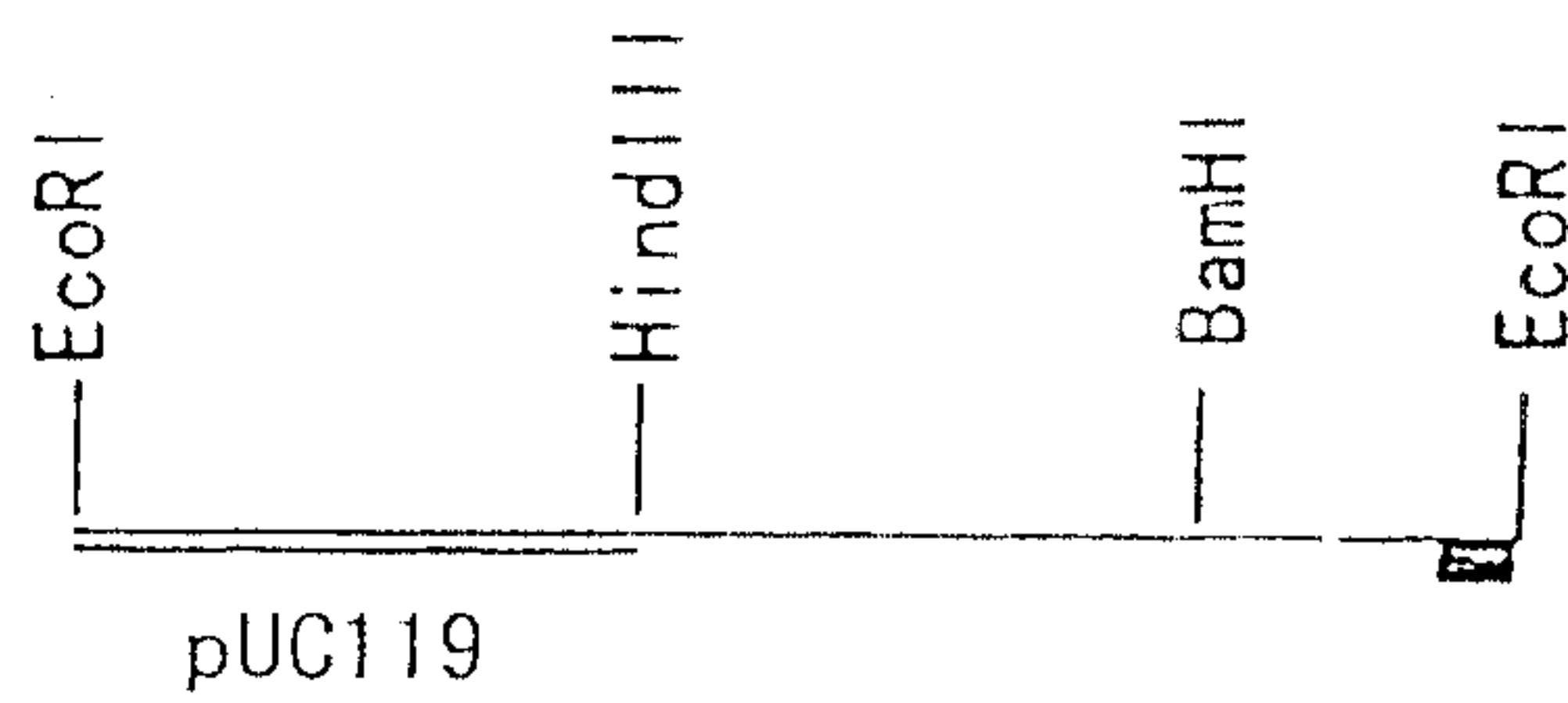
Introduction Gene



Plasmid 50



Plasmid E70



Plasmid K8

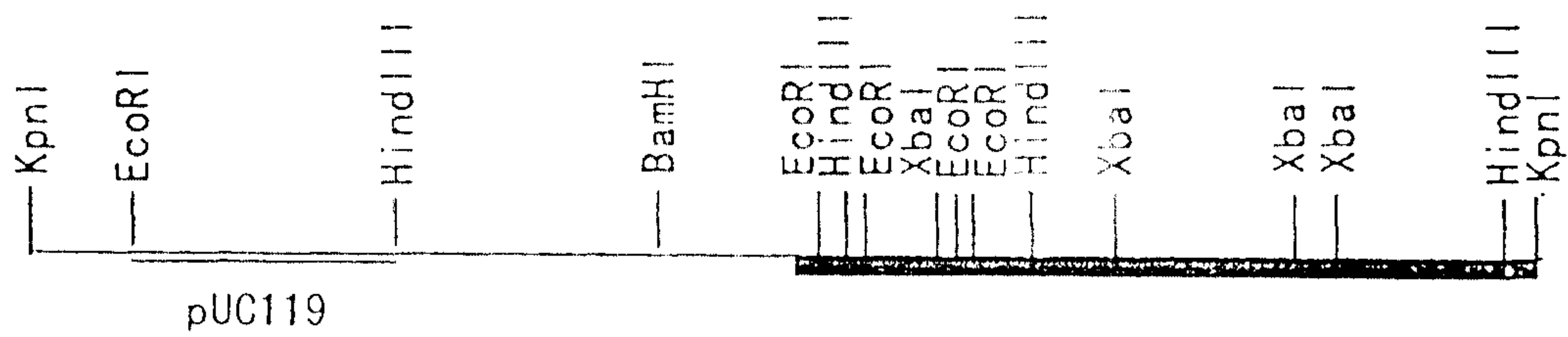


Fig. 2

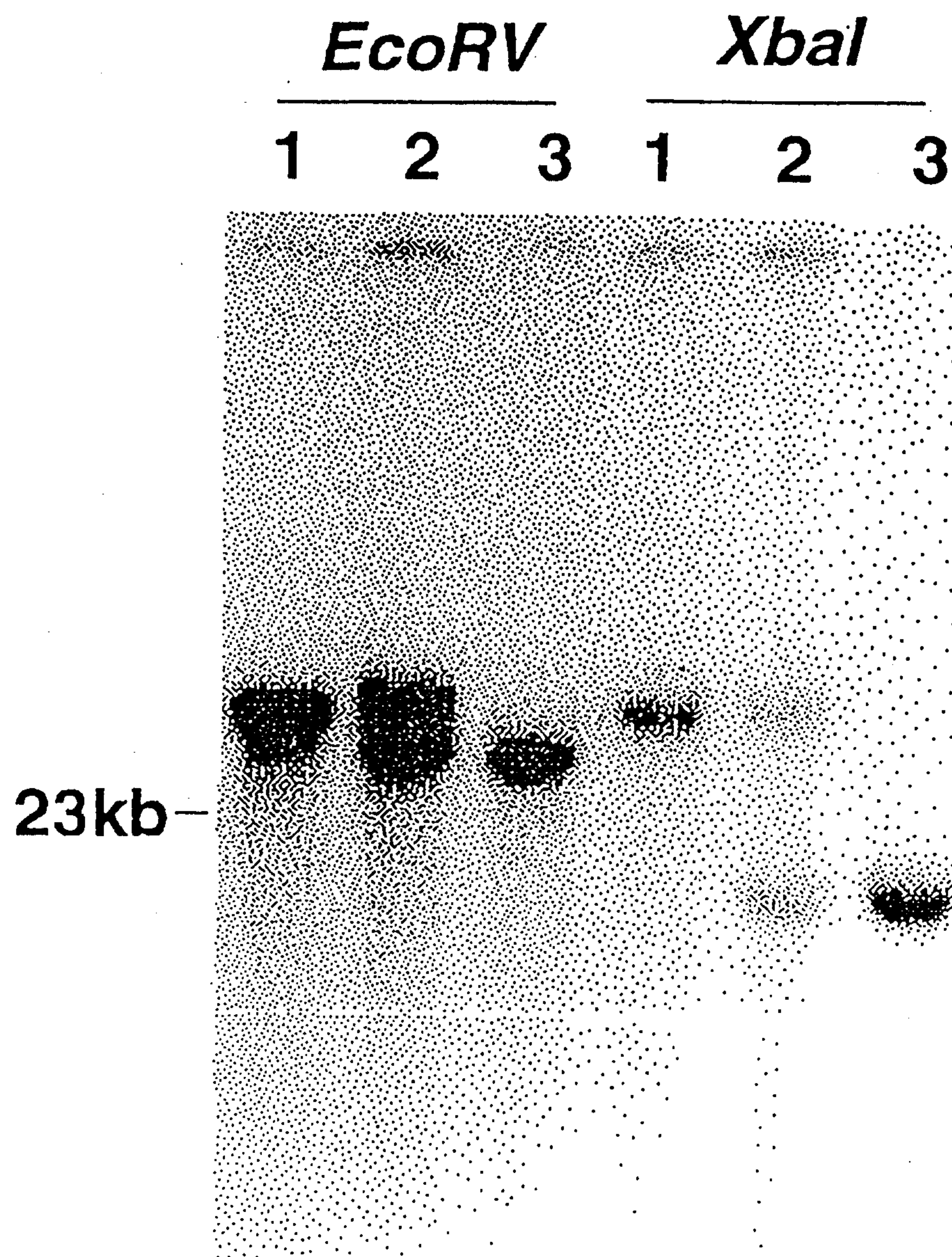


Fig. 3

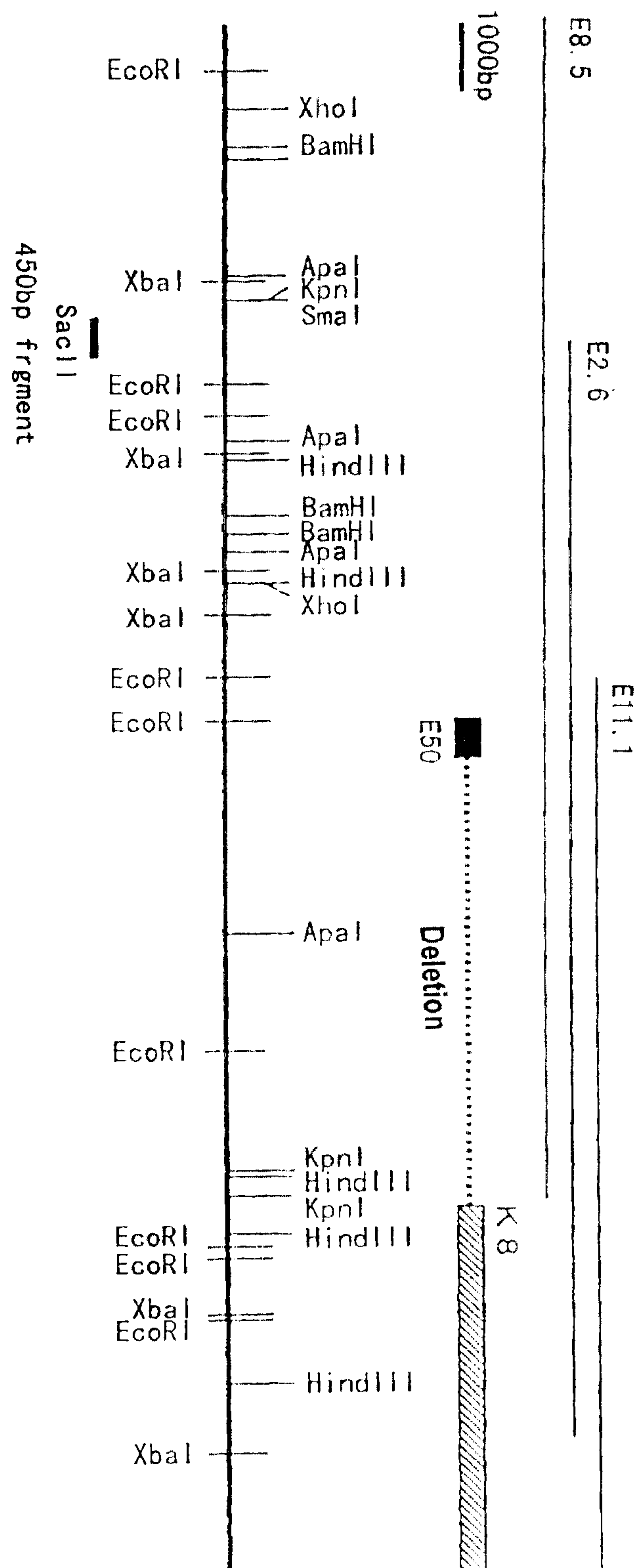


Fig. 4

Northern blotting

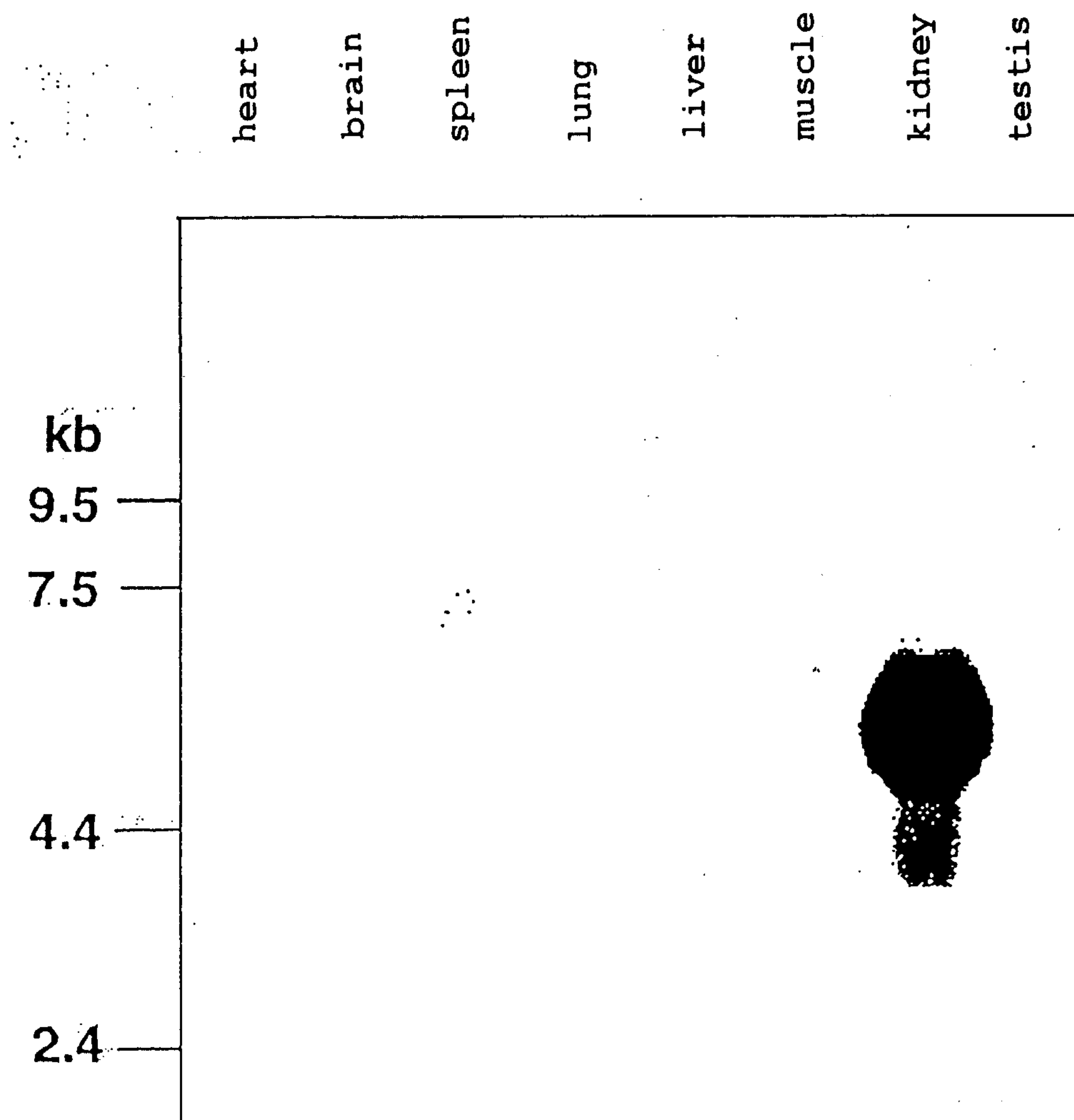


Fig. 5

Northern blotting

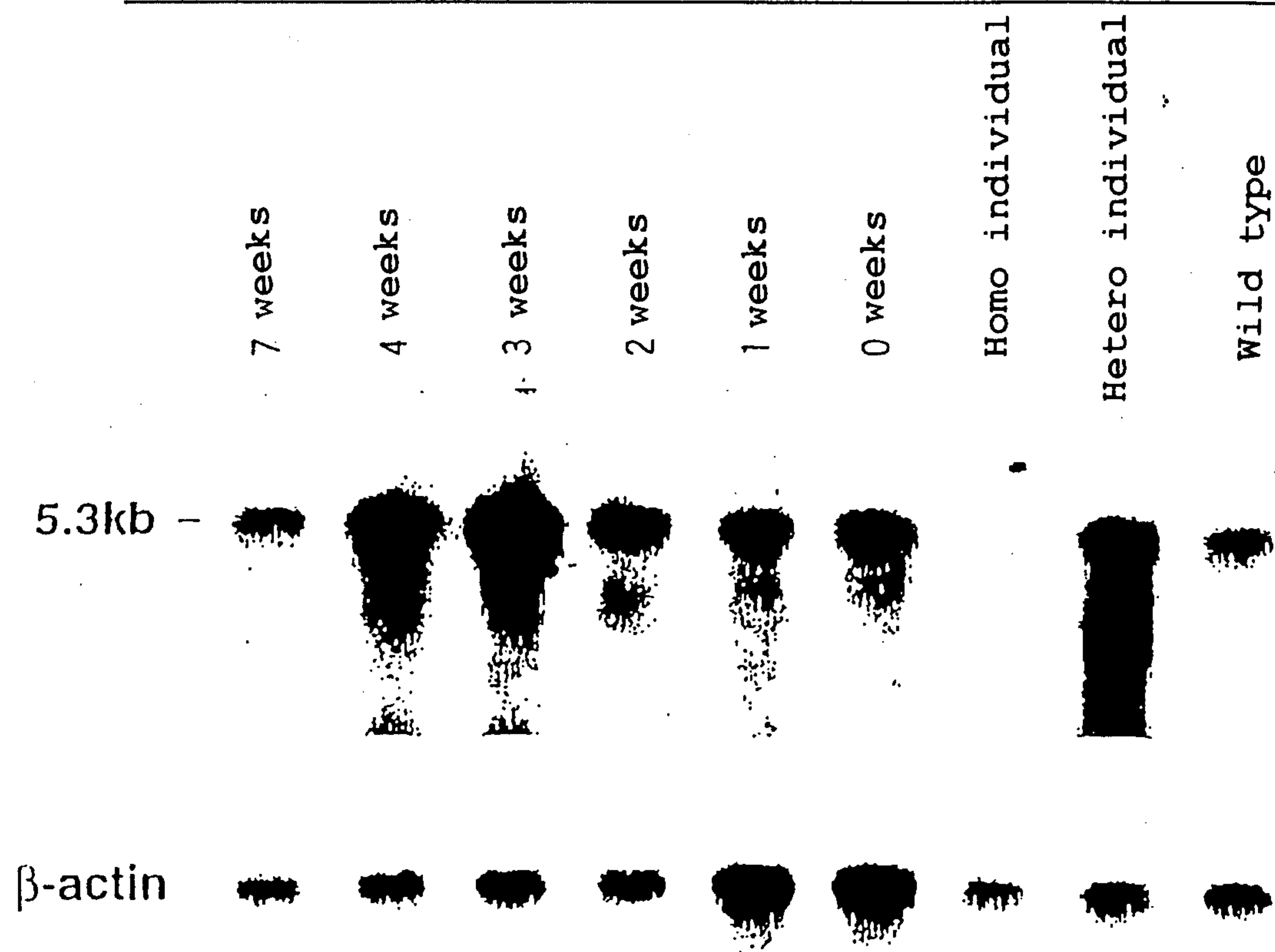


Fig. 6

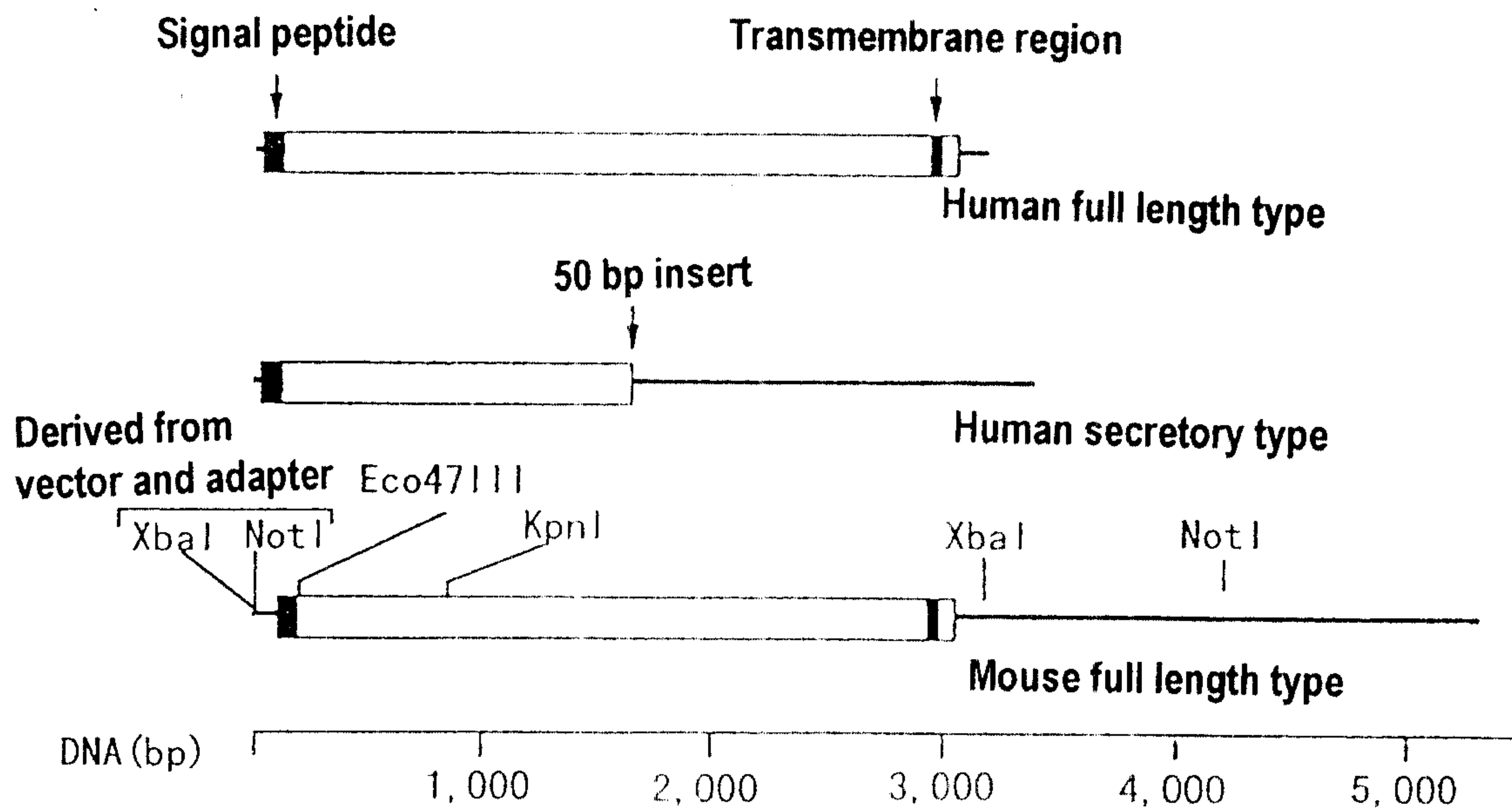


Fig. 7

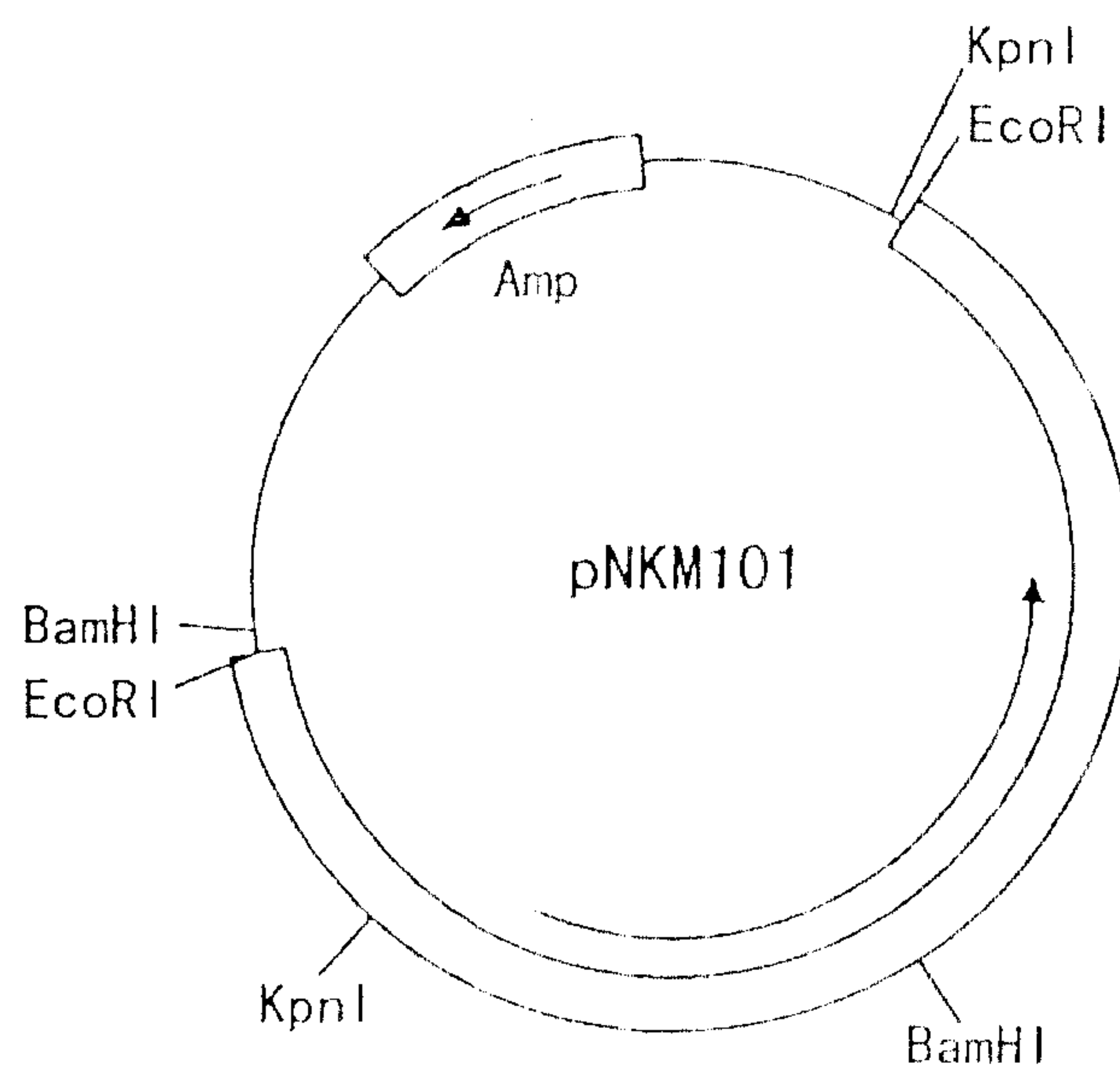


Fig. 8

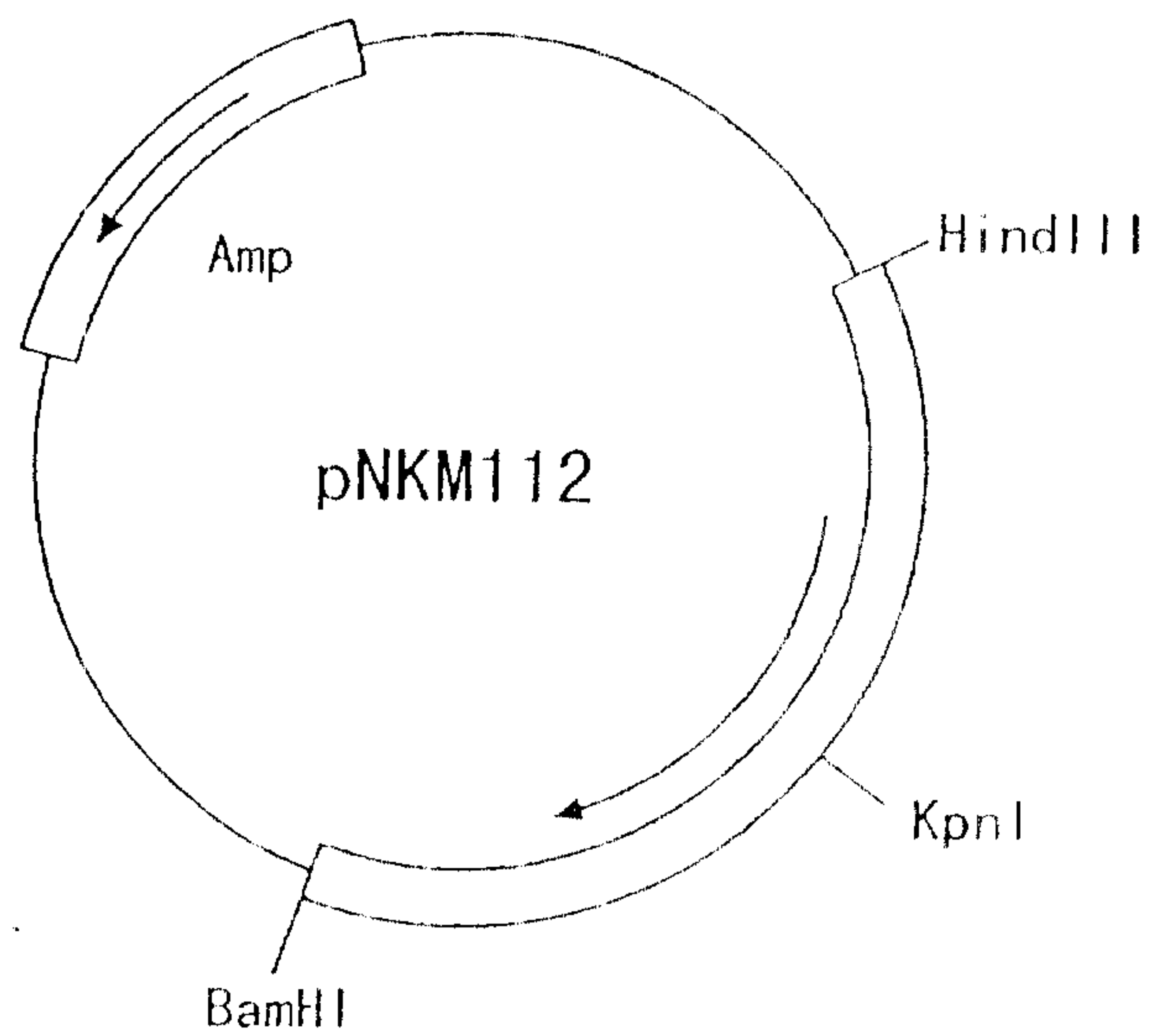


Fig. 9

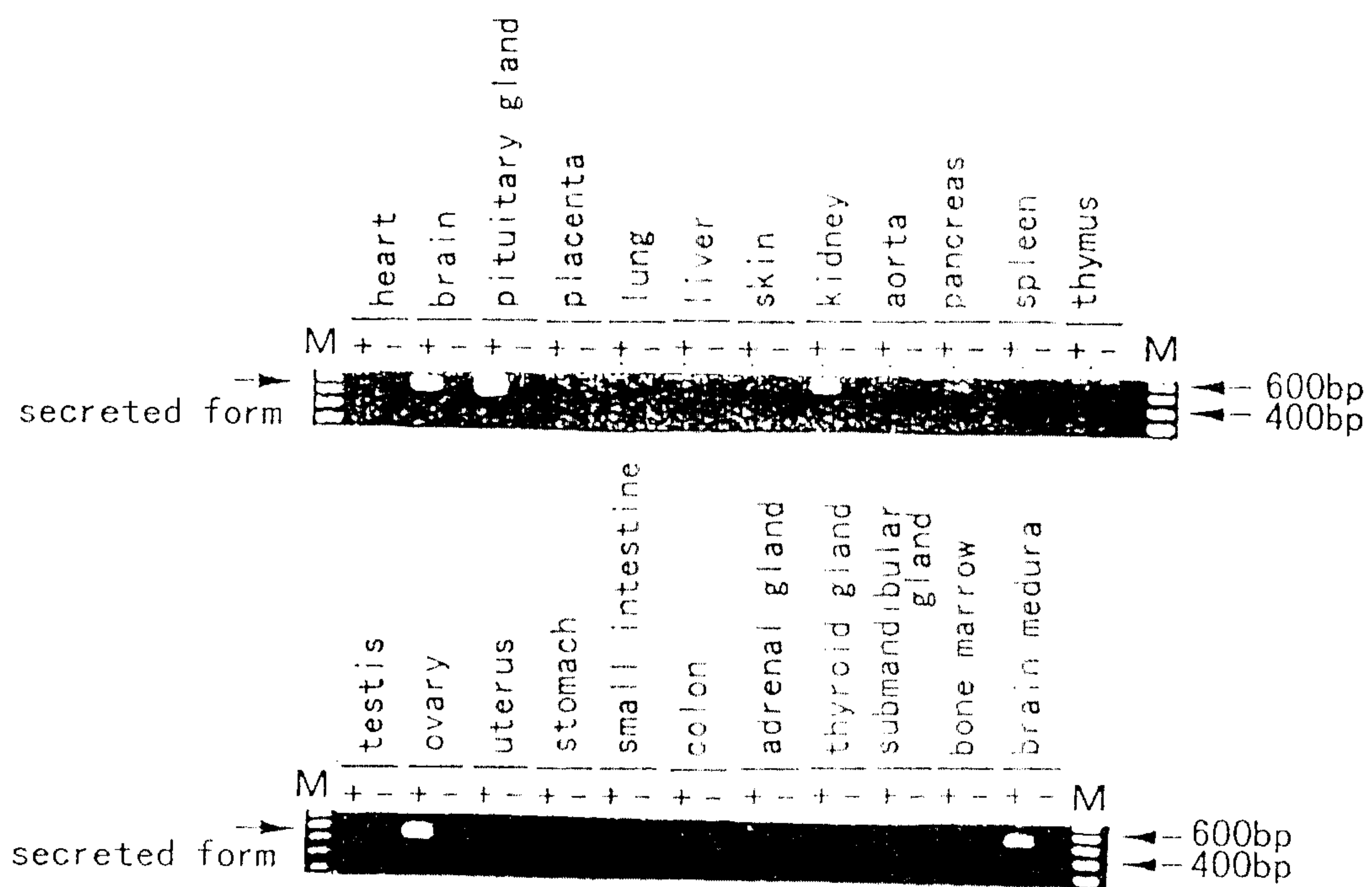


Fig. 10

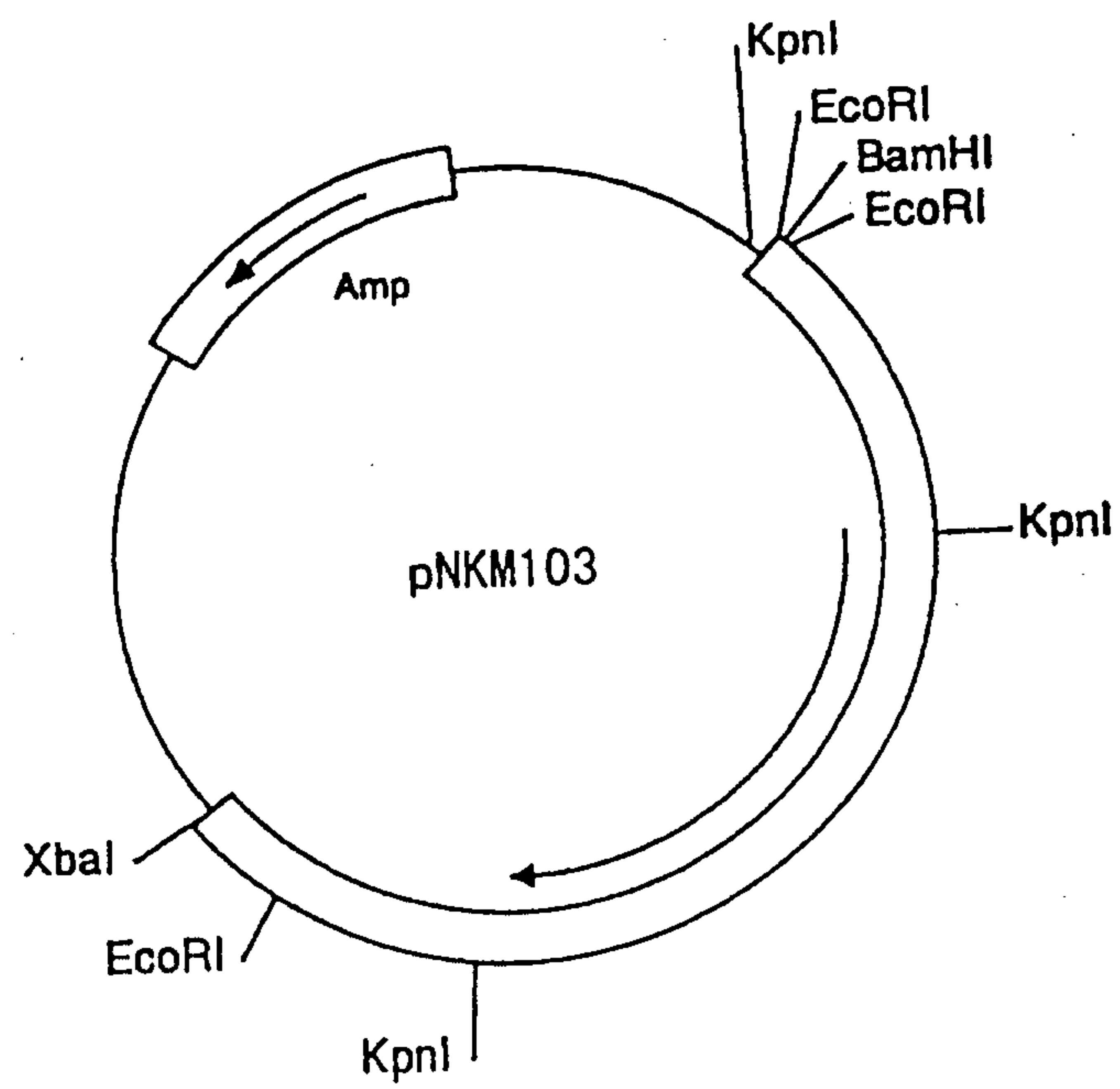


Fig. 11

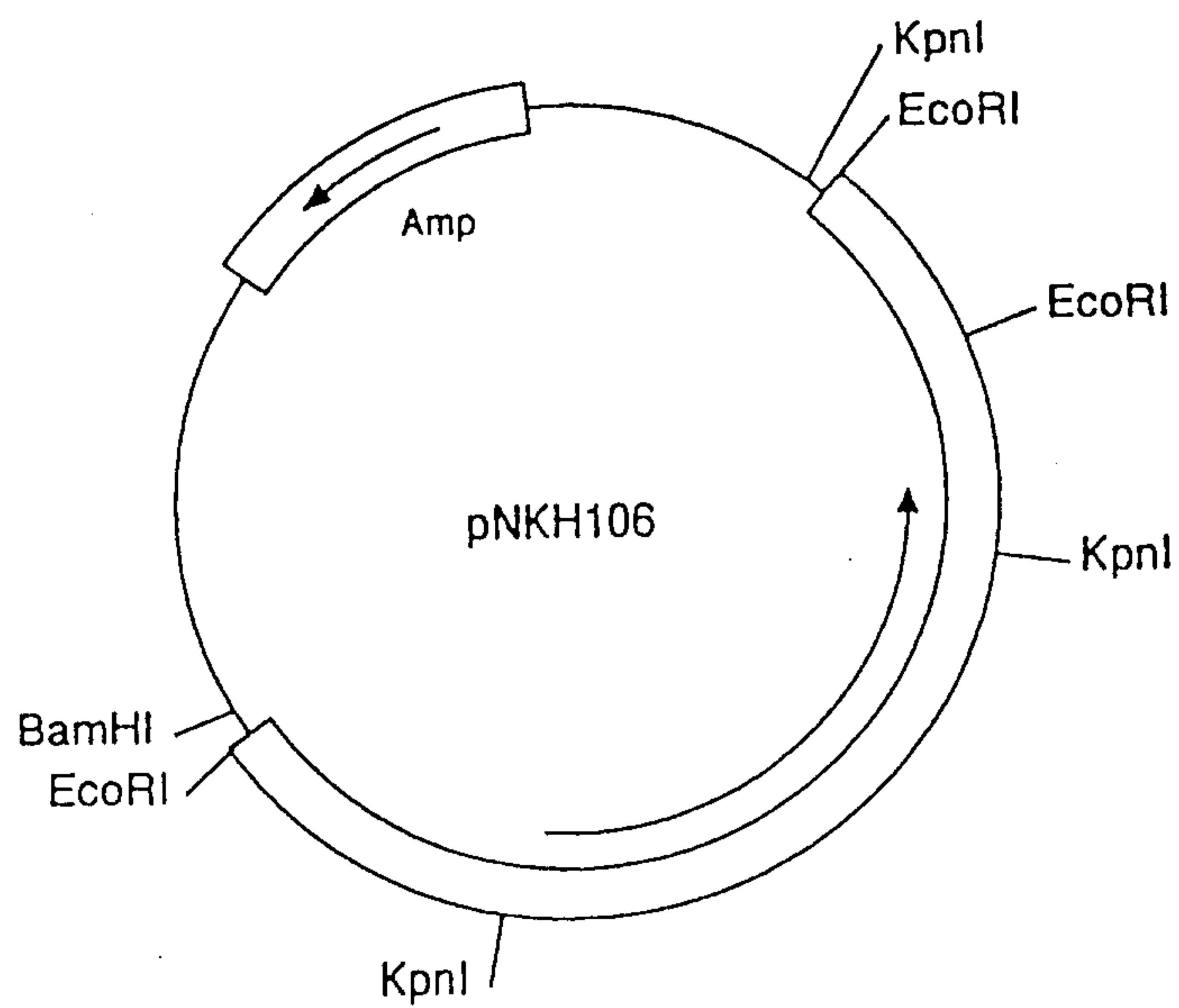


Fig. 12

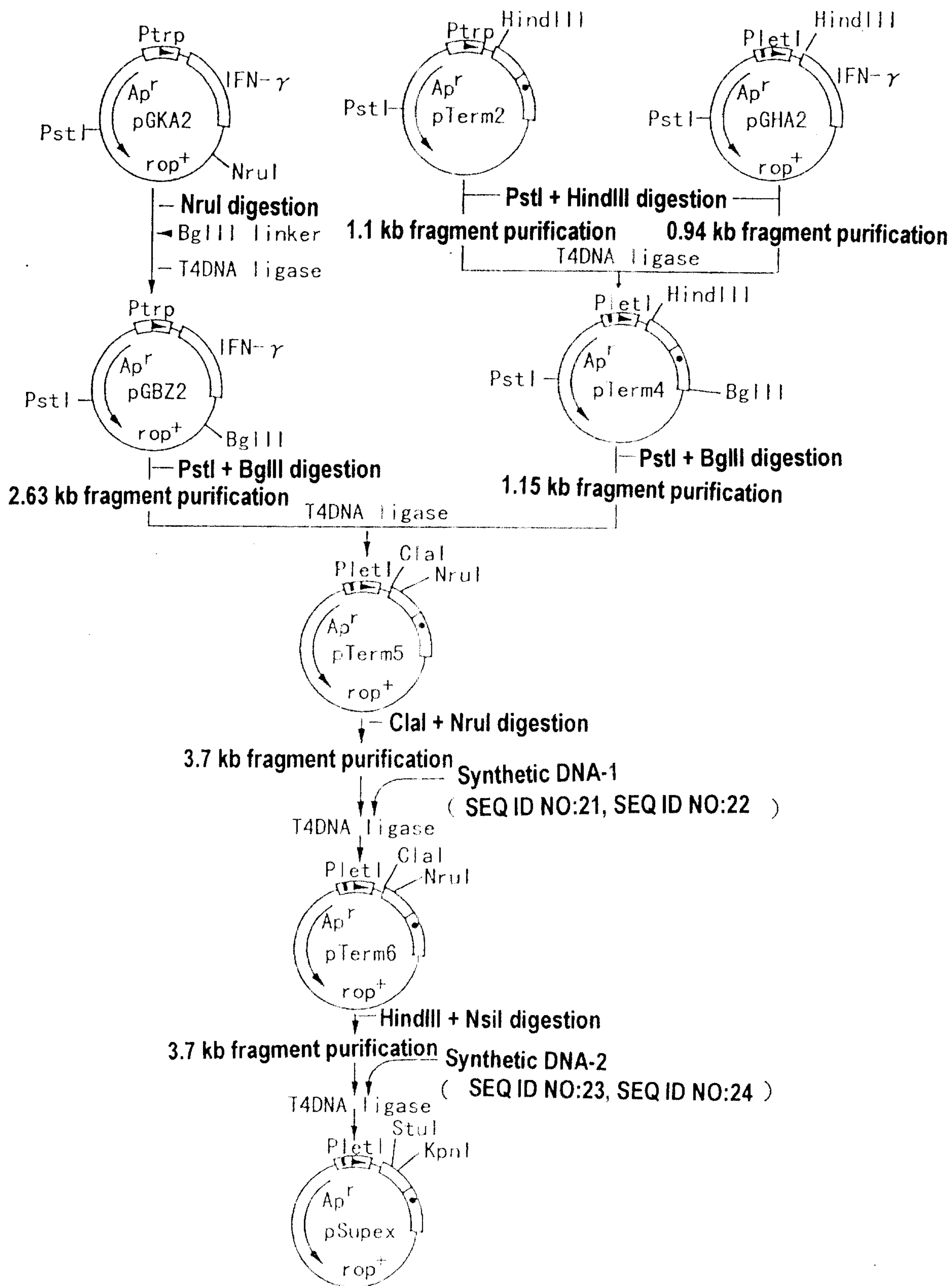


Fig. 13

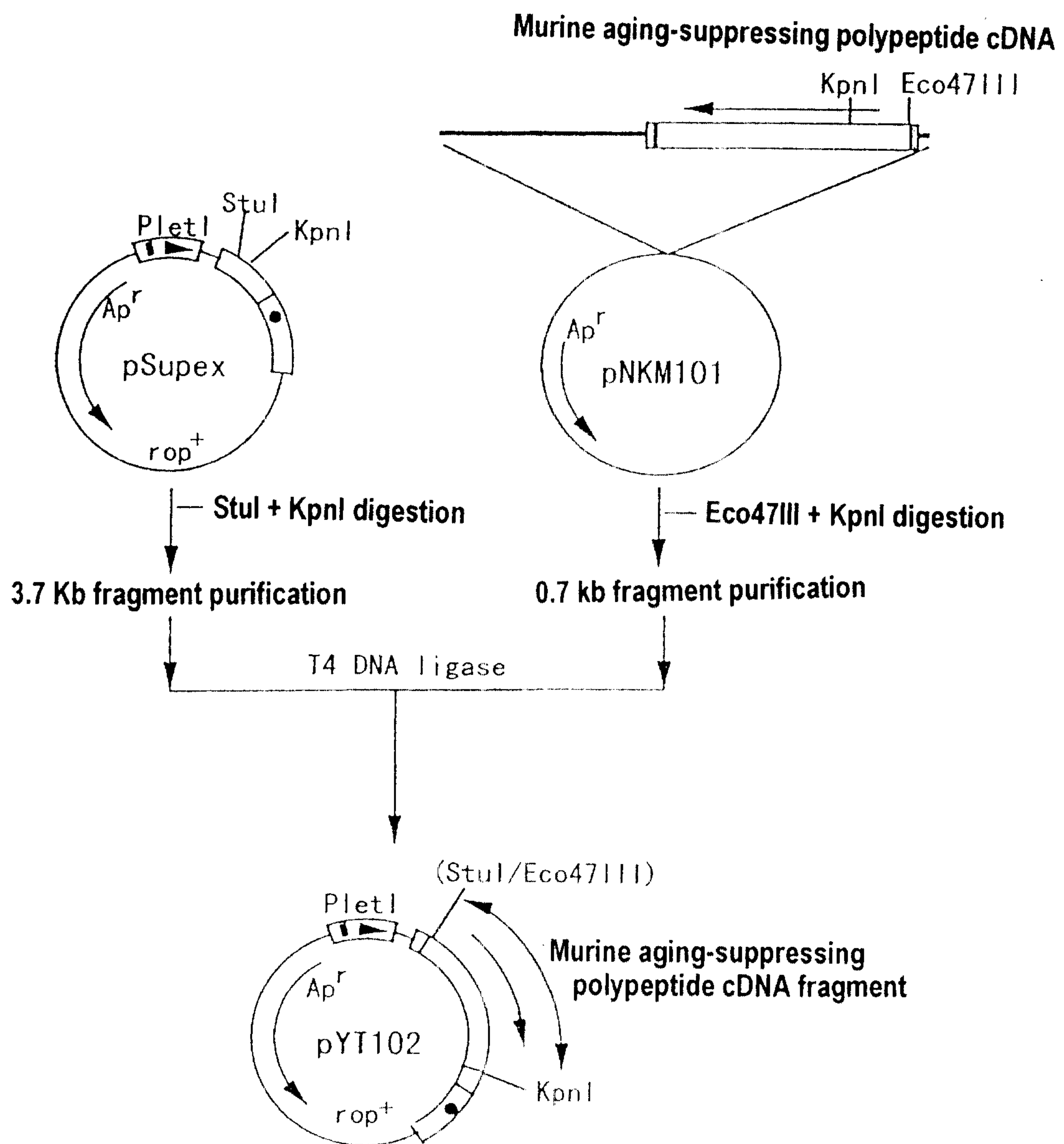


Fig. 14

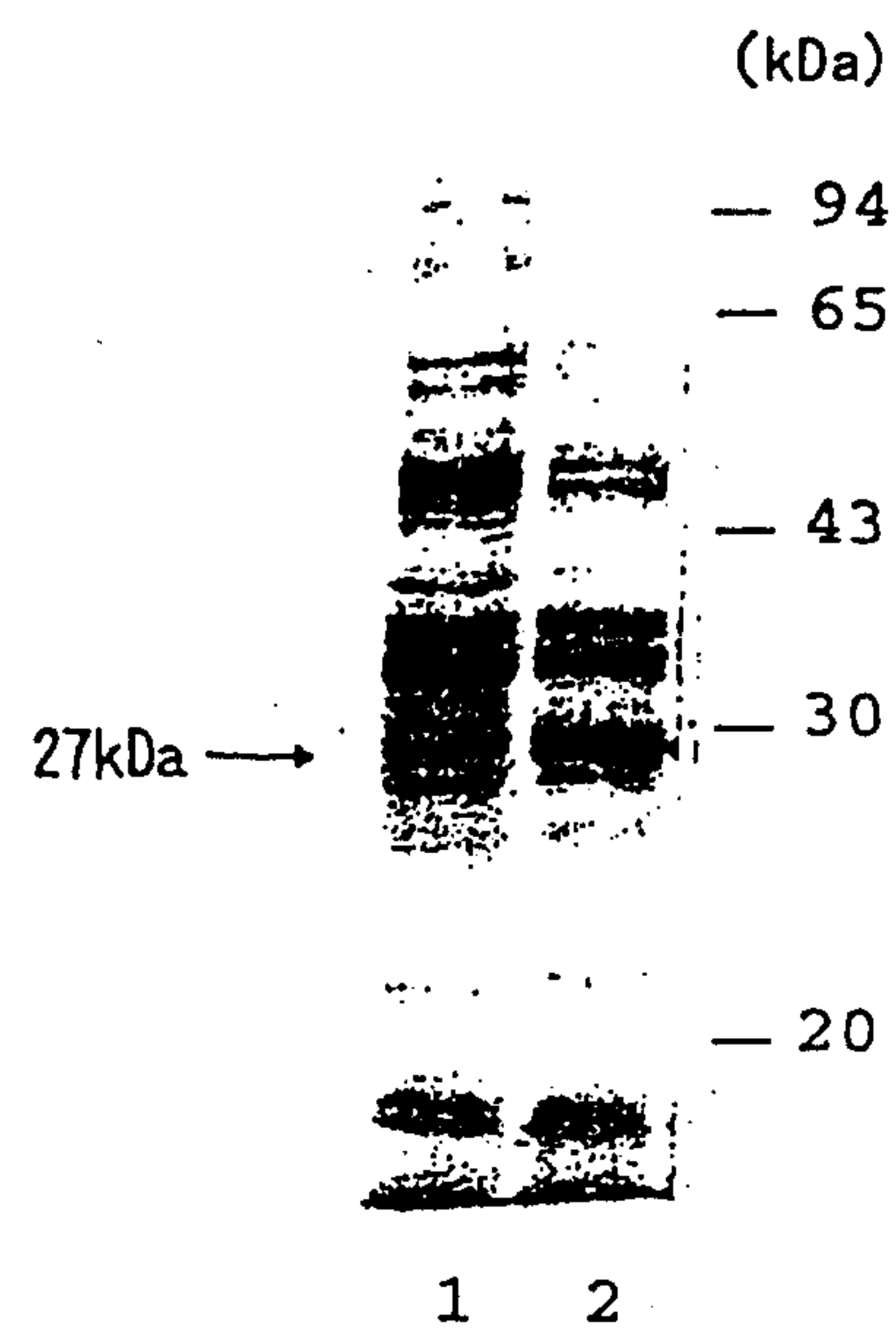


Fig. 15

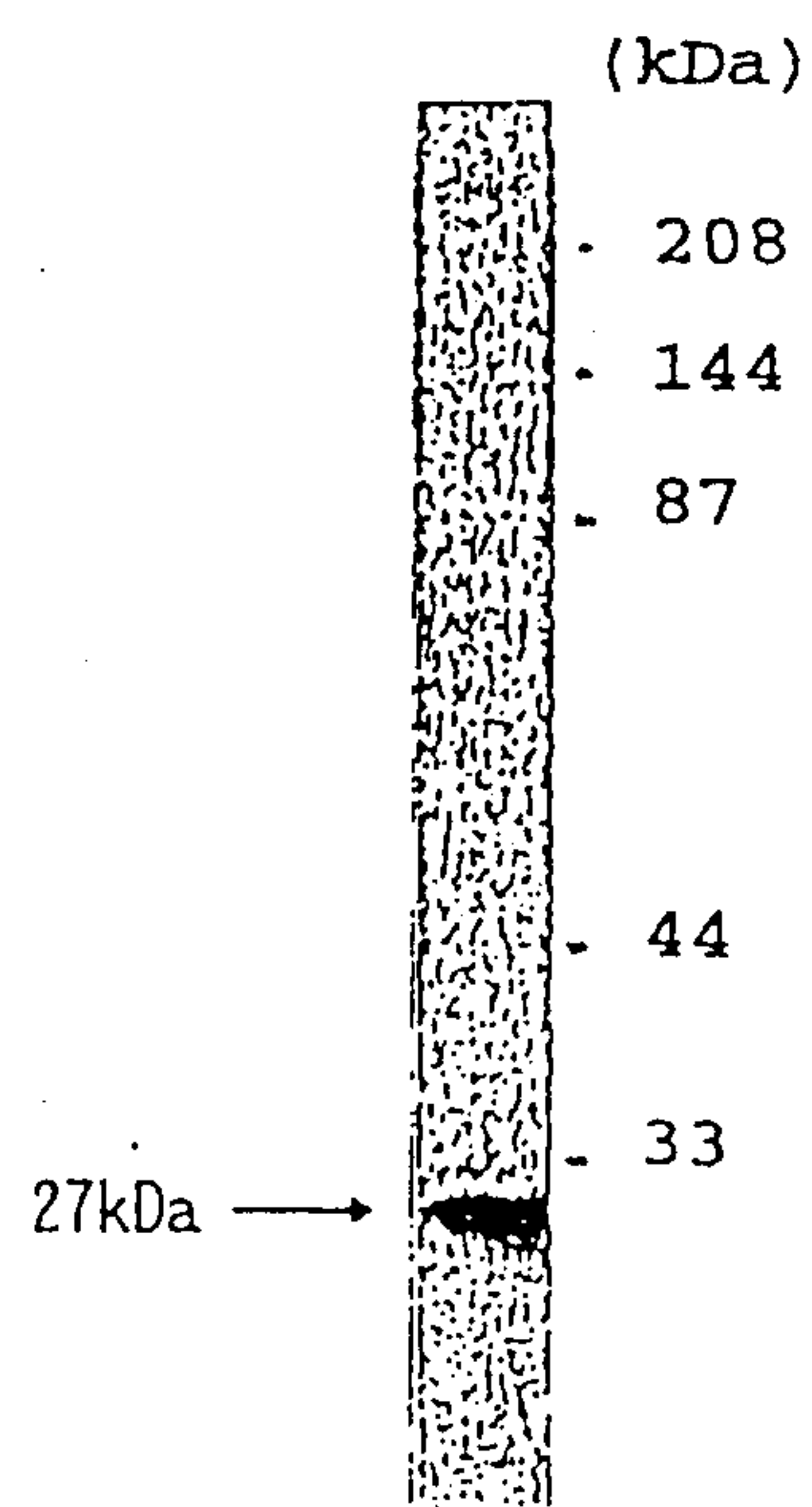


Fig. 16

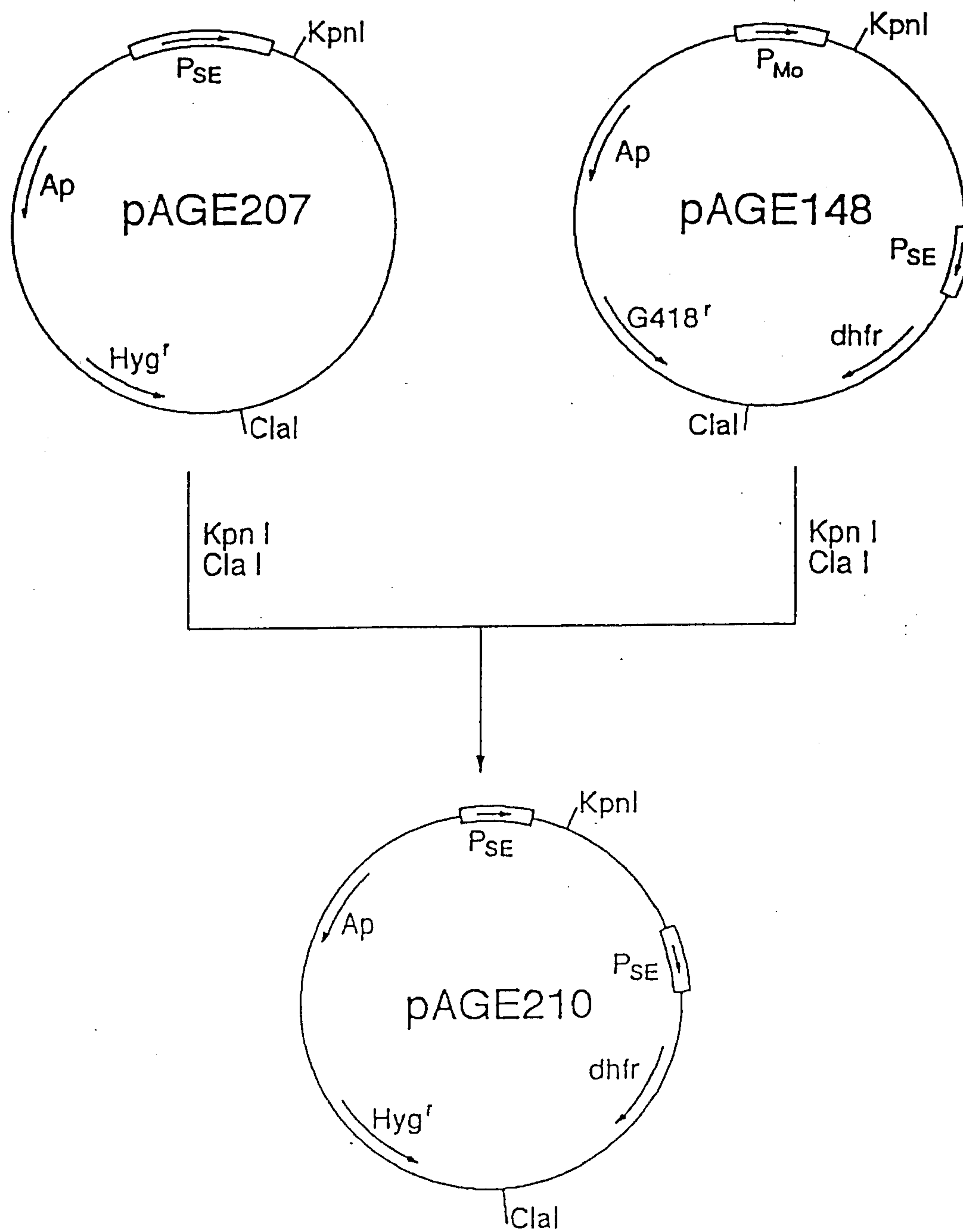


Fig. 17

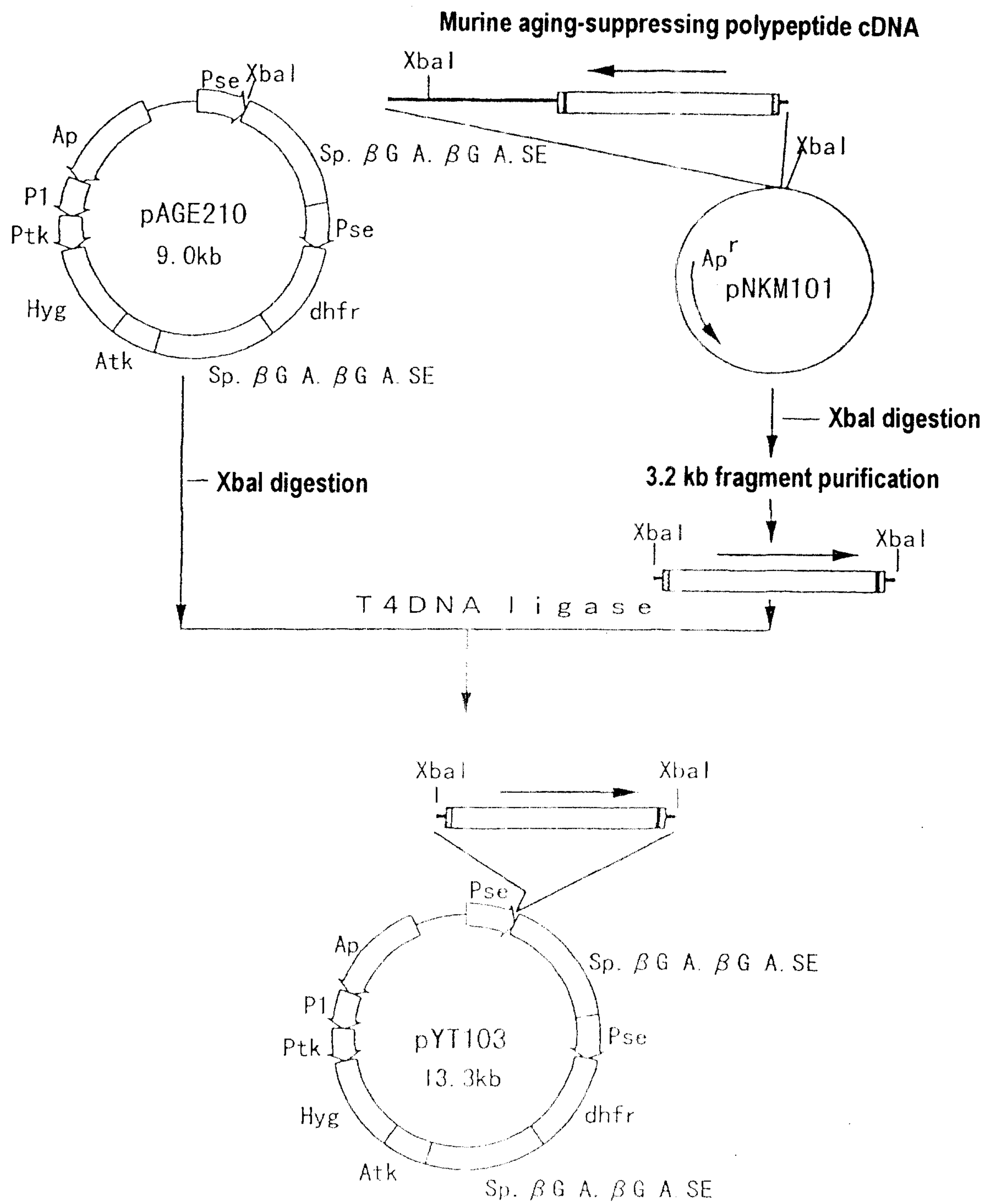


Fig. 18



Fig. 19

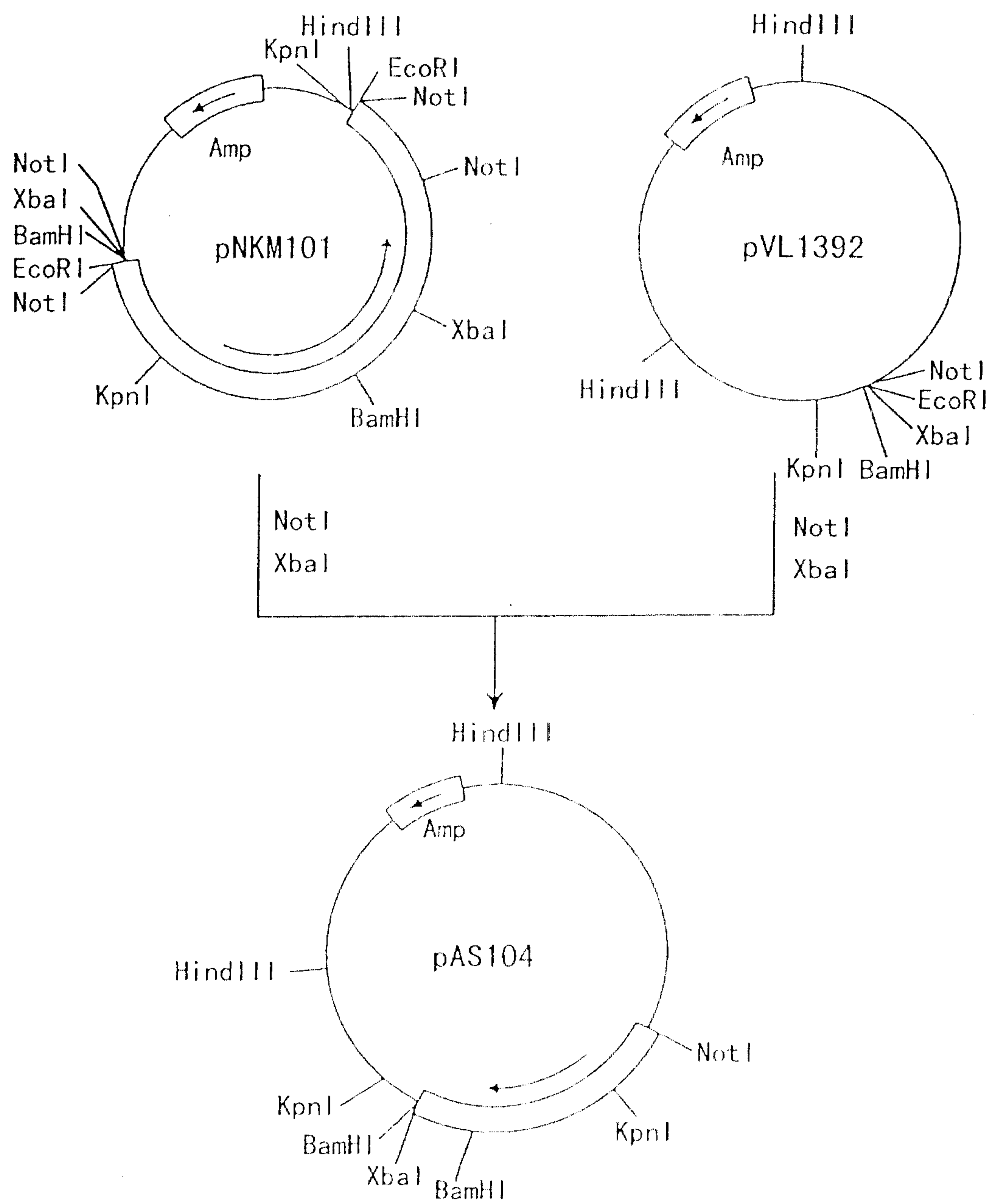


Fig. 20



Fig. 21

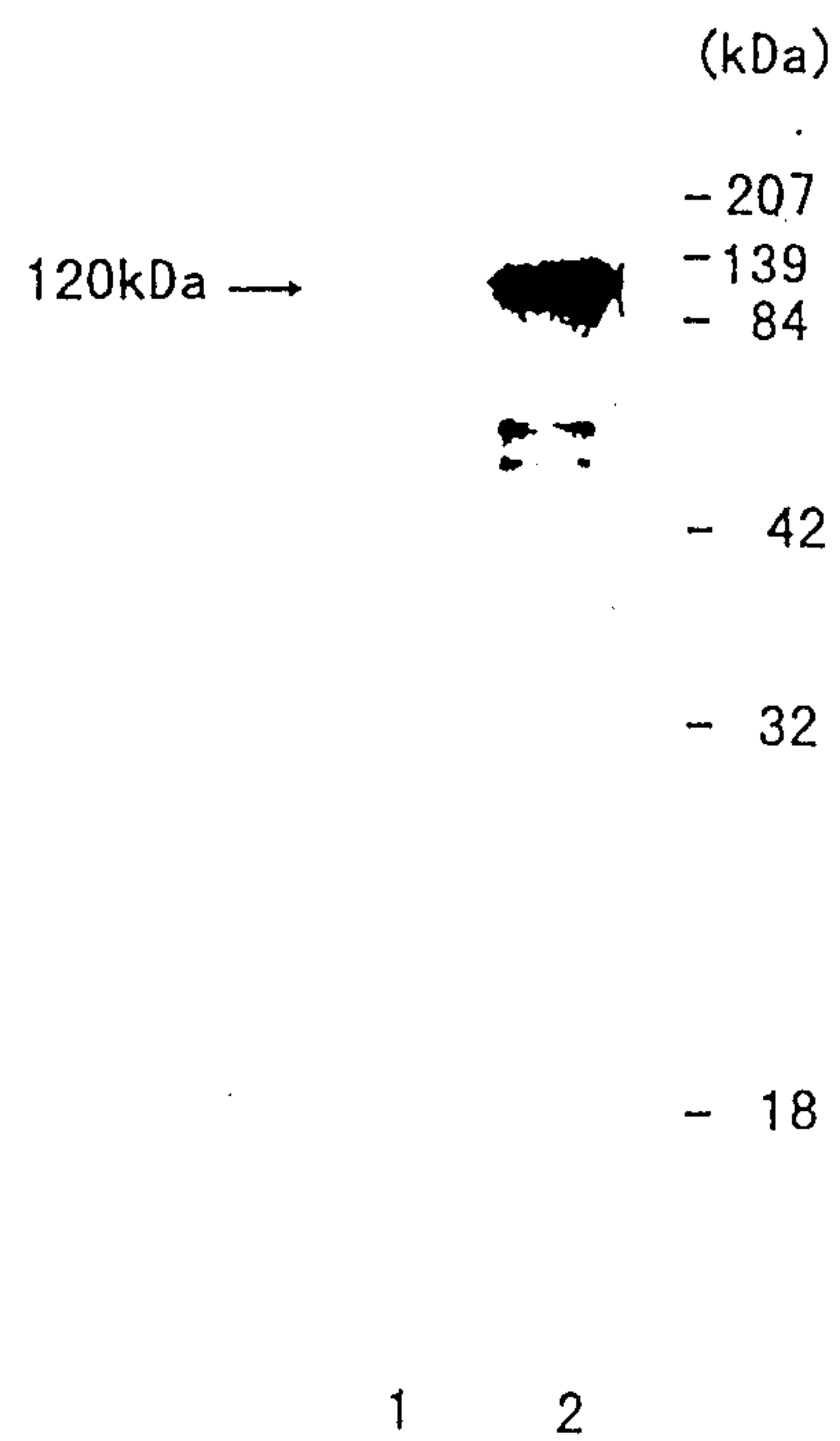


Fig. 22

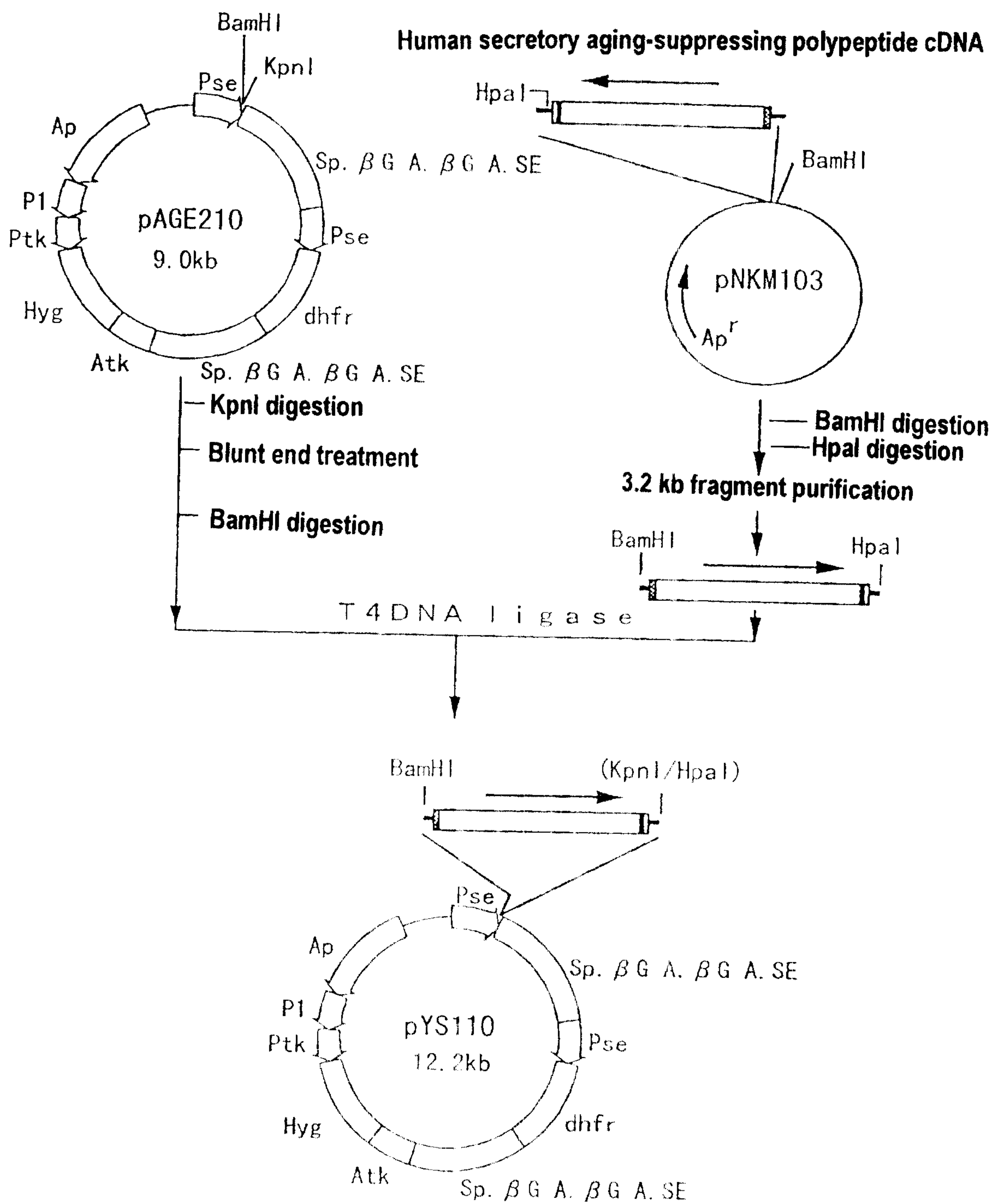


Fig. 23

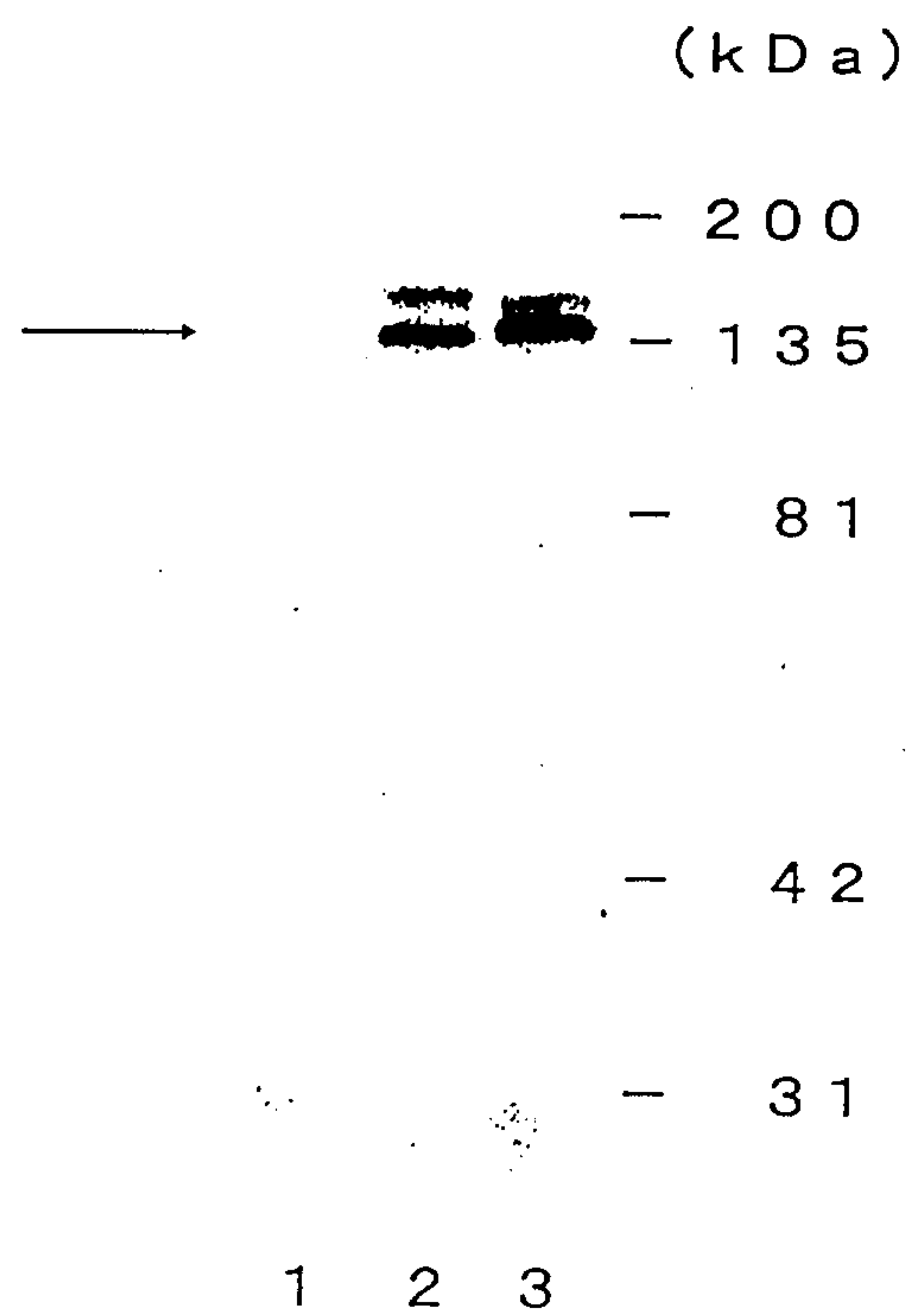


Fig. 24

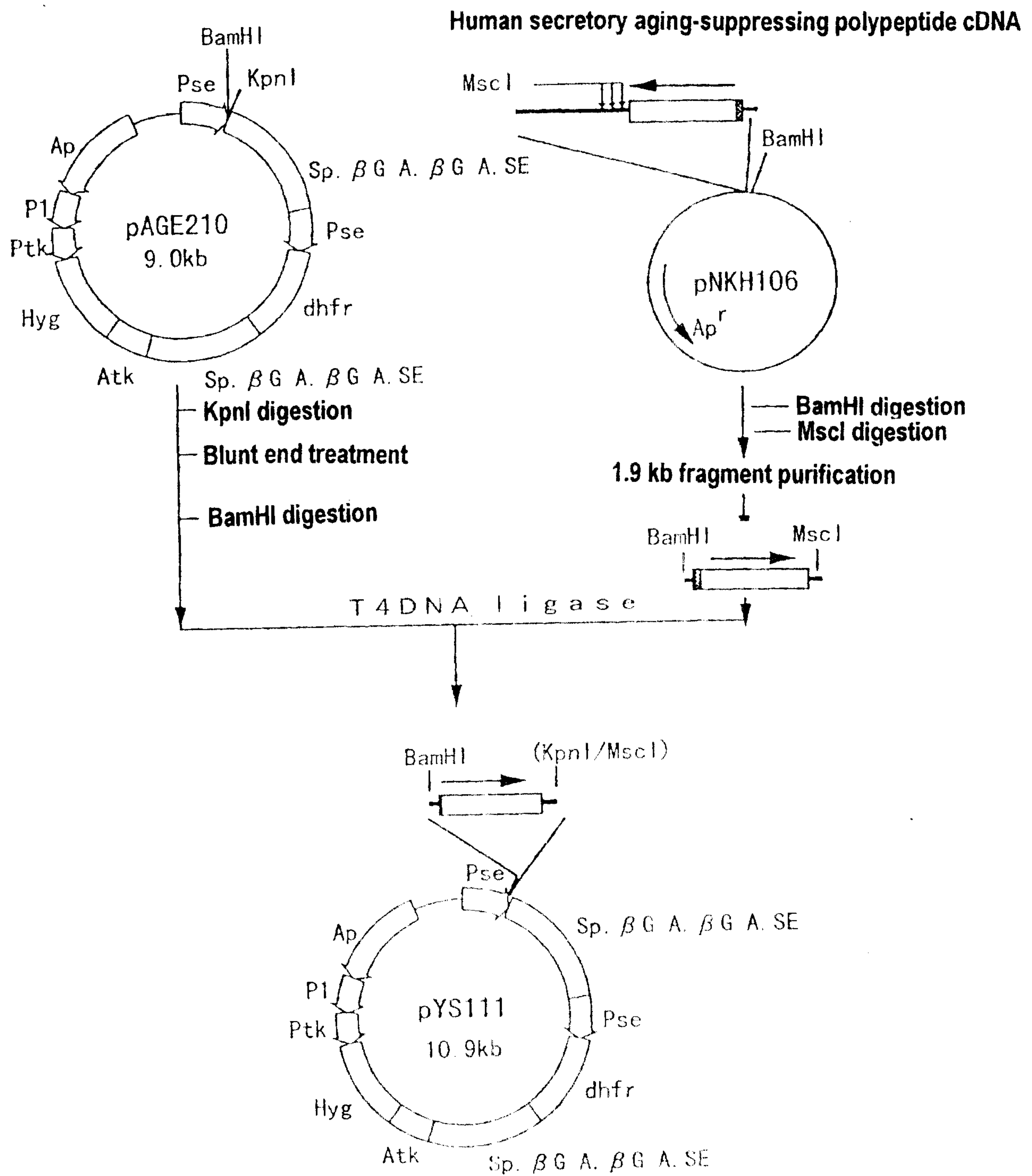


Fig. 25



Fig. 26

Human secretory aging-suppressing polypeptide cDNA

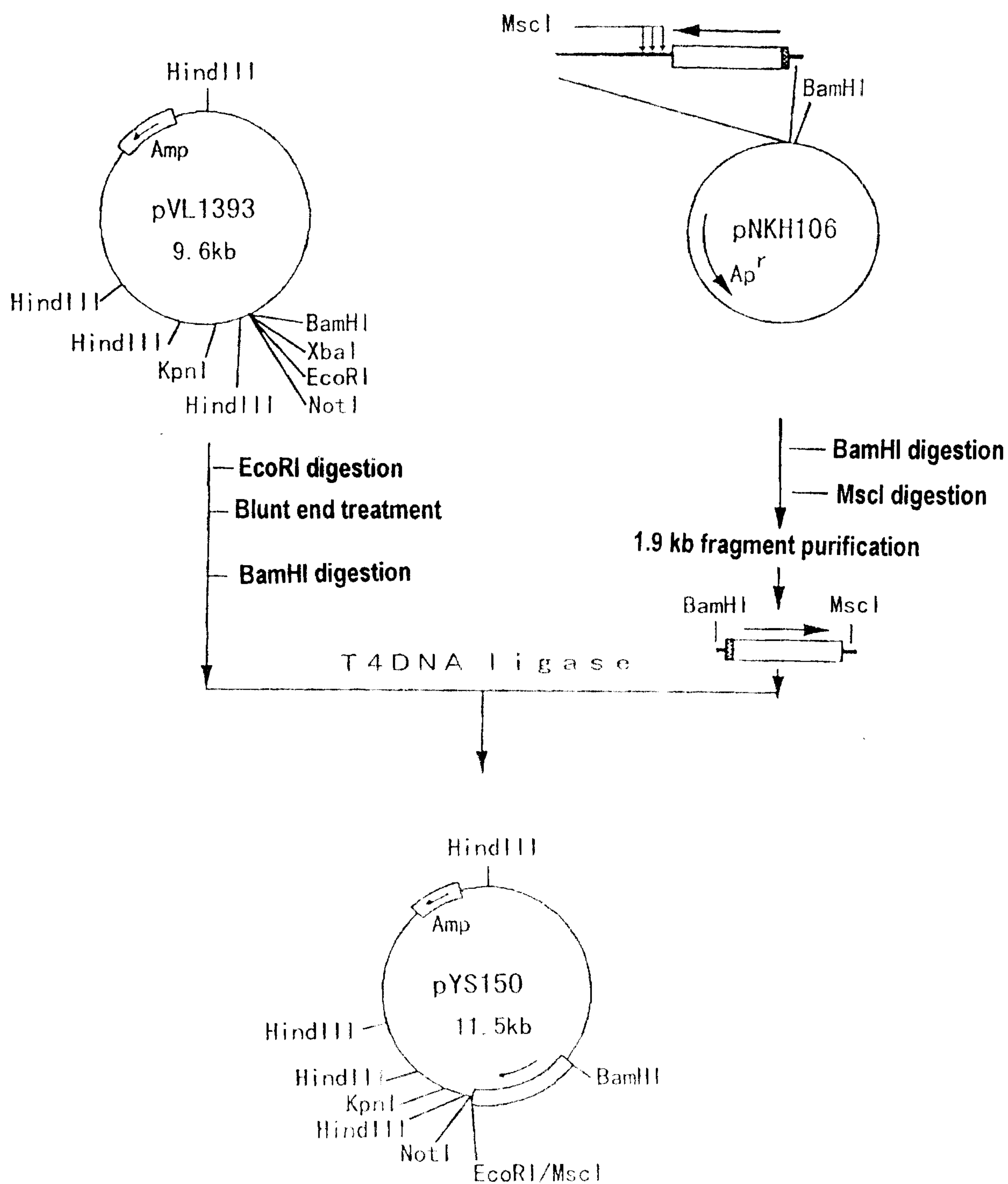


Fig. 27

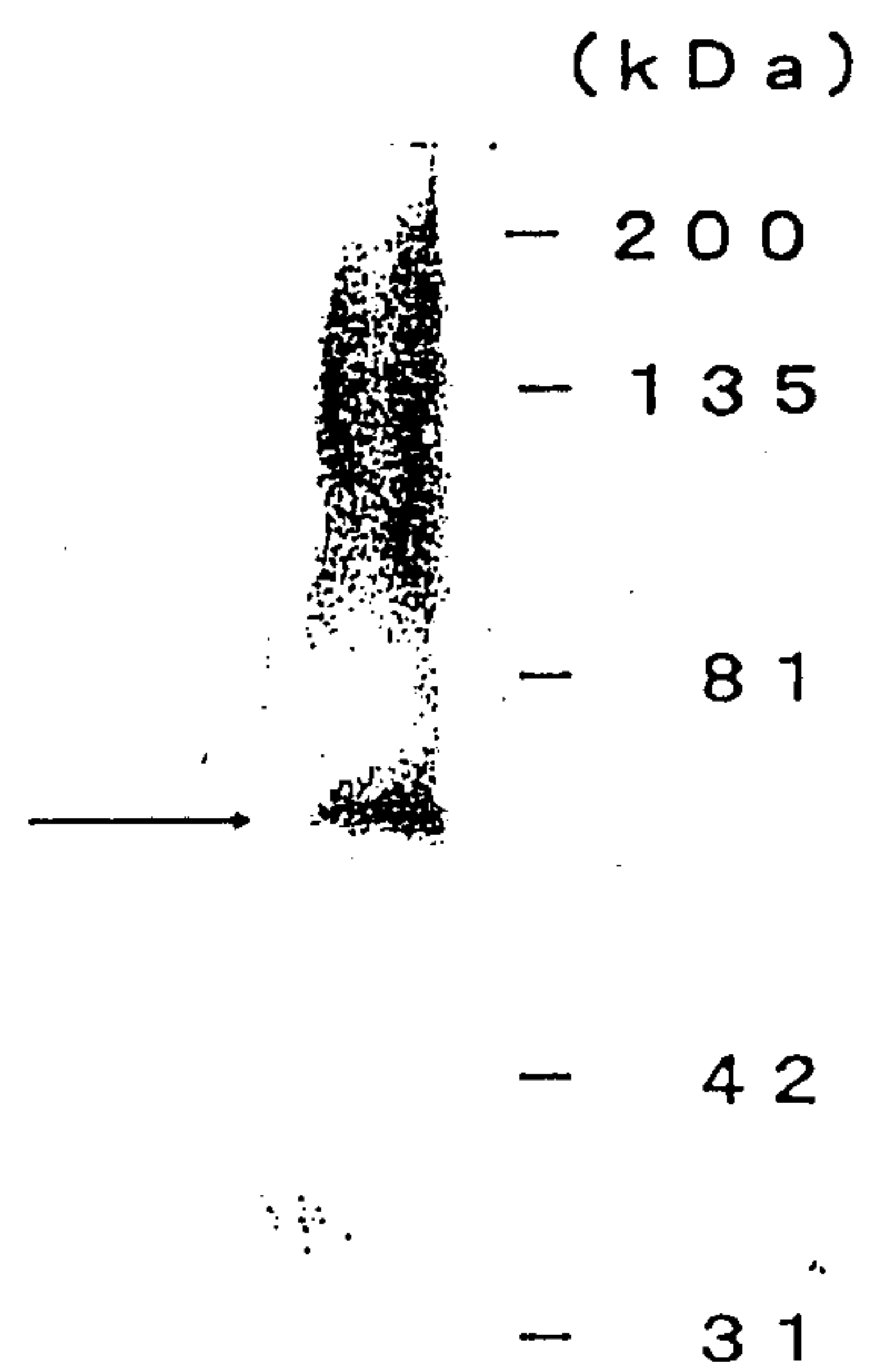


Fig. 28

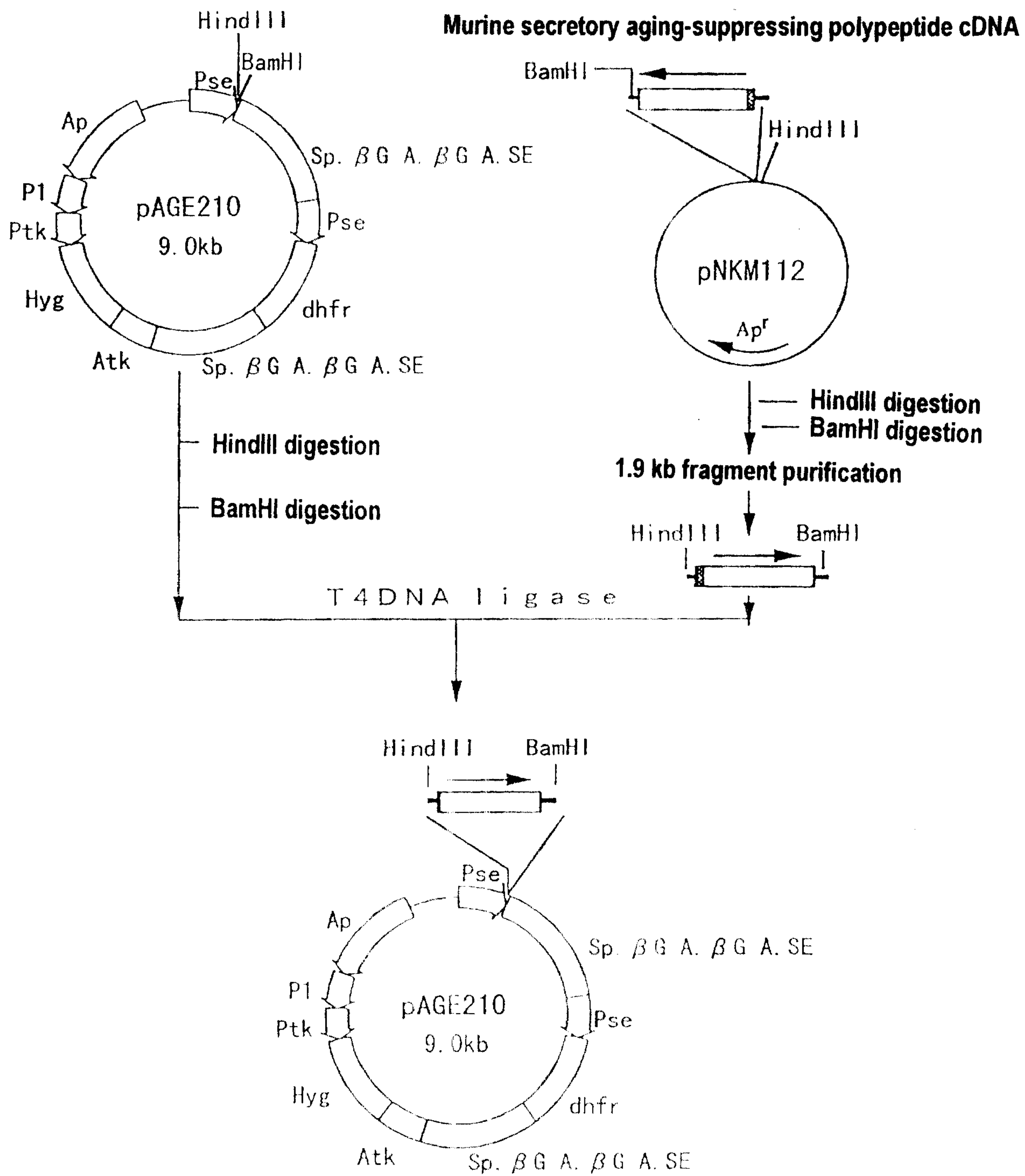


Fig. 29



Fig. 30

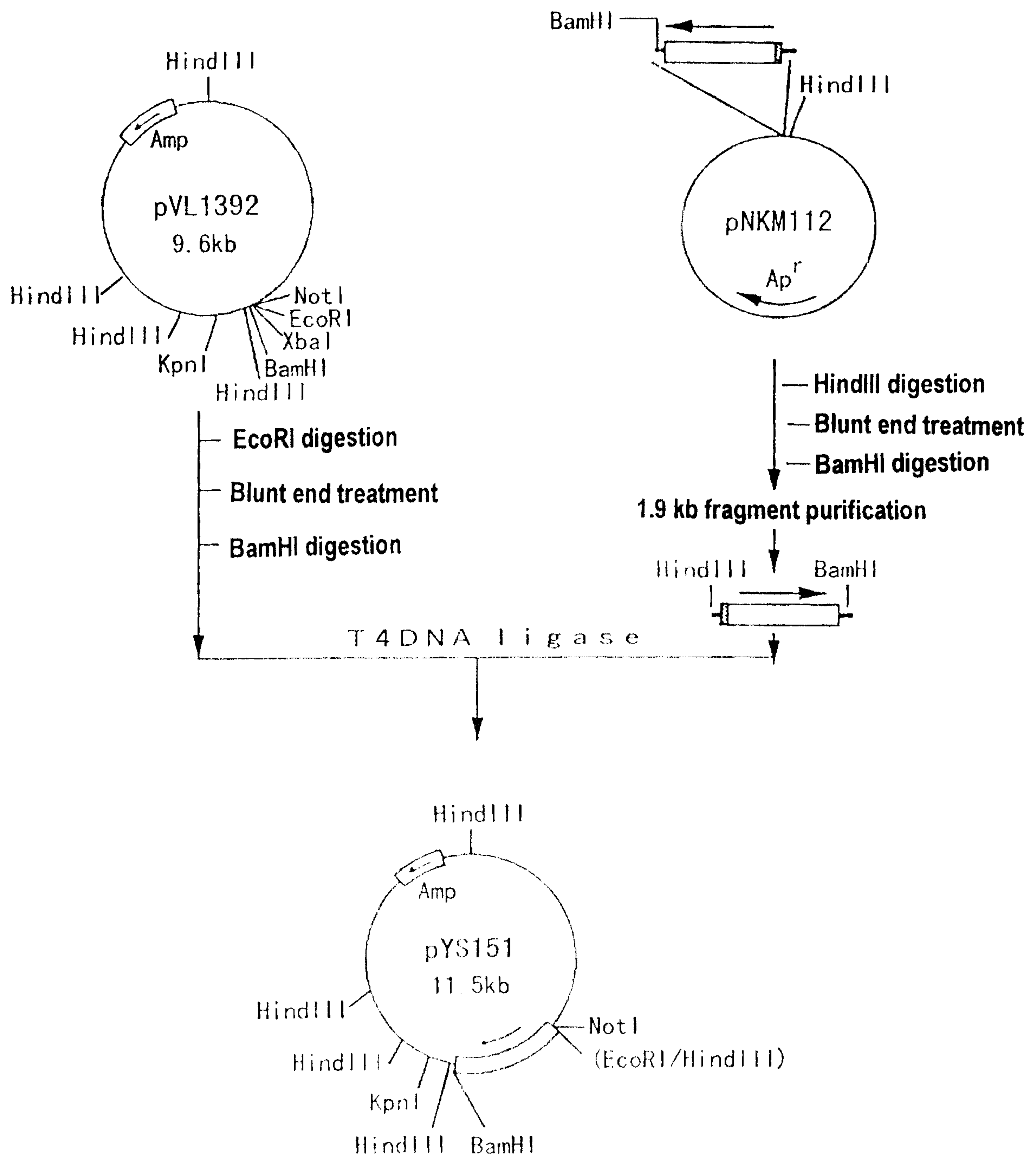
Murine secretory aging-suppressing polypeptide cDNA

Fig. 31

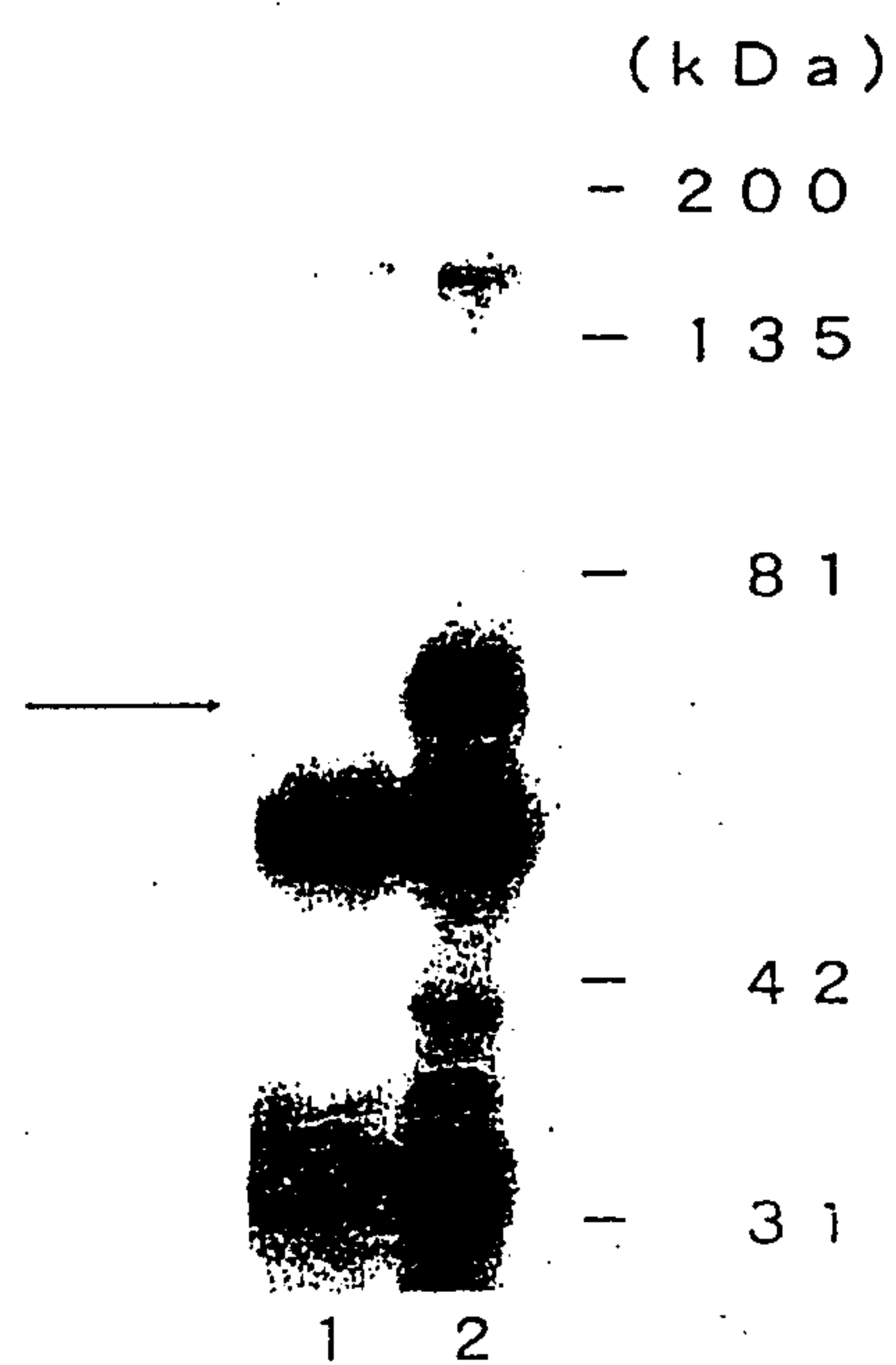


Fig. 32

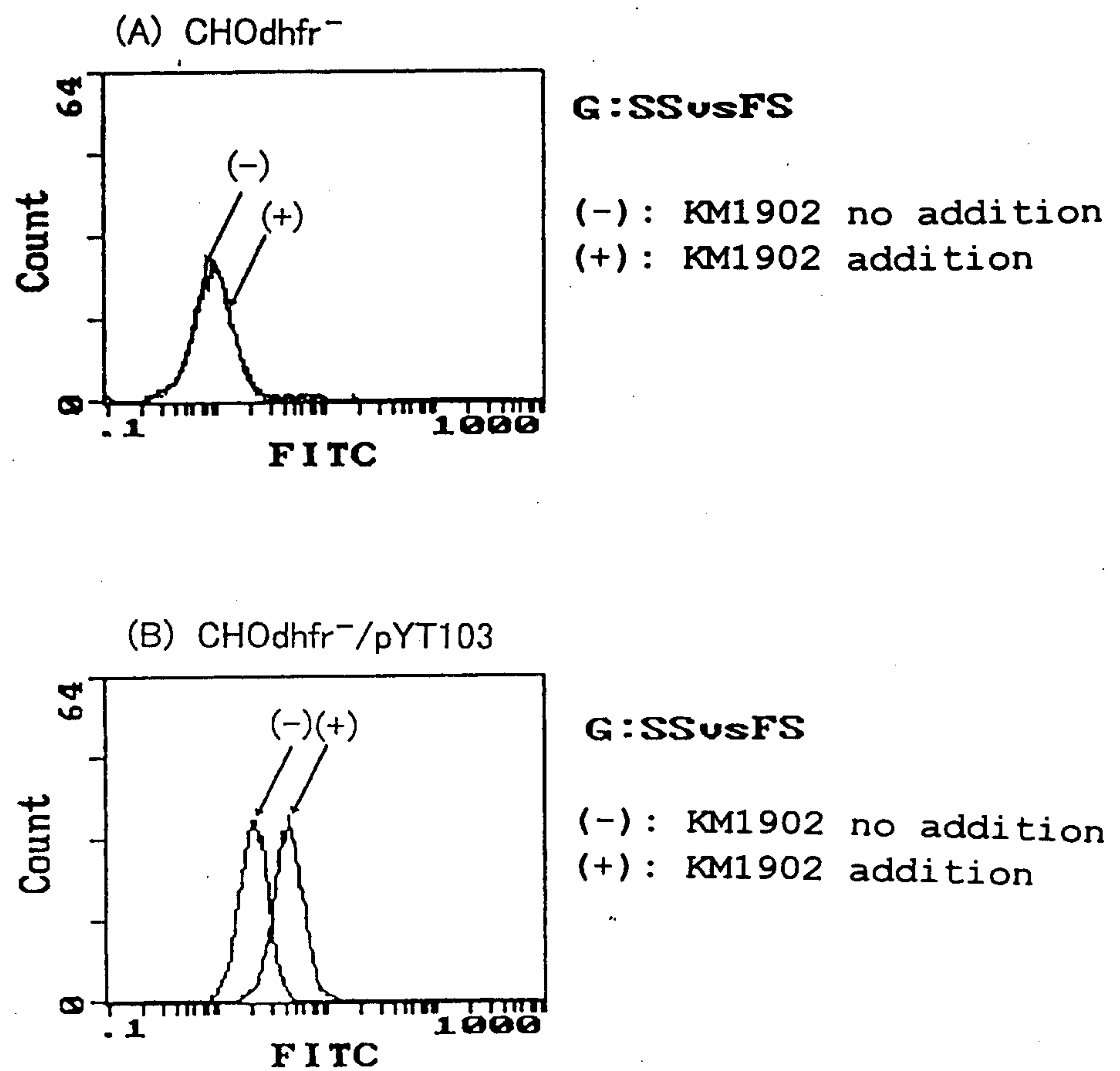


Fig. 33

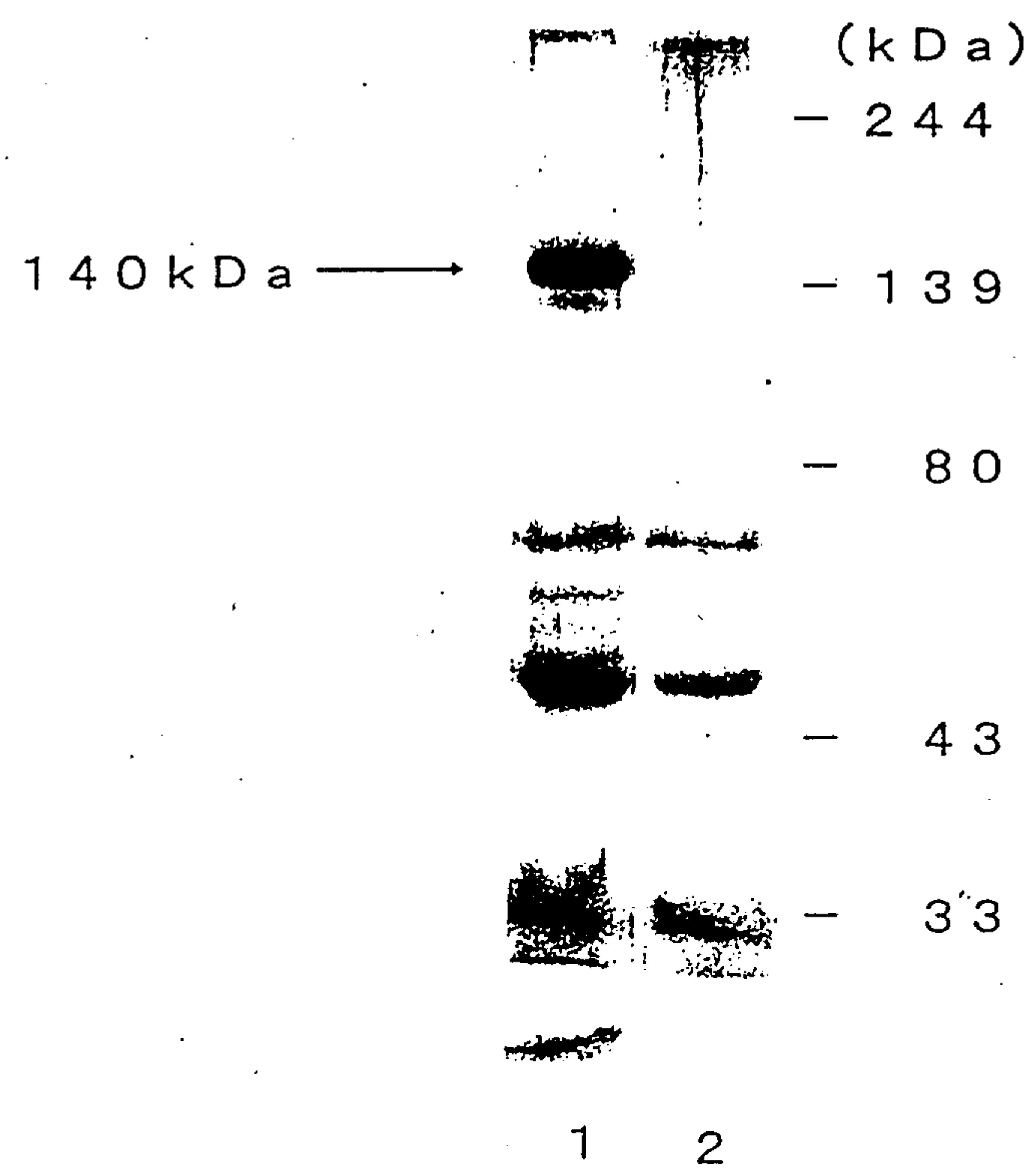


Fig. 34

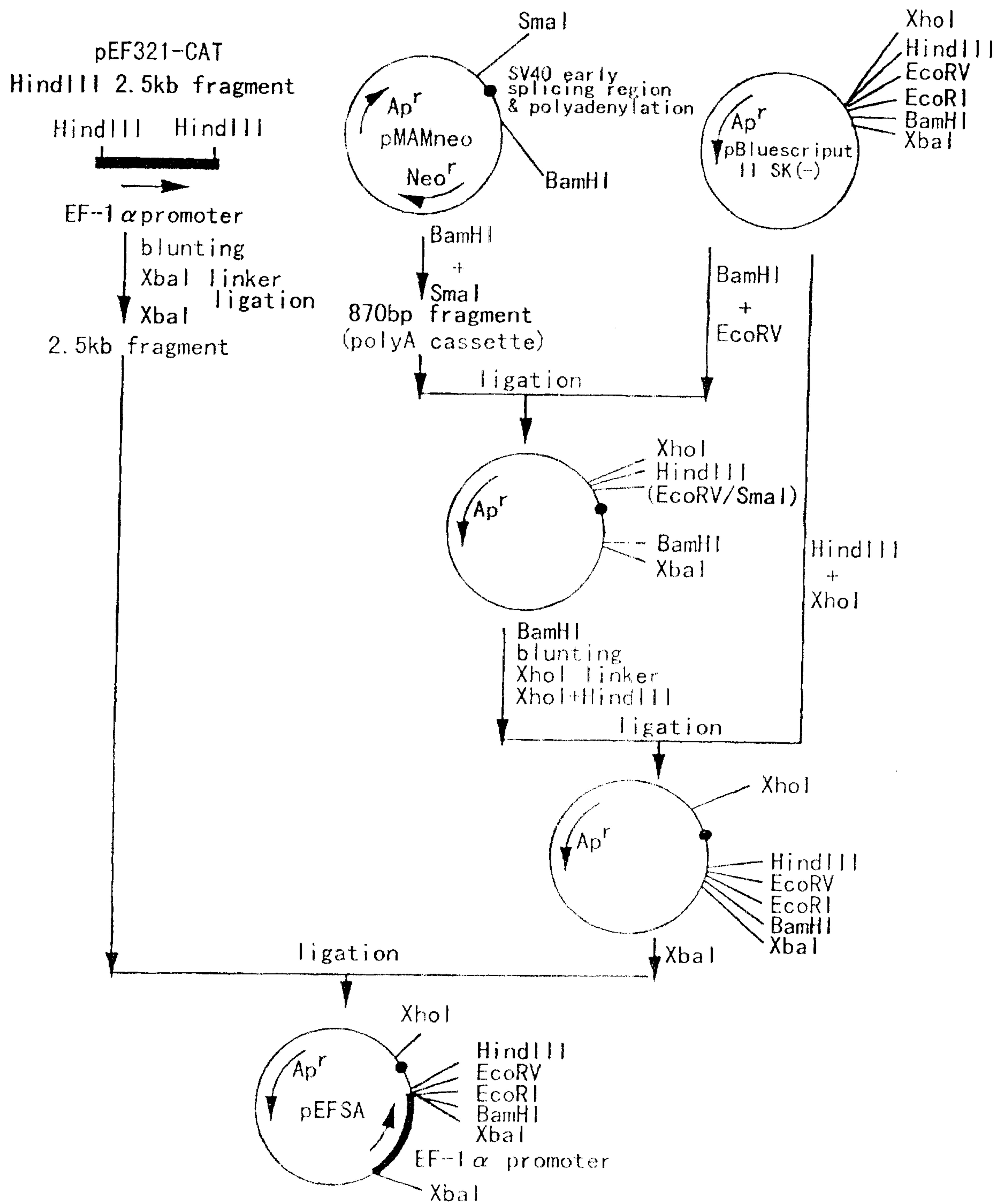


Fig. 35

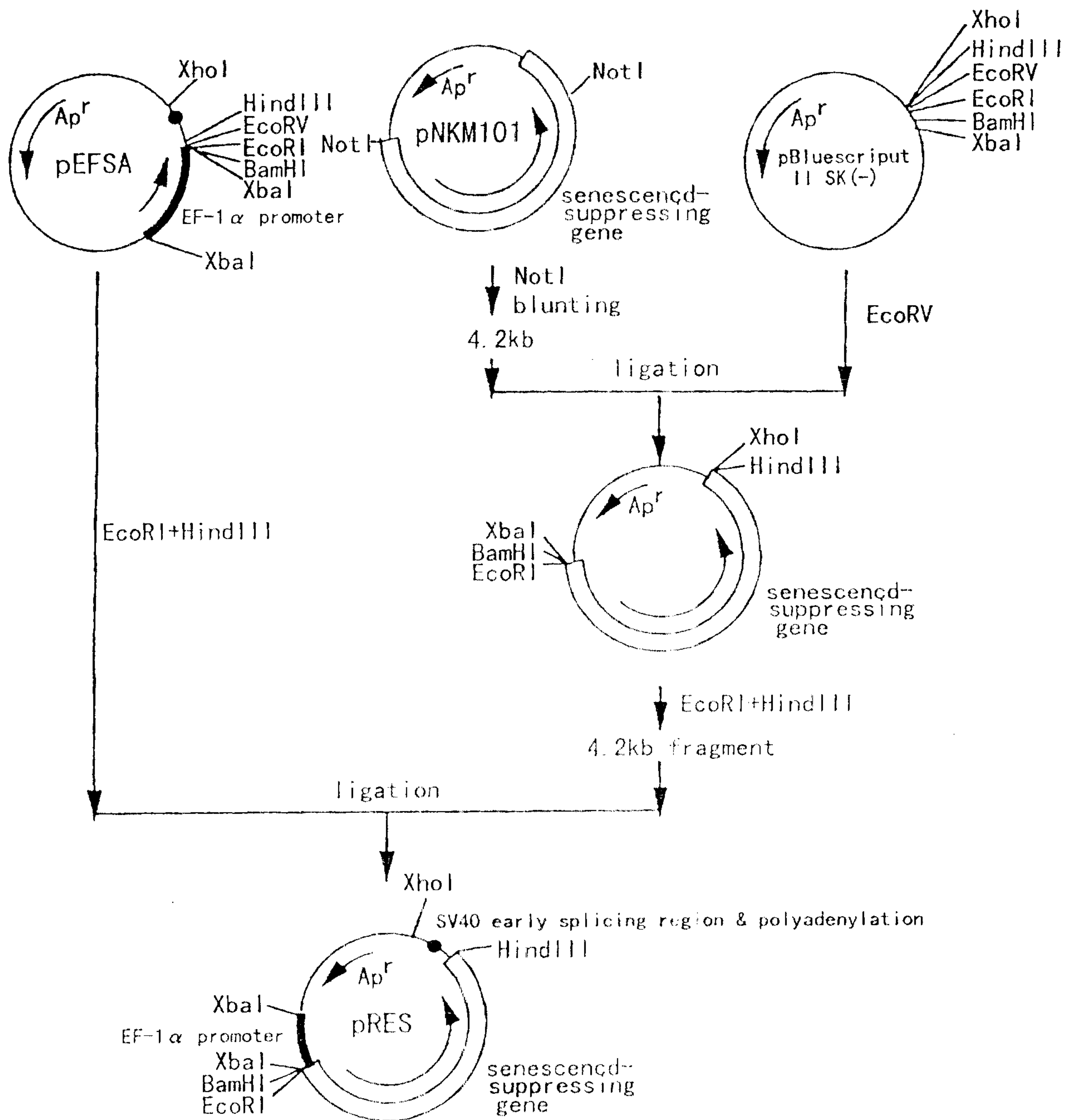
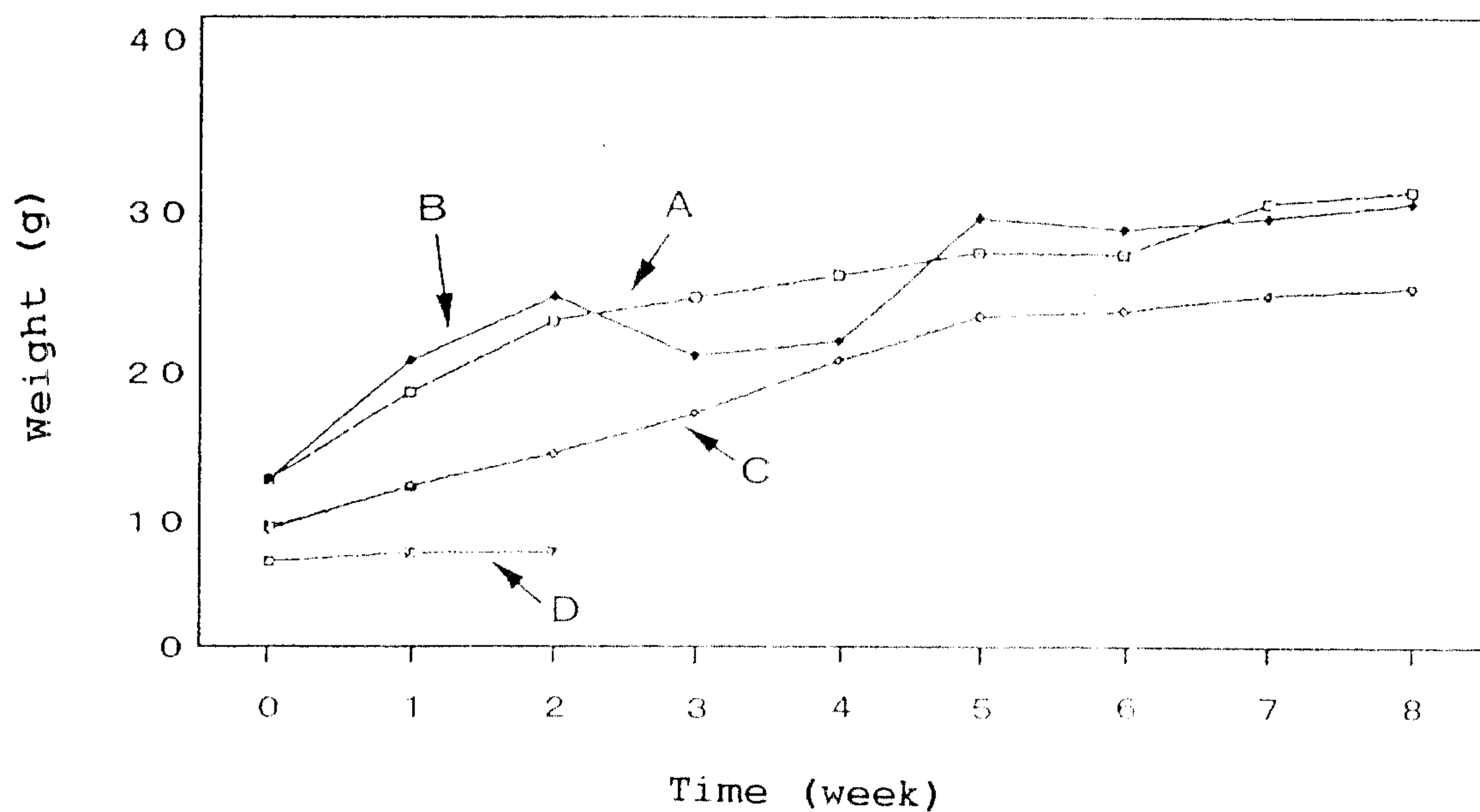


Fig. 36



- A: wild-type mouse - no administration
 B: wild-type mouse - administration of virus
 C: homozygote mouse showing a syndrome resembling premature aging - administration of virus
 D: homozygote mouse showing a syndrome resembling premature aging - no administration

Fig. 37

Human aging-suppressing polypeptide cDNA

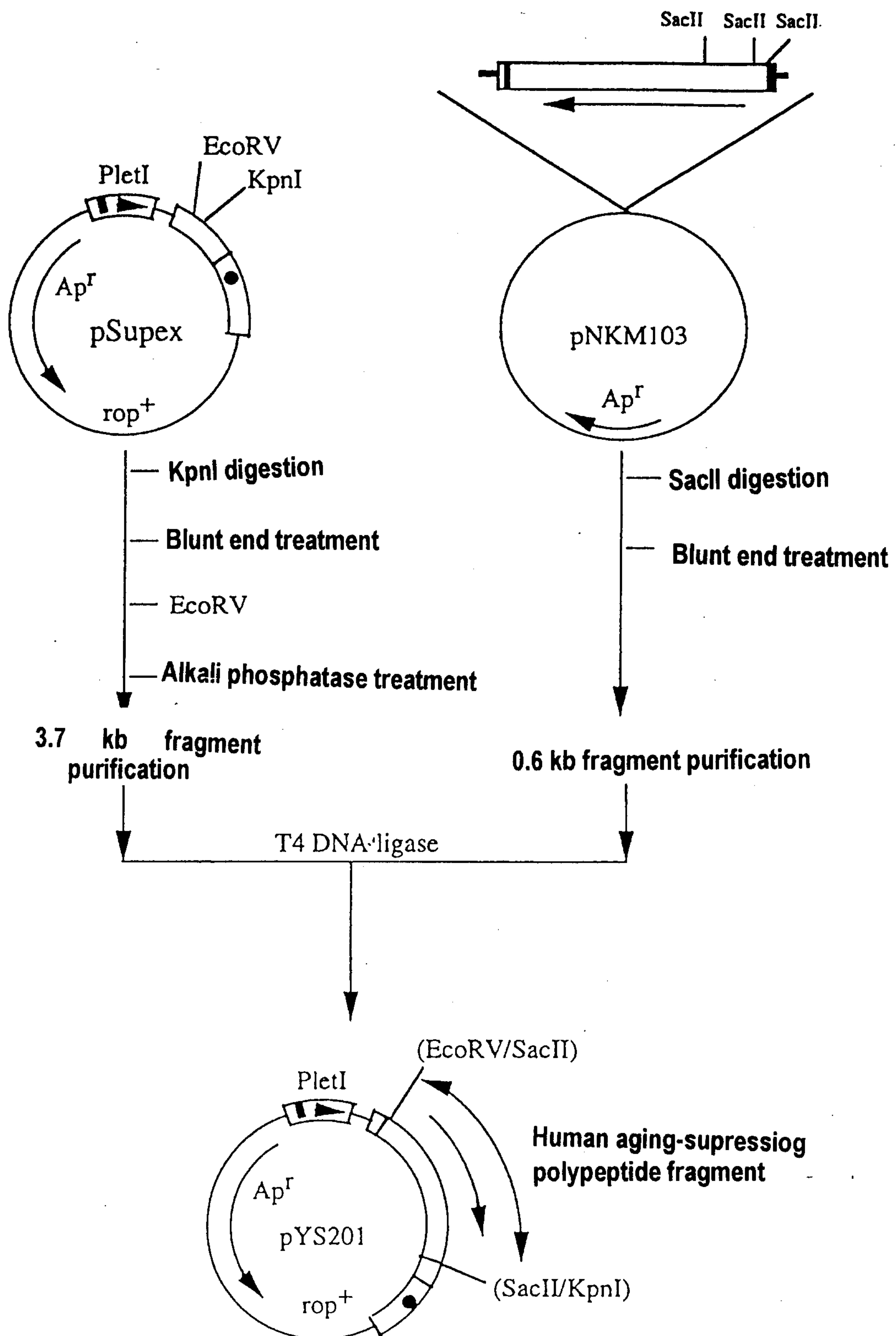


Fig. 38

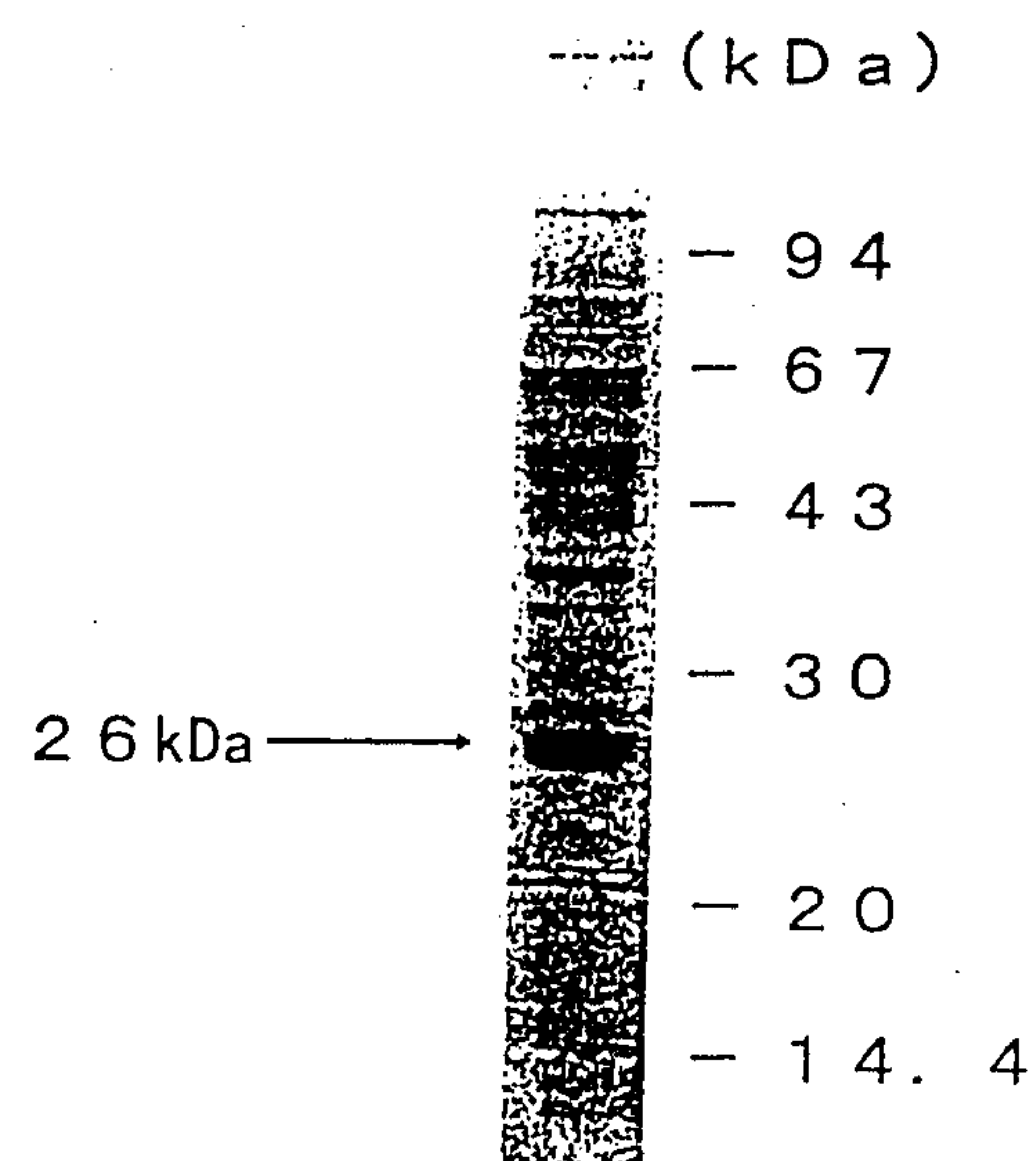


Fig. 39

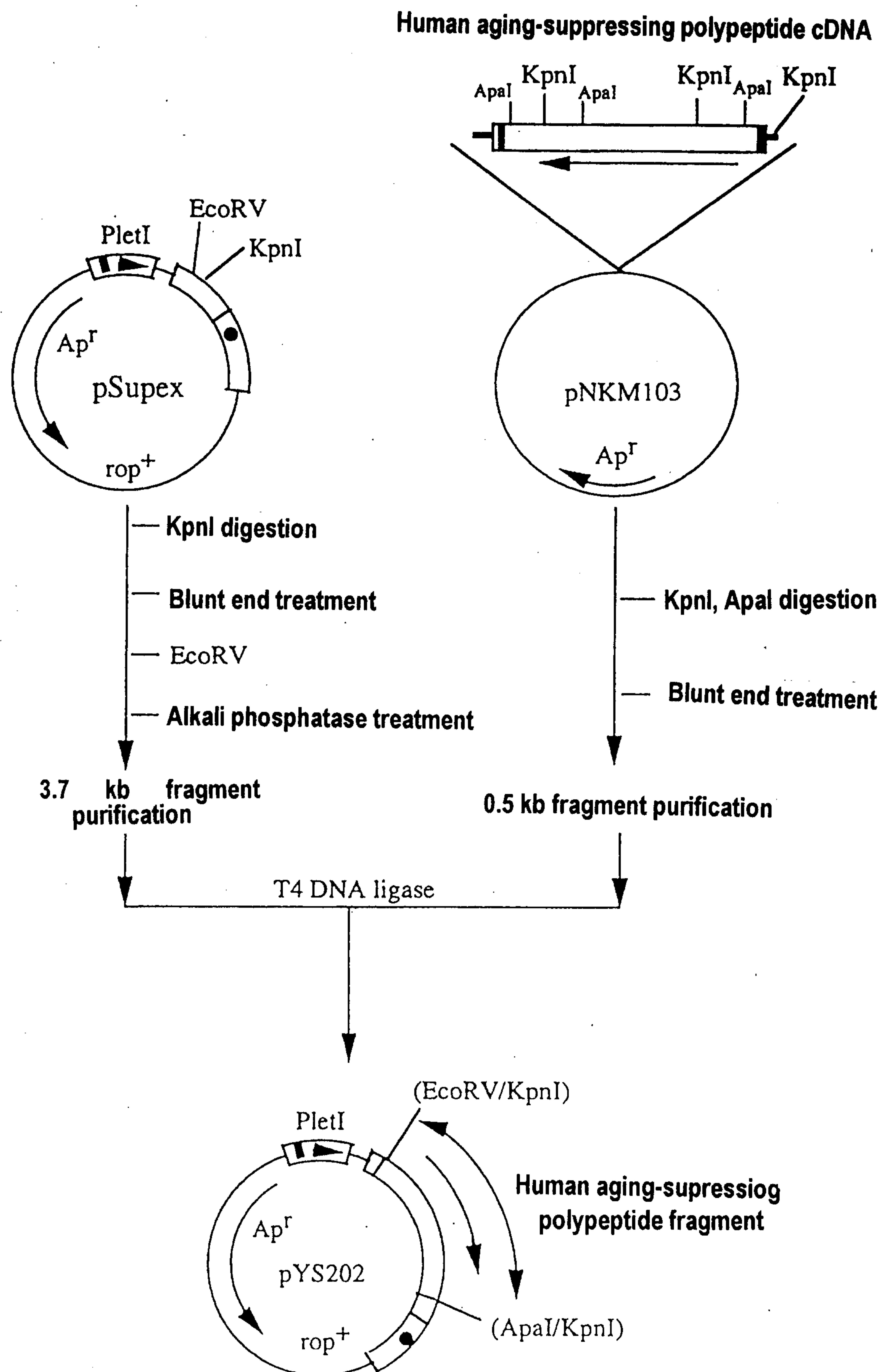


Fig. 40

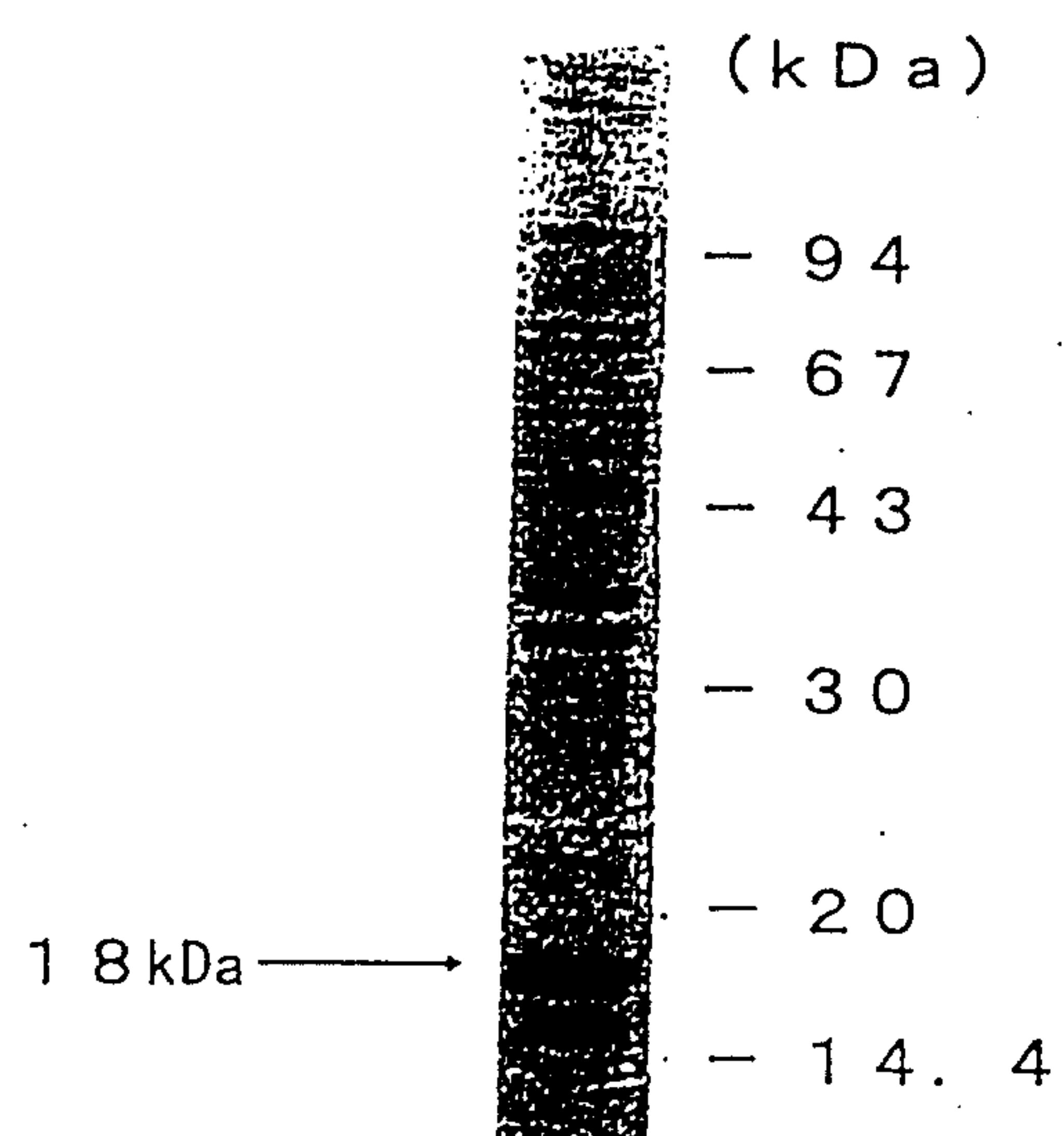


Fig. 41

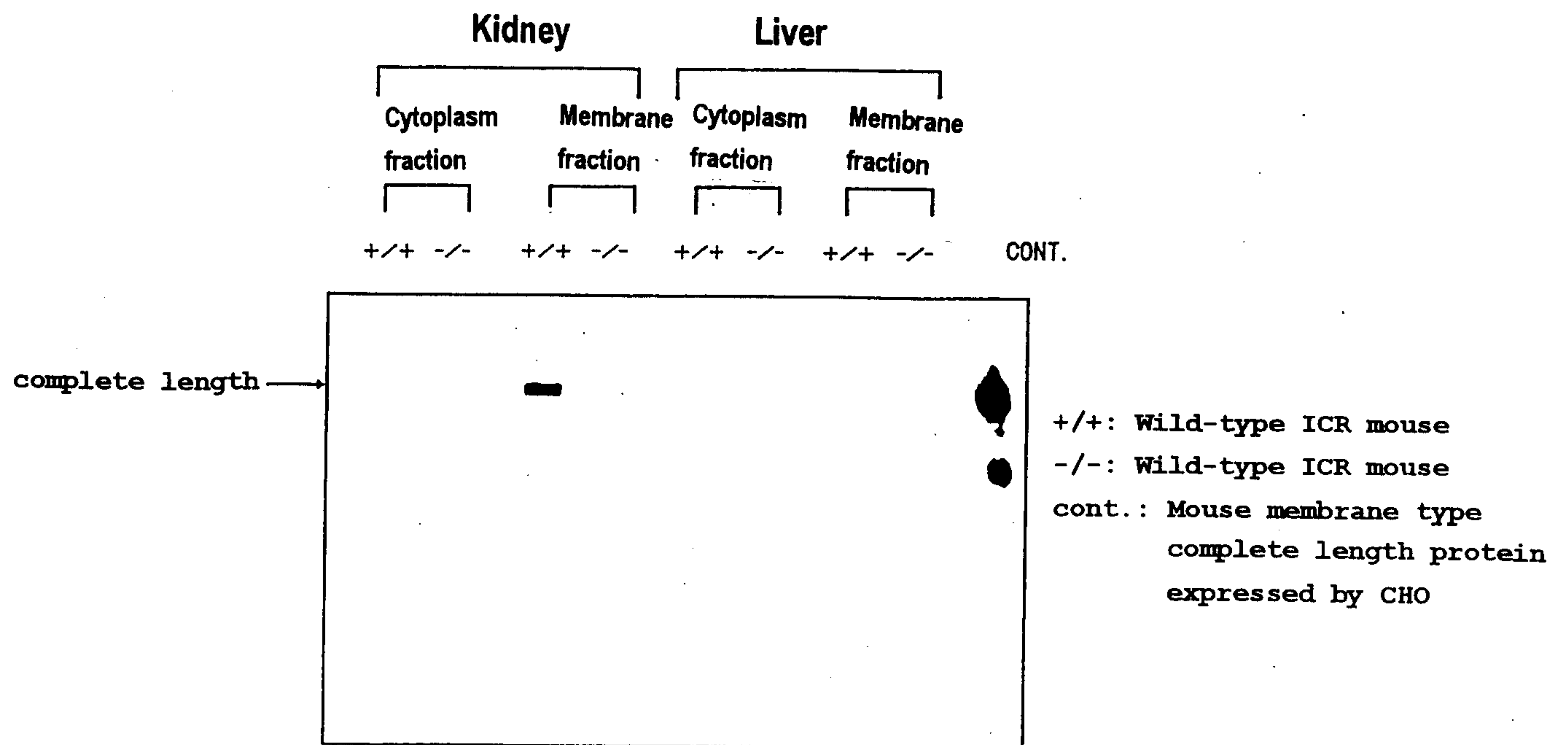


Fig. 42

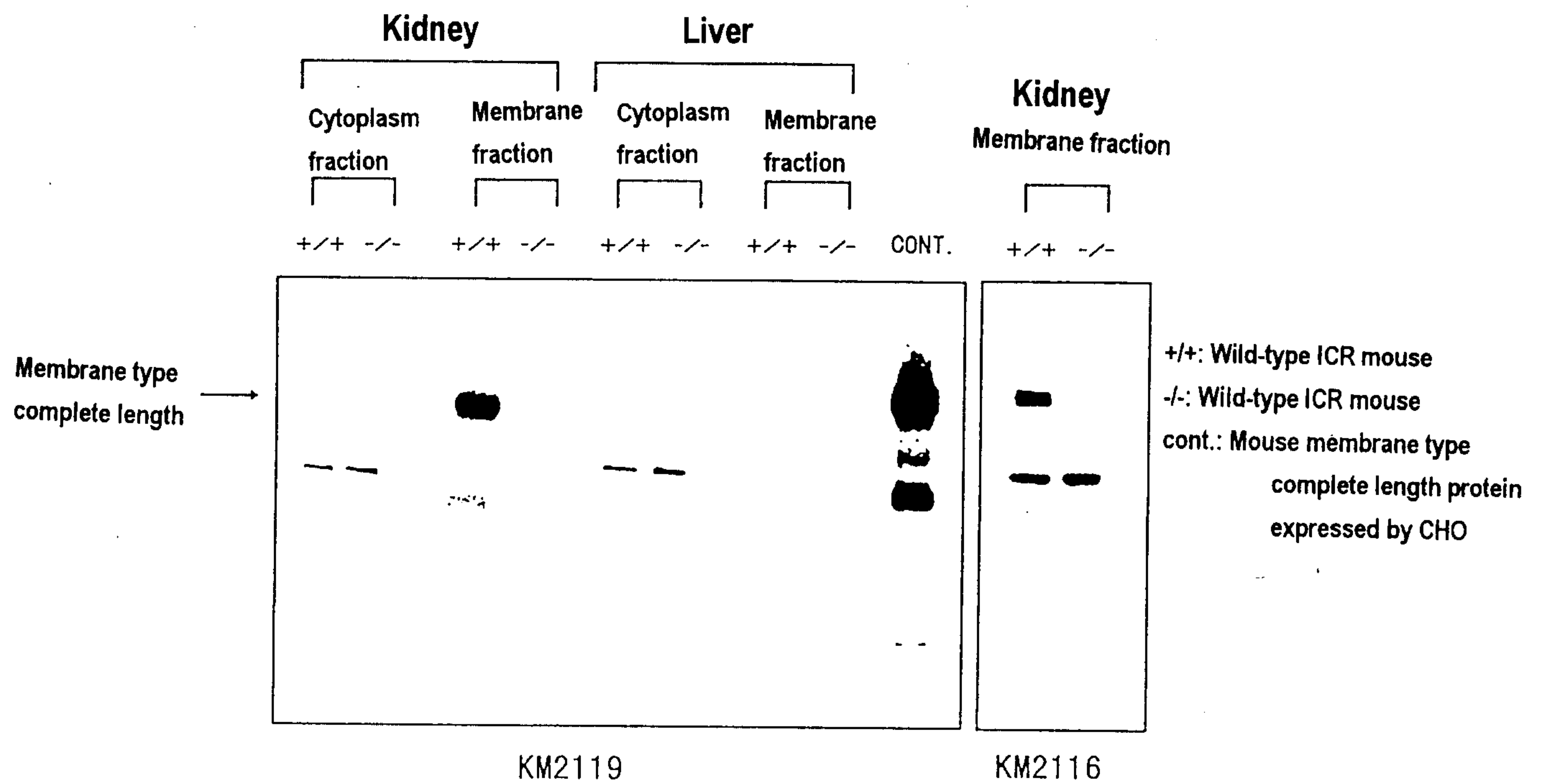


Fig. 43

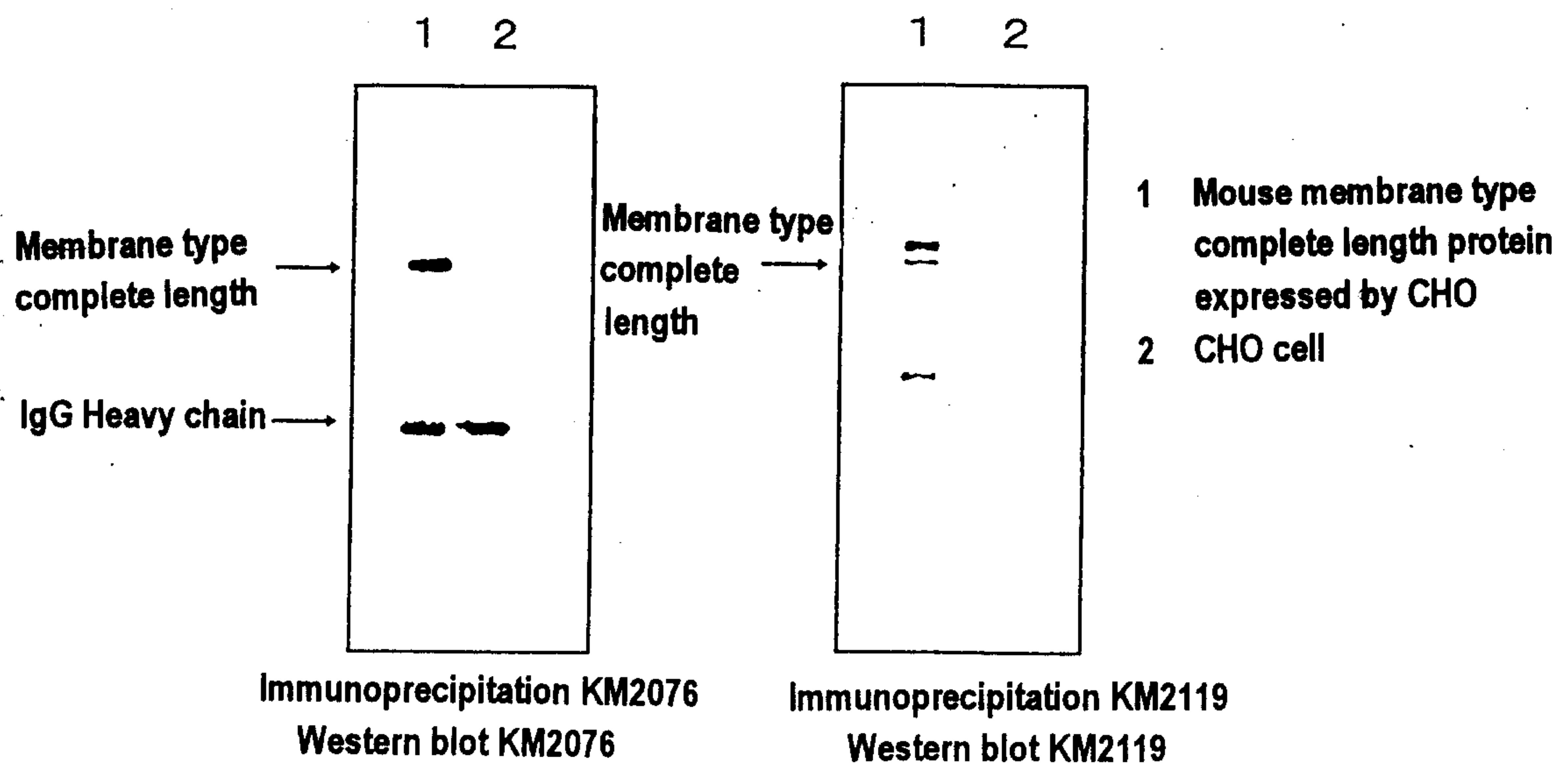


Fig. 44

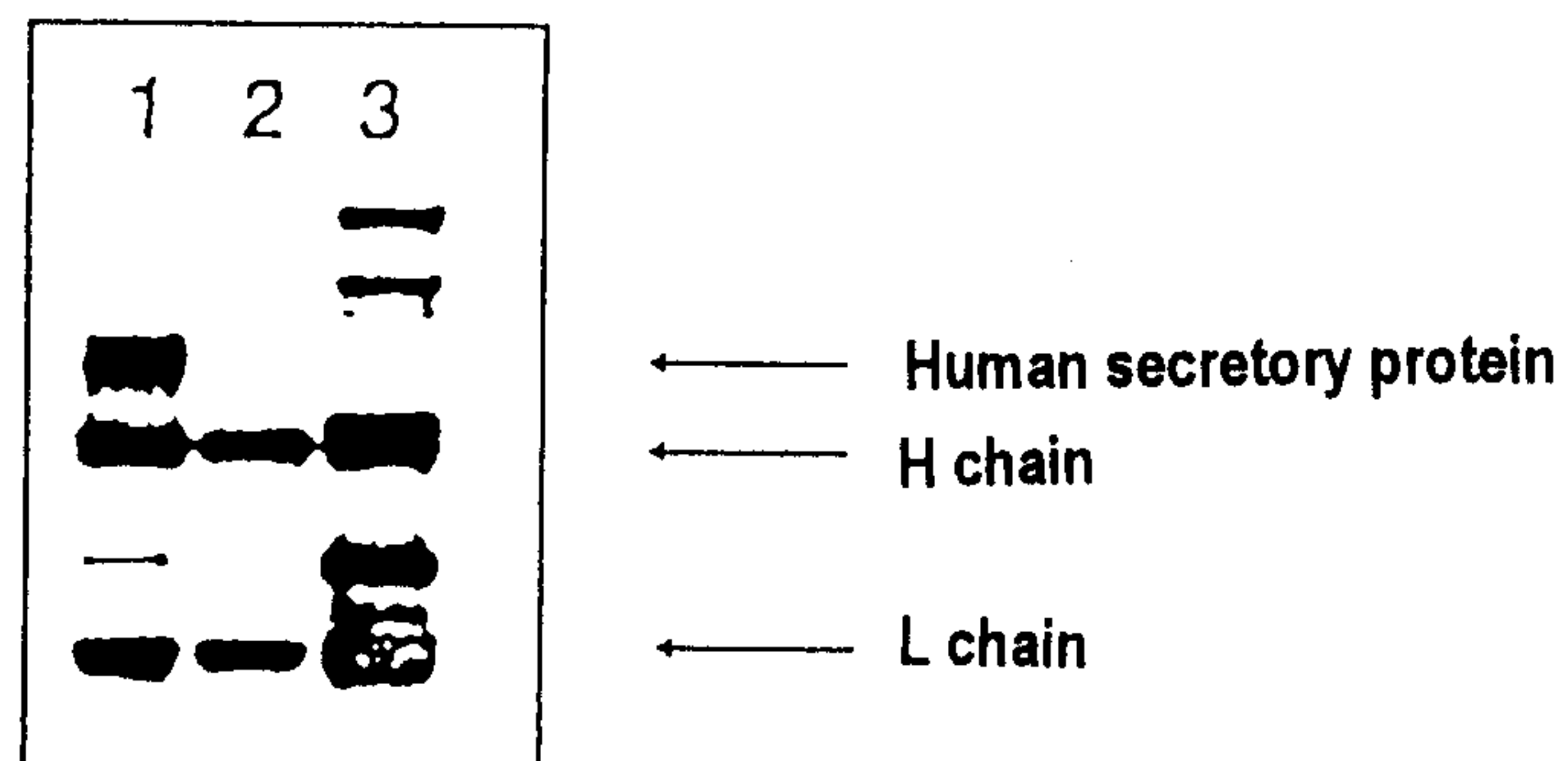


Fig. 45