



HU000035689T2

(19) **HU**(11) Lajstromszám: **E 035 689**(13) **T2****MAGYARORSZÁG**
Szellemi Tulajdon Nemzeti Hivatala**EURÓPAI SZABADALOM**
SZÖVEGÉNEK FORDÍTÁSA

(21) Magyar ügyszám: **E 12 819759** (51) Int. Cl.: **C12N 15/09** (2006.01)
(22) A bejelentés napja: **2012. 08. 03.** **A61K 39/395** (2006.01)
A61K 48/00 (2006.01)
(96) Az európai bejelentés bejelentési száma: **A61P 35/00** (2006.01)
EP 20120819759 **C07K 16/18** (2006.01)
(97) Az európai bejelentés közzétételi adatai: **C07K 16/28** (2006.01)
EP 2740793 A1 **2013. 02. 07.** **C07K 16/30** (2006.01)
(97) Az európai szabadalom megadásának meghirdetési adatai: **A61K 39/00** (2006.01)
EP 2740793 B1 **2017. 11. 29.** **A61P 35/02** (2006.01)

(86) A nemzetközi (PCT) bejelentési szám:
PCT/JP 12/069857(87) A nemzetközi közzétételi szám:
WO 13018892

(30) Elsőbbségi adatok: 2011171332 2011. 08. 04. JP	(73) Jogosult(ak): Toray Industries, Inc., Tokyo, 103-8666 (JP)
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(54) **Gyógyszerkészítmény rák kezelésére és/vagy megelőzésére**

Az európai szabadalom ellen, megadásának az Európai Szabadalmi Közlönyben való meghirdetésétől számított kilenc hónapon belül, felszólalást lehet benyújtani az Európai Szabadalmi Hivatalnál. (Európai Szabadalmi Egyezmény 99. cikk(1))

A fordítást a szabadalmas az 1995. évi XXXIII. törvény 84/H. §-a szerint nyújtotta be. A fordítás tartalmi helyességét a Szellemi Tulajdon Nemzeti Hivatala nem vizsgálta.

(19)



(11)

EP 2 740 793 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:

29.11.2017 Bulletin 2017/48

(21) Application number: **12819759.7**

(22) Date of filing: **03.08.2012**

(51) Int Cl.:

C12N 15/09 <small>(2006.01)</small>	A61K 39/395 <small>(2006.01)</small>
A61K 48/00 <small>(2006.01)</small>	A61P 35/00 <small>(2006.01)</small>
A61P 35/02 <small>(2006.01)</small>	C07K 16/30 <small>(2006.01)</small>
C07K 16/28 <small>(2006.01)</small>	C07K 16/18 <small>(2006.01)</small>
A61K 39/00 <small>(2006.01)</small>	

(86) International application number:
PCT/JP2012/069857

(87) International publication number:
WO 2013/018892 (07.02.2013 Gazette 2013/06)

(54) DRUG COMPOSITION FOR CANCER TREATMENT AND/OR PREVENTION

ARZNEIMITTELZUSAMMENSETZUNG ZUR KREBSBEHANDLUNG UND/ODER VORBEUGUNG
COMPOSITION DE MÉDICAMENT POUR TRAITEMENT ET/OU PRÉVENTION DU CANCER

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **04.08.2011 JP 2011171332**

(43) Date of publication of application:
11.06.2014 Bulletin 2014/24

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Description

Technical Field

5 **[0001]** The present invention relates to novel use of an antibody against CAPRIN-1 or a fragment thereof in a drug such as a therapeutic and/or preventive agent for cancer.

Background Art

10 **[0002]** Cancer is the leading cause of death. This disease is currently treated principally by surgical therapy, in combination with radiation therapy and/or chemotherapy. In spite of recent development of novel surgical techniques or discovery of novel anticancer agents, the existing treatment of cancer has an insufficiently improved outcome, except for some cancer types. With recent advances of molecular biology or cancer immunology, antibodies that specifically react with cancer, cancer antigens that are recognized by cytotoxic T cells, genes encoding such cancer antigens, and the like have been identified, raising expectations on specific cancer therapy targeting the cancer antigens (Non Patent Literature 1).

15 **[0003]** For reducing the adverse reaction of cancer therapy, it is desired that peptides, polypeptides, or proteins recognized as antigens of the cancer should rarely exist in normal cells and specifically exist in cancer cells. In 1991, Boon et al. (Ludwig Institute for Cancer Research, Belgium) isolated a human melanoma antigen MAGE1 recognized by CD8-positive T cells by a cDNA expression cloning method using autologous cancer cell lines and cancer-reactive T cells (Non Patent Literature 2). Then, a SEREX (serological identification of antigens by recombinant expression cloning) method has been reported, which adopts a gene expression cloning approach to identify tumor antigens recognized by antibodies produced in response to autologous cancer *in vivo* in a cancer patient (Non Patent Literature 3 and Patent Literature 1). According to this method, some cancer antigens that are rarely expressed in normal cells and are specifically expressed in cancer have been isolated (Non Patent Literatures 4 to 9). In addition, cell therapy using immunocytes that specifically react with cancer antigens or cancer-specific immunotherapy using vaccines or the like comprising cancer antigens is under clinical trial targeting some of the isolated cancer antigens.

20 **[0004]** In recent years, various antibody drugs for cancer treatment targeting antigenic proteins on cancer cells have emerged in the world. These drugs have received attention because of their certain efficacy as cancer-specific therapeutic agents. A large majority of antigenic proteins targeted by the drugs, however, are also expressed in normal cells. As a result of administering the antibodies, cancer cells as well as normal cells expressing the antigens are damaged, disadvantageously resulting in adverse reaction. Thus, if cancer antigens specifically expressed on the surface of cancer cells can be identified and antibodies targeting the antigens can be used as drugs, these antibody drugs can be expected to achieve treatment with less adverse reaction.

25 **[0005]** Cytoplasmic- and proliferation-associated protein 1 (CAPRIN-1) has been known as an intracellular protein that is expressed upon activation or cell division of resting normal cells and forms cytoplasmic stress granules with RNAs in cells to participate in the regulation of transport and translation of mRNAs. This protein has been found to be specifically expressed on the surface of cancer cells and is therefore under study as a target of antibody drugs for cancer treatment (Patent Literature 2 and 3).

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Citation List

Patent Literature

45 **[0006]**

Patent Literature 1: U.S. Patent No. 5698396

Patent Literature 2: WO2010/016526

Patent Literature 3: WO2010/016525

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Non Patent Literature

[0007]

55 Non Patent Literature 1: Tsuyoshi Akiyoshi, "Japanese Journal of Cancer and Chemotherapy", 1997, Vol. 24, p. 551-519 (Japanese Journal of Cancer and Chemotherapy Publishers Inc., Japan)

Non Patent Literature 2: Bruggen P. et al., Science, 254: 1643-1647 (1991)

Non Patent Literature 3: Proc. Natl. Acad. Sci. USA, 92: 11810-11813 (1995)

Non Patent Literature 4: Int. J. Cancer, 72: 965-971 (1997)
Non Patent Literature 5: Cancer Res., 58: 1034-1041 (1998)
Non Patent Literature 6: Int. J. Cancer, 29: 652-658 (1998)
Non Patent Literature 7: Int. J. Oncol., 14: 703-708 (1999)
Non Patent Literature 8: Cancer Res., 56: 4766-4772 (1996)
Non Patent Literature 9: Hum. Mol. Genet. 6: 33-39, 1997

Summary of Invention

10 Technical Problem

[0008] An object of the present invention is to produce an antibody which targets CAPRIN-1 specifically expressed on the surface of cancer cells and has better antitumor activity than conventional antibodies, and provide the antibody for use as a therapeutic and/or preventive agent for cancer.

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Solution to Problem

[0009] The present invention has the following aspects:

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The present invention provides an antibody or a fragment thereof which has immunological reactivity with a CAPRIN-1 protein, wherein the antibody or the fragment thereof comprises a heavy chain variable region comprising complementarity determining regions of SEQ ID NOs: 5, 6, and 7 and a light chain variable region comprising complementarity determining regions of SEQ ID NOs: 9, 10, and 11, and a pharmaceutical composition for treatment and/or prevention of cancer, comprising the same as an active ingredient.

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[0010] In one embodiment of the present invention, the cancer is breast cancer, kidney cancer, pancreatic cancer, colorectal cancer, lung cancer, brain tumor, gastric cancer, uterine cervix cancer, ovary cancer, prostate cancer, urinary bladder cancer, esophageal cancer, leukemia, lymphoma, fibrosarcoma, mastocytoma, or melanoma.

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[0011] In an alternative embodiment, the antibody is a human antibody, a humanized antibody, a chimeric antibody, a single-chain antibody, or a multispecific antibody (e.g. bispecific antibody).

Advantageous Effects of Invention

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[0012] The antibody against CAPRIN-1 according to the present invention damages cancer cells. Thus, the antibody against CAPRIN-1 is useful in the treatment and/or prevention of cancer.

Description of Embodiments

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[0013] The antibody against CAPRIN-1 according to the present invention may be a monoclonal antibody or a polyclonal antibody and is preferably a monoclonal antibody. The antibody against CAPRIN-1 according to the present invention may be any type of antibody that can exert antitumor activity and includes, for example, recombinant antibodies, for example, synthetic antibodies, multispecific antibodies (e.g., bispecific antibodies), humanized antibodies, chimeric antibodies, and single-chain antibodies (scFv), human antibodies, and their antibody fragments, for example, Fab, F(ab')₂, and Fv. These antibodies and fragments thereof can be prepared by methods generally known to those skilled in the art. In the case of a human subject, a human antibody or a humanized antibody is desirable for avoiding or suppressing rejection.

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[0014] In this context, the phrase "specifically binding to the CAPRIN-1 protein" means that the antibody specifically binds to the CAPRIN-1 protein without substantially binding to other proteins.

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[0015] The antibody against CAPRIN-1 polypeptide according to the present invention can be examined for its antitumor activity, as described later, by examining *in vivo* the inhibition of tumor growth in a cancer-bearing animal or by examining *ex vivo* the presence or absence of immunocyte- or complement-mediated cytotoxic activity exhibited by the antibody against tumor cells expressing the polypeptide.

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[0016] The subject to receive the treatment and/or prevention of cancer according to the present invention is a mammal such as a human, a pet animal, livestock, or a sport animal, preferably a human.

[0017] Hereinafter, the present invention will be described in more detail.

<Preparation of antigen for antibody preparation>

5 [0018] Proteins or fragments thereof used as sensitizing antigens for obtaining the antibody against CAPRIN-1 according to the present invention are not limited by animal species serving as their origins, including humans, dogs, cattle, horses, mice, rats, and chickens. The proteins or the fragments thereof, however, are preferably selected in view of compatibility with parent cells for use in cell fusion. In general, mammal-derived proteins are preferred. Particularly, human-derived proteins are preferred. For example, when CAPRIN-1 is human CAPRIN-1, human CAPRIN-1 proteins, partial peptides thereof, or cells expressing human CAPRIN-1 can be used.

10 [0019] The nucleotide sequences and amino acid sequences of human CAPRIN-1 and homologs thereof are available, for example, by accessing GenBank (NCBI, USA) and using BLAST or FASTA algorithm (Karlin and Altschul, Proc. Natl. Acad. Sci. USA, 90: 5873-5877, 1993; and Altschul et al., Nucleic Acids Res. 25: 3389-3402, 1997).

15 [0020] In the present invention, with reference to the nucleotide sequence (SEQ ID NO: 1 or 3) or amino acid sequence (SEQ ID NO: 2 or 4) of human CAPRIN-1, the target CAPRIN-1 is nucleic acids or proteins consisting of sequences having 70% to 100%, preferably 80% to 100%, more preferably 90% to 100%, further preferably 95% to 100%, for example, 97% to 100%, 98% to 100%, 99% to 100%, or 99.5% to 100% sequence identity to the nucleotide sequence or amino acid sequence of the ORF or mature portion of the reference sequence. In this context, the term "% sequence identity" means a percentage (%) of the number of identical amino acids (or nucleotide bases) to the total number of amino acids (or nucleotide bases) when two sequences are aligned such that the maximum degree of similarity (or identity) can be achieved with or without introduced gaps.

20 [0021] As the fragments of each CAPRIN-1 protein, those comprising an epitope (or an antigenic determinant), which is the smallest unit recognized by an antibody, and having lengths ranging from the amino acid length of the epitope, to less than the full-length of the protein can be used. The epitope refers to a polypeptide fragment having antigenicity or immunogenicity in mammals, preferably humans. Its smallest unit consists of approximately 7 to 12 amino acids, for example, 8 to 11 amino acids.

25 [0022] Polypeptide fragments comprising the above human CAPRIN-1 proteins and partial peptides thereof can be synthesized according to chemical synthesis methods, for example, Fmoc (fluorenylmethyloxycarbonyl) and tBoc (t-butylloxycarbonyl) methods (Seikagaku Jikken Koza (Biochemical Experimentation Course in English) 1, the Japanese Biochemical Society ed., Protein Chemistry IV, Chemical Modification and Peptide Synthesis, Tokyo Kagaku Dojin Co., Ltd. (Japan), 1981). Also, these polypeptides can be synthesized by conventional methods using various commercially available peptide synthesizers. Alternatively, polynucleotides encoding the polypeptides may be prepared using genetic engineering approaches known in the art (Sambrook et al., Molecular Cloning, the 2nd edition, Current Protocols in Molecular Biology (1989), Cold Spring Harbor Laboratory Press; Ausubel et al., Short Protocols in Molecular Biology, the 3rd edition, A compendium of Methods from Current Protocols in Molecular Biology (1995), John Wiley & Sons; etc.) and incorporated into expression vectors, which are then introduced into host cells to produce the polypeptides in the host cells. In this way, the human CAPRIN-1 proteins or polypeptide fragments thereof of interest can be obtained.

30 [0023] The polynucleotides encoding the polypeptides can be readily prepared by genetic engineering approaches known in the art or conventional methods using commercially available nucleic acid synthesizers. For example, a DNA comprising the nucleotide sequence of human CAPRIN-1 gene can be prepared by PCR using a human chromosomal DNA or cDNA library as a template and a pair of primers designed so as to be capable of amplifying the nucleotide sequence shown in SEQ ID NO: 1. Reaction conditions for this PCR can be appropriately determined. Examples of the conditions can include, but not limited to, 30 cycles each involving reaction steps consisting of 94°C for 30 seconds (denaturation), 55°C for 30 seconds to 1 minute (annealing), and 72°C for 2 minutes (elongation) using thermostable DNA polymerase (e.g., Taq polymerase, Pfu polymerase or the like) and a Mg²⁺-containing PCR buffer, followed by reaction at 72°C for 7 minutes. The PCR approach, conditions, etc. are described in, for example, Ausubel et al., Short Protocols in Molecular Biology, the 3rd edition, A Compendium of Methods from Current Protocols in Molecular Biology (1995), John Wiley & Sons (particularly, Chapter 15).

35 [0024] Also, appropriate probes or primers can be prepared on the basis of information about the nucleotide sequences of CAPRIN-1 gene and the amino acid sequences of CAPRIN-1 proteins, and used in the screening of, for example, a human cDNA library, to isolate the desired DNA. Preferably, such a cDNA library is produced from cells, organs, or tissues expressing CAPRIN-1 proteins. Examples of such cells or tissues include cells or tissues derived from the testis or from cancers or tumors such as leukemia, breast cancer, lymphoma, brain tumor, lung cancer, pancreatic cancer, and colorectal cancer. These operations, including the preparation of probes or primers, the construction of a cDNA library, the screening of the cDNA library, and the cloning of the gene of interest, are known to those skilled in the art and can be performed according to methods described in, for example, Sambrook et al., Molecular Cloning, the 2nd edition, Current Protocols in Molecular Biology (1989), and Ausubel et al. (ibid.). DNAs encoding the human CAPRIN-1 proteins and the partial peptides thereof can be obtained from the DNA thus obtained.

50 [0025] The host cells into which the expression vectors are introduced may be any cell capable of expressing the above polypeptides. Examples of prokaryotic cells include, but not limited to, *E. coli*. Examples of eukaryotic cells include,

but not limited to: mammalian cells such as monkey kidney cells COS1 and Chinese hamster ovary cells CHO; a human embryonic kidney cell line HEK293; mouse embryonic skin cell line NIH3T3; yeast cells such as budding yeast and fission yeast cells; silkworm cells; and *Xenopus* egg cells.

[0026] In the case of using prokaryotic cells as the host cells, the expression vectors used may have an origin that permits replication in the prokaryotic cells, a promoter, a ribosomal binding site, a multicloning site, a terminator, a drug resistance gene, an auxotrophic complementary gene, etc. Examples of expression vectors for *E. coli* can include pUC series, pBluescript II, pET expression systems, and pGEX expression systems. The DNAs encoding the above polypeptides can be incorporated into such expression vectors, with which prokaryotic host cells are then transformed, followed by culture of the obtained transformants so that the polypeptides encoded by the DNAs are expressed in the prokaryotic host cells. In this respect, the polypeptides may be expressed as fusion proteins with other proteins.

[0027] In the case of using eukaryotic cells as the host cells, expression vectors for eukaryotic cells having a promoter, a splicing region, a poly(A) addition site, etc. may be used as the expression vectors. Examples of such expression vectors can include pKAI, pCDM8, pSVK3, pMSG, pSVL, pBK-CMV, pBK-RSV, EBV, pRS, pcDNA3, and pYES2 vectors. In the same way as above, the DNAs encoding the above polypeptides can be incorporated into such expression vectors, with which eukaryotic host cells are then transformed, followed by culture of the obtained transformants so that the polypeptides encoded by the DNAs are expressed in the eukaryotic host cells. In the case of using expression vectors such as pIND/V5-His, pFLAG-CMV-2, pEGFP-N1, or pEGFP-C1, the polypeptides may be expressed as various fusion proteins tagged with His tag (e.g., (His)₆ to (His)₁₀), FLAG tag, myc tag, HA tag, GFP, or the like.

[0028] The expression vectors can be introduced into the host cells using well known methods such as electroporation, a calcium phosphate method, a liposome method, a DEAE dextran method, microinjection, viral infection, lipofection, and binding with cell-penetrating peptides.

[0029] The polypeptide of interest can be isolated and purified from the host cells by a combination of separation operations known in the art. Examples thereof include, but not limited to, treatment with a denaturant (e.g., urea) or a surfactant, ultrasonication, enzymatic digestion, salting-out, solvent fractionation and precipitation, dialysis, centrifugation, ultrafiltration, gel filtration, SDS-PAGE, isoelectric focusing electrophoresis, ion-exchange chromatography, hydrophobic chromatography, affinity chromatography, and reverse-phase chromatography.

[0030] In order to prepare the antibody according to the present invention, antigens thus prepared can be used as sensitizing antigens as described later.

<Structure of antibody>

[0031] Antibodies (immunoglobulin) are usually heteromultimeric glycoproteins each comprising at least two heavy chains and two light chains. The immunoglobulins, except for IgM, are heterotetrameric glycoproteins of approximately 150 kDa each composed of two identical light (L) chains and two identical heavy (H) chains. Typically, each light chain is connected to a heavy chain via a single covalent disulfide bond, though the number of disulfide bonds between heavy chains varies among different immunoglobulin isotypes. Each of the heavy and light chains also has an intrachain disulfide bond. Each heavy chain has a variable domain (VH region) at one end, followed by a series of constant regions. Each light chain has a variable domain (VL region) at one end and has a single constant region at the other end. The light chain constant region is aligned with the first heavy chain constant region, while the light chain variable domain is aligned with the heavy chain variable domain. Particular regions called complementarity determining regions (CDRs) in the antibody variable domains exhibit specific variability and impart binding specificity to the antibody. Portions relatively conserved in the variable regions are called framework regions (FRs). The complete heavy and light chain variable domains each comprise four FRs connected via three CDRs. These three CDRs are called CDRH1, CDRH2, and CDRH3 in this order from the N-terminus of the heavy chain. Likewise, the CDRs are called CDRL1, CDRL2, and CDRL3 in the light chain. CDRH3 is most important for the binding specificity of the antibody for its antigen. In addition, CDRs in each chain are kept close to each other by the FR regions and contribute to the formation of an antigen-binding site in the antibody, together with CDRs in the other chain. The constant regions do not directly contribute to antibody-antigen binding, but exhibit various effector functions, for example, involvement in antibody-dependent cellular cytotoxicity (ADCC), phagocytosis mediated by binding to an Fc γ receptor, half-life/clearance rate mediated by a neonatal Fc receptor (FcRn), and complement-dependent cytotoxicity (CDC) mediated by a C1q component in the complement cascade.

<Preparation of antibody>

[0032] The anti-CAPRIN-1 antibody according to the present invention means an antibody having immunological reactivity with a full-length CAPRIN-1 protein or a fragment thereof.

[0033] In this context, the "immunological reactivity" means the property of the antibody binding to the CAPRIN-1 antigen (a full-length CAPRIN-1 protein or a partial polypeptide thereof) *in vivo*. Via such binding of the antibody of the present invention to the CAPRIN-1, the antibody exerts the function of damaging (e.g., killing, suppressing, or regressing)

tumor cells. The antibody of the present invention can damage tumors such as breast cancer, kidney cancer, pancreatic cancer, colorectal cancer, lung cancer, brain tumor, gastric cancer, uterine cervix cancer, ovary cancer, prostate cancer, urinary bladder cancer, esophageal cancer, leukemia, lymphoma, fibrosarcoma, mastocytoma, or melanoma as a result of binding to the CAPRIN-1 protein.

5 **[0034]** Preferably, the antibody of the present invention is not particularly limited as long as the antibody is monoclonal antibodies, and examples thereof include synthetic antibodies, multispecific antibodies, human antibodies, humanized antibodies, chimeric antibodies, single-chain antibodies, and antibody fragments (e.g., Fab, F(ab')₂, and Fv). Also, the antibody is any class of immunoglobulin molecule, for example, IgG, IgE, IgM, IgA, IgD, or IgY, or any subclass, for example, IgG1, IgG2, IgG3, IgG4, IgA1, or IgA2.

10 **[0035]** Further, the antibody may be modified by acetylation, formylation, amidation, phosphorylation, PEGylation, or the like, as well as glycosylation.

[0036] Hereinafter, preparation examples of various monoclonal antibodies will be shown.

15 **[0037]** For example, breast cancer cell lines SK-BR-3 expressing CAPRIN-1 is administered to each mouse for immunization. The spleen is extracted from this mouse. After separation of spleen cells, the cells are fused with mouse myeloma cells. Clones producing antibodies having a cancer cell growth inhibitory effect are selected from among the obtained fusion cells (hybridomas). The hybridomas producing monoclonal antibodies having a cancer cell growth inhibitory effect are isolated and cultured. The antibody of the present invention can be prepared by purification from the culture supernatant according to a general affinity purification method.

20 **[0038]** The monoclonal antibody-producing hybridomas may be prepared, for example, as follows. First, animals are immunized with sensitizing antigens according to a method known in the art. This immunization method generally involves intraperitoneally or subcutaneously injecting the sensitizing antigens to mammals. Specifically, the sensitizing antigens are diluted with or suspended in PBS (phosphate-buffered saline), physiological saline, or the like into an appropriate amount and then mixed, if desired, with an appropriate amount of a conventional adjuvant, for example, a complete Freund's adjuvant. After emulsification, it is administered to each mammal several times every 4 to 21 days. Alternatively,

25 an appropriate carrier may be used for the immunization with sensitizing antigens.

[0039] After confirmation of a rise in the level of the desired antibody in the serum of the mammal thus immunized, immunocytes are collected from the mammal and subjected to cell fusion. Preferred examples of the immunocytes particularly include spleen cells.

30 **[0040]** Mammalian myeloma cells are used as partner parent cells to be fused with the immunocytes. Various cell lines known in the art, for example, P3U1 (P3-X63Ag8U1), P3 (P3x63Ag8.653) (J. Immunol. (1979) 123, 1548-1550), P3x63Ag8U.1 (Current Topics in Microbiology and Immunology (1978) 81, 1-7), NS-1 (Kohler, G. and Milstein, C. Eur. J. Immunol. (1976) 6, 511-519), MPC-11 (Margulies, D.H. et al., Cell (1976) 8,405-415), SP2/0 (Shulman, M. et al., Nature (1978) 276, 269-270), FO (deSt. Groth, S.F. et al., J. Immunol. Methods (1980) 35, 1-21), S194 (Trowbridge, I.S. J. Exp. Med. (1978) 148, 313-323), and R210 (Galfre, G. et al., Nature (1979) 277, 131-133), are preferably used

35 as the myeloma cells.

[0041] The cell fusion between the immunocytes and the myeloma cells can be performed basically according to a method known in the art, for example, the method of Kohler and Milstein (Kohler, G. and Milstein, C. Methods Enzymol. (1981) 73, 3-46).

40 **[0042]** More specifically, the cell fusion is carried out, for example, in the presence of a cell fusion promoter in a conventional nutrient medium. For example, polyethylene glycol (PEG) or hemagglutinating virus of Japan (HVJ) is used as the fusion promoter. If desired, an auxiliary such as dimethyl sulfoxide may be further added in order to enhance fusion efficiency.

45 **[0043]** The ratio between the immunocytes and the myeloma cells used can be arbitrarily set. For example, the amount of the immunocytes is preferably set to 1 to 10 times the amount of the myeloma cells. Examples of the medium that can be used in the cell fusion include RPMI1640 and MEM media suitable for the growth of the myeloma cell lines as well as conventional media for use in this type of cell culture. In addition, a serum supplement such as fetal calf serum (FCS) may be used in combination with these media.

50 **[0044]** For the cell fusion, the immunocytes and the myeloma cells are well mixed in a predetermined amount of the medium. A PEG solution (average molecular weight: for example, approximately 1000 to 6000) preheated to approximately 37°C is usually added to the mixture at a concentration of 30 to 60% (w/v) and mixed therewith to form the hybridomas of interest. Subsequently, procedures of sequentially adding an appropriate medium and removing the supernatant by centrifugation are preferably repeated to remove cell fusion agents or the like unfavorable for the growth of the hybridomas.

55 **[0045]** The hybridomas thus obtained are cultured in a conventional selective medium, for example, a HAT medium (medium containing hypoxanthine, aminopterin, and thymidine) for selection. Culture in the HAT medium is continued for a period (usually, several days to several weeks) sufficient for the death of cells (non-fused cells) other than the hybridomas of interest. Subsequently, hybridomas producing the antibody of interest are screened for and cloned as single clones by a conventional limiting dilution method.

[0046] In addition to such obtainment of the hybridomas by the immunization of non-human animals with antigens, hybridomas producing human antibodies having the desired activity (e.g., cell growth inhibitory activity) may be obtained by sensitizing human lymphocytes, for example, EB virus-infected human lymphocytes, with proteins, protein-expressing cells, or lysates thereof *in vitro* and fusing the sensitized lymphocytes with human-derived myeloma cells capable of dividing permanently, for example, U266 (Accession No. TIB 196).

[0047] The monoclonal antibody-producing hybridomas thus prepared can be subcultured in a conventional medium and can also be stored for a long period in liquid nitrogen.

[0048] Specifically, the desired antigens or cells expressing the desired antigens are used as sensitizing antigens in immunization according to a conventional immunization method. The obtained immunocytes are fused with parent cells known in the art according to a conventional cell fusion method. Monoclonal antibody-producing cells (hybridomas) can be screened for by a conventional screening method to prepare the hybridomas producing monoclonal antibodies of interest.

[0049] In this context, for example, KM mice (Kirin Pharma Co., Ltd./Medarex) and Xenomice (Amgen Inc.) are known as the human antibody-producing mice (e.g., International Publication Nos. WO02/43478 and WO02/092812). Complete human polyclonal antibodies can be obtained from the blood of such mice immunized with CAPRIN-1 proteins or fragments thereof. Alternatively, spleen cells may be isolated from the mice thus immunized and fused with myeloma cells. In this way, human monoclonal antibodies can be obtained.

[0050] The antigens can be prepared according to, for example, a method using animal cells (JP Patent Publication (Kohyo) No. 2007-530068 A (2007)) or a method using baculovirus (e.g., International Publication No. WO98/46777). Antigens having low immunogenicity can be bound to immunogenic macromolecules such as albumin for immunization. Antigens may be administered with adjuvants for immunization.

[0051] Alternatively, the antibody of the present invention may be obtained as recombinant antibodies, which are produced using a genetic engineering technique which involves: cloning the antibody genes from hybridomas; incorporating the antibody genes into appropriate vectors; and introducing the vectors into hosts (see, e.g., Carl, A.K. Borrebaeck, James, W. Larrick, THERAPEUTIC MONOCLONAL ANTIBODIES, Published in the United Kingdom by MACMILLAN PUBLISHERS LTD, 1990). Specifically, antibody variable region (V region) cDNAs are synthesized from the mRNAs of hybridomas using reverse transcriptase. After obtainment of DNAs encoding the antibody V regions of interest, the DNAs are ligated with DNAs encoding the desired antibody constant regions (C regions). The resulting ligation products are incorporated into expression vectors. Alternatively, the antibody V region-encoding DNAs may be incorporated into expression vectors containing antibody C region DNAs. These DNAs are incorporated into the expression vectors so as to be expressed under the control of expression control regions, for example, an enhancer and a promoter. Next, host cells can be transformed with the resulting expression vectors and allowed to express antibodies.

[0052] The anti-CAPRIN-1 antibody of the present invention is a monoclonal antibody. The monoclonal antibody includes human monoclonal antibodies, non-human animal monoclonal antibodies (e.g., mouse, rat, rabbit, and chicken monoclonal antibodies), chimeric monoclonal antibodies, and the like. The monoclonal antibody may be prepared by the culture of hybridomas obtained by the fusion between spleen cells from non-human animals (e.g., mice or human antibody-producing mice, chickens, and rabbits) immunized with CAPRIN-1 proteins or fragments thereof and myeloma cells. The chimeric antibody is an antibody prepared from a combination of sequences derived from different animals and is, for example, an antibody composed of mouse antibody heavy and light chain variable regions and human antibody heavy and light chain constant regions. The chimeric antibody can be prepared using a method known in the art which involves, for example: ligating DNAs encoding the antibody V regions with DNAs encoding human antibody C regions; incorporating the resulting ligation products into expression vectors; and introducing the vectors into hosts so that antibodies are produced.

[0053] Human-mouse chimeric monoclonal antibodies having an antitumor effect are prepared by a method described later in Examples. The monoclonal antibodies comprise, for example, a heavy chain variable (VH) region having the amino acid sequence of SEQ ID NO: 8 and a light chain variable (VL) region having the amino acid sequence of SEQ ID NO: 12. In the monoclonal antibodies, the VH region can comprise CDR1 shown by the amino acid sequence of SEQ ID NO: 5, CDR2 shown by the amino acid sequence of SEQ ID NO: 6, and CDR3 shown by the amino acid sequence of SEQ ID NO: 7, and the VL region can comprise CDR1 shown by the amino acid sequence of SEQ ID NO: 9, CDR2 shown by the amino acid sequence of SEQ ID NO: 10, and CDR3 shown by the amino acid sequence of SEQ ID NO: 11.

[0054] The humanized antibody, also called reshaped human antibody, is an engineered antibody. The humanized antibody is constructed by grafting antibody CDRs derived from an immunized animal into the complementarity determining regions of a human antibody. A general gene recombination approach therefor is also known.

[0055] Specifically, for example, DNA sequences designed so as to link mouse and chicken antibodies CDRs and human antibody framework regions (FRs) are synthesized by PCR using several prepared oligonucleotides having terminal portions overlapping with each other. The obtained DNAs are ligated with DNAs encoding human antibody constant regions. Subsequently, the resulting ligation products are incorporated into expression vectors, which are then introduced into hosts for antibody production to obtain the antibody of interest (see European Patent Application Publi-

cation No. EP239400 and International Publication No. WO96/02576). The human antibody FRs connected via CDRs are selected such that the complementarity determining regions form a favorable antigen-binding site. If necessary, amino acids in the framework regions of antibody variable regions may be substituted such that the complementarity determining regions of the resulting reshaped human antibody form an appropriate antigen-binding site (Sato K. et al., Cancer Research 1993, 53: 851-856). In addition, these framework regions may be replaced with framework regions derived from various human antibodies (see International Publication No. WO99/51743).

[0056] The human antibody framework regions connected via CDRs are selected such that the complementarity determining regions form a favorable antigen-binding site. If necessary, amino acids in the framework regions of antibody variable regions may be substituted such that the complementarity determining regions of the resulting reshaped human antibody form an appropriate antigen-binding site (Sato K. et al., Cancer Research 1993, 53: 851-856).

[0057] Amino acids in variable regions (e.g., FRs) or constant regions of the chimeric antibody or the humanized antibody thus prepared may be substituted, for example, by other amino acids.

[0058] The amino acid substitution is the substitution of, for example, less than 15, less than 10, 8 or less, 7 or less, 6 or less, 5 or less, 4 or less, 3 or less, or 2 or less amino acids, preferably 1 to 5 amino acids, more preferably 1 or 2 amino acids. The substituted antibody should be functionally equivalent to an unsubstituted antibody. The substitution is desirably conservative amino acid substitution, which is the substitution between amino acids similar in properties such as charge, side chains, polarity, and aromaticity. The amino acids can be classified in terms of similar properties into, for example: basic amino acids (arginine, lysine, and histidine); acidic amino acids (aspartic acid and glutamic acid); uncharged polar amino acids (glycine, asparagine, glutamine, serine, threonine, cysteine, and tyrosine); nonpolar amino acids (leucine, isoleucine, alanine, valine, proline, phenylalanine, tryptophan, and methionine); branched amino acids (leucine, valine, and isoleucine); and aromatic amino acids (phenylalanine, tyrosine, tryptophan, and histidine).

[0059] Examples of modified antibodies can include antibodies bound with various molecules such as polyethylene glycol (PEG). In the modified antibody of the present invention, the substance to be bound is not limited. In order to obtain such a modified antibody, the obtained antibody can be chemically modified. A method therefor has already been established in the art.

[0060] In this context, the phrase "functionally equivalent" means that an antibody concerned has biological or biochemical activity similar to that of the antibody of the present invention, specifically, the antibody concerned has the function of damaging tumor and essentially causes no rejection when applied to humans, for example. Examples of such activity can include cell growth inhibitory activity and binding activity.

[0061] A method for preparing a polypeptide functionally equivalent to a certain polypeptide, which involves introducing a mutation into a polypeptide, is well known to those skilled in the art. For example, those skilled in the art can introduce a mutation as appropriate into the antibody of the present invention using site-directed mutagenesis (Hashimoto-Gotoh, T. et al., (1995) Gene 152, 271-275; Zoller, MJ., and Smith, M. (1983) Methods Enzymol. 100, 468-500; Kramer, W. et al., (1984) Nucleic Acids Res. 12, 9441-9456; Kramer, W. and Fritz, HJ., (1987) Methods Enzymol. 154, 350-367; Kunkel, TA., (1985) Proc. Natl. Acad. Sci. USA. 82, 488-492; and Kunkel (1988) Methods Enzymol. 85, 2763-2766) or the like, thereby prepare an antibody functionally equivalent to the antibody of the present invention.

[0062] An antibody that recognizes an epitope of a CAPRIN-1 protein described above can be obtained by a method generally known to those skilled in the art. For example, the antibody can be obtained by a method which involves determining the epitope of the CAPRIN-1 protein recognized by the anti-CAPRIN-1 antibody having a cancer cell growth inhibitory effect obtained by the above by a conventional method (e.g., epitope mapping) and preparing an antibody using a polypeptide having an amino acid sequence contained in the epitope as an immunogen, or a method which involves determining an epitope for an antibody prepared by a conventional method and selecting an antibody that recognizes the same epitope as that for the anti-CAPRIN-1 antibody. In this context, the "epitope" refers to a polypeptide fragment having antigenicity or immunogenicity in mammals, preferably humans. Its smallest unit consists of approximately 7 to 12 amino acids, preferably 8 to 11 amino acids.

[0063] The antibody of the present invention is an antibody having immunological reactivity with CAPRIN-1, an antibody specifically recognizing CAPRIN-1, or an antibody specifically binding to CAPRIN-1 and exhibits cytotoxic activity or tumor growth inhibitory effect on cancer. The antibody preferably has a structure that causes little or no rejection in recipient animals. Examples of such antibodies include human antibodies, humanized antibodies, chimeric antibodies (e.g., human-mouse chimeric antibodies), single-chain antibodies, and bispecific antibodies when the recipient animals are humans. These antibodies have heavy and light chain variable regions derived from a human antibody or have heavy and light chain variable regions consisting of complementarity determining regions (CDR1, CDR2, and CDR3) derived from a non-human animal antibody and framework regions derived from a human antibody. Alternatively, these antibodies are recombinant antibodies having heavy and light chain variable regions derived from a non-human animal antibody and heavy and light chain constant regions derived from a human antibody. The antibody of the present invention is preferably the former two antibodies.

[0064] Such recombinant antibodies can be prepared as follows: DNAs encoding monoclonal antibodies (e.g., human, mouse, rat, rabbit, and chicken monoclonal antibodies) against human CAPRIN-1 are cloned from the antibody-producing

cells such as hybridomas and used as templates to prepare DNAs encoding the light and heavy chain variable regions of the antibodies by RT-PCR or the like. The respective sequences of the light and heavy chain variable regions and the respective sequences of CDR1, CDR2, and CDR3 in each region are determined on the basis of the Kabat EU numbering system (Kabat et al., Sequences of Proteins of Immunological Interest, 5th Ed. Public Health Service, National Institute of Health, Bethesda, Md. (1991)).

[0065] A DNA encoding each variable region or a DNA encoding each CDR is prepared using a genetic engineering technique (Sambrook et al., Molecular Cloning A Laboratory Manual, Cold Spring Harbor Laboratory Press (1989)) or a DNA synthesizer. The above-mentioned human monoclonal antibody-producing hybridomas can be prepared by immunizing human antibody-producing animals (e.g., mice) with human CAPRIN-1 and then fusing spleen cells excised from the immunized animals with myeloma cells. Separately, DNAs encoding light or heavy chain variable and constant regions derived from a human antibody are prepared, if necessary, using a genetic engineering technique or a DNA synthesizer.

[0066] For the humanized antibody, a DNA encoding the humanized antibody can be prepared by producing DNAs in which the CDR coding sequences in DNAs encoding a human antibody-derived light or heavy chain variable regions are substituted by corresponding CDR coding sequences of a non-human animal (e.g., mouse, rat, rabbit, or chicken)-derived antibody, ligating the resulting DNAs with the DNAs encoding human antibody-derived light or heavy chain constant regions, respectively.

[0067] For the chimeric antibody, a DNA encoding the chimeric antibody can be prepared by ligating DNAs encoding light or heavy chain variable regions of a non-human animal (e.g., mouse, rat, rabbit, or chicken)-derived antibody with DNAs encoding human antibody-derived light or heavy chain constant regions.

[0068] The single-chain antibody means an antibody in which heavy and light chain variable regions are linearly linked to each other via a linker. A DNA encoding the single-chain antibody can be prepared by ligating a DNA encoding the heavy chain variable region, a DNA encoding the linker, and a DNA encoding the light chain variable region. In this context, the heavy and light chain variable regions are both derived from a human antibody or derived from a human antibody in which CDRs alone are substituted by CDRs of a non-human animal (e.g., mouse, rat, rabbit, or chicken)-derived antibody. The linker consists of 12 to 19 amino acids. Examples thereof include (G₄S)₃ consisting of 15 amino acids (G.B. Kim et al., Protein Engineering Design and Selection 2007, 20 (9): 425-432).

[0069] The bispecific antibody (diabody) means an antibody capable of specifically binding to two different epitopes. A DNA encoding the bispecific antibody can be prepared by, for example, ligating, for example, a DNA encoding a heavy chain variable region A, a DNA encoding a light chain variable region B, a DNA encoding a heavy chain variable region B, and a DNA encoding a light chain variable region A in this order, wherein the DNA encoding the light chain variable region B and the DNA encoding the heavy chain variable region B are ligated via a DNA encoding a linker as described above). In this context, the heavy and light chain variable regions are all derived from a human antibody or derived from a human antibody in which CDRs alone are substituted by CDRs of a non-human animal (e.g., mouse, rat, rabbit, or chicken)-derived antibody.

[0070] The recombinant DNAs thus prepared can be incorporated into one or more appropriate vectors, which are then introduced into host cells (e.g., mammalian cells, yeast cells, and insect cells), and the DNAs are (co)expressed to produce recombinant antibodies (see, P.J. Delves., ANTIBODY PRODUCTION ESSENTIAL TECHNIQUES., 1997 WILEY, P. Shepherd and C. Dean., Monoclonal Antibodies., 2000 OXFORD UNIVERSITY PRESS; and J.W. Goding., Monoclonal Antibodies: principles and practice., 1993 ACADEMIC PRESS).

[0071] Examples of the antibody of the present invention prepared by any of the methods described above include the following antibody (a) obtained in Examples described later:

(a) an antibody comprising a heavy chain variable region comprising complementarity determining regions of SEQ ID NOs: 5, 6, and 7 and a light chain variable region comprising complementarity determining regions of SEQ ID NOs: 9, 10, and 11 (e.g., an antibody having a heavy chain variable region of SEQ ID NO: 8 and a light chain variable region of SEQ ID NO: 12);

[0072] In this context, the amino acid sequences shown by SEQ ID NOs: 5, 6, and 7 correspond to CDR1, CDR2, and CDR3, respectively, of a mouse antibody-derived heavy chain variable region. The amino acid sequences shown by SEQ ID NOs: 9, 10, and 11 correspond to CDR1, CDR2, and CDR3, respectively, of a mouse antibody-derived light chain variable region.

[0073] Examples of the humanized antibody, the chimeric antibody, the single-chain antibody, or the bispecific antibody of the present invention include antibodies described below.

(i) an antibody comprising a heavy chain variable region comprising the amino acid sequences of SEQ ID NOs: 5, 6, and 7 and the amino acid sequences of human antibody-derived framework regions and a light chain variable region comprising the amino acid sequences of SEQ ID NOs: 9, 10, and 11 and the amino acid sequences of human

antibody-derived framework regions.

(ii) an antibody comprising a heavy chain variable region comprising the amino acid sequences of SEQ ID NOs: 5, 6, and 7 and the amino acid sequences of human antibody-derived framework regions, a heavy chain constant region comprising a human antibody-derived amino acid sequence, a light chain variable region comprising the amino acid sequences of SEQ ID NOs: 9, 10, and 11 and the amino acid sequences of human antibody-derived framework regions, and a light chain constant region comprising a human antibody-derived amino acid sequence.

(iii) an antibody comprising a heavy chain variable region comprising the amino acid sequence of SEQ ID NO: 8, a heavy chain constant region comprising a human antibody-derived amino acid sequence, a light chain variable region comprising the amino acid sequence of SEQ ID NO: 12, and a light chain constant region comprising a human antibody-derived amino acid sequence.

[0074] The sequences of the constant and variable regions of human antibody heavy and light chains are available from, for example, NCBI (USA; GenBank, UniGene, etc.). For example, the following sequences can be referred to: Accession No. J00228 for a human IgG1 heavy chain constant region; Accession No. J00230 for a human IgG2 heavy chain constant region; Accession No. X03604 for a human IgG3 heavy chain constant region; Accession No. K01316 for a human IgG4 heavy chain constant region; Accession Nos. V00557, X64135, and X64133 for a human light chain κ constant region; and Accession Nos. X64132 and X64134 for a human light chain λ constant region.

[0075] Preferably, these antibodies have cytotoxic activity and can thereby exert an antitumor effect.

[0076] The above particular sequences of the heavy and light chain variable regions and CDRs in the above-mentioned antibodies are provided merely for illustrative purposes, and it is clear that the antibody of the present invention is not limited by the particular sequences. Hybridomas capable of producing anti-human CAPRIN-1 human antibodies or non-human animal antibodies (e.g., mouse antibodies) different from those specifically described above are prepared, and monoclonal antibodies produced by the hybridomas are recovered and it is determined whether or not the recovered antibodies are the antibodies of interest using the immunological binding activity against human CAPRIN-1 and cytotoxic activity as indicators. The monoclonal antibody-producing hybridomas of interest are thereby identified. Then, DNAs encoding heavy and light chain variable regions of the antibodies of interest are prepared from the hybridomas and sequenced, as described above. The DNAs are used for the preparation of different antibodies.

[0077] The antibody described above may be the antibody (a) having the substitution, deletion, or addition of one or several amino acids, in particular, in a framework region sequence and/or a constant region sequence, as long as the antibody has such specificity that it can specifically recognize CAPRIN-1. Herein, the term "several" preferably means 2 to 5, more preferably 2 or 3.

[0078] The antibody of the present invention has an affinity constant K_a (k_{on}/k_{off}) of preferably at least 10^7 M⁻¹, at least 10^8 M⁻¹, at least 5×10^8 M⁻¹, at least 10^9 M⁻¹, at least 5×10^9 M⁻¹, at least 10^{10} M⁻¹, at least 5×10^{10} M⁻¹, at least 10^{11} M⁻¹, at least 5×10^{11} M⁻¹, at least 10^{12} M⁻¹, or at least 10^{13} M⁻¹ for the CAPRIN-1 protein or the fragment thereof.

[0079] The antibody of the present invention can be conjugated with an antitumor agent. The conjugation of the antibody with the antitumor agent can be performed via a spacer having a group reactive with an amino group, a carboxyl group, a hydroxy group, a thiol group, or the like (e.g., a succinimidyl group, a formyl group, a 2-pyridyldithio group, a maleimidyl group, an alkoxy carbonyl group, or a hydroxy group).

[0080] Examples of the antitumor agent include the following antitumor agents known by literatures, etc.: paclitaxel, doxorubicin, daunorubicin, cyclophosphamide, methotrexate, 5-fluorouracil, thiotepa, busulfan, improsulfan, piposulfan, benzodopa, carboquone, meturedopa, uredopa, altretamine, triethylenemelamine, triethylenephosphoramidate, triethylenephosphoramide, trimethylolmelamine, bullatacin, bullatacinone, camptothecin, bryostatin, callistatin, cryptophycin 1, cryptophycin 8, dolastatin, duocarmycin, eleutherobin, pancratistatin, sarcodictyin, spongistatin, chlorambucil, chlornaphazine, cholophosphamide, estramustine, ifosfamide, mechlorethamine, mechlorethamine oxide hydrochloride, melphalan, novembichin, phenesterine, prednimustine, trofosfamide, uracil mustard, carmustine, chlorozotocin, fotemustine, lomustine, nimustine, ranimustine, calicheamicin, dynemicin, clodronate, esperamicin, aclacinomycin, actinomycin, authramycin, azaserine, bleomycin, cactinomycin, carabycin, carminomycin, carzinophilin, chromomycin, dactinomycin, detorbicin, 6-diazo-5-oxo-L-norleucine, Adriamycin, epirubicin, esorubicin, idarubicin, marcellomycin, mitomycin C, mycophenolic acid, nogalamycin, olivomycin, peplomycin, potfiromycin, puromycin, quelamycin, rodorubicin, streptonigrin, streptozocin, tubercidin, ubenimex, zinostatin, zorubicin, denopterin, pteropterin, trimetrexate, fludarabine, 6-mercaptopurine, thiamiprine, thioguanine, ancitabine, azacitidine, 6-azauridine, carmofur, cytarabine, dideoxyuridine, doxifluridine, enocitabine, floxuridine, androgens (e.g., calusterone, dromostanolone propionate, epitostanol, mepitostane, and testolactone), aminoglutethimide, mitotane, trilostane, frolic acid, aceglatone, aldophosphamide glycoside, aminolevulinic acid, eniluracil, amsacrine, bestabucil, bisantrene, edatraxate, defofamine, demecolcine, diaziquone, elfornithine, elliptinium acetate, epothilone, etoglucid, lentinan, lonidamine, maytansine, ansamitocin, mitoguazone, mitoxantrone, mopidanmol, nitraerine, pentostatin, phenamet, pirarubicin, losoxantrone, podophyllinic acid, 2-ethylhydrazide, procarbazine, razoxane, rhizoxin, schizophyllan, spirogermanium, tenuazonic acid, triaziquone, roridin A, anguidine, urethane, vindesine, dacarbazine, mannomustine, mitobronitol, mitolactol, pipobroman, gacytosine, docetaxel, chlorambucil, gem-

citabine, 6-thioguanine, mercaptopurine, cisplatin, oxaliplatin, carboplatin, vinblastine, etoposide, ifosfamide, mitoxantrone, vincristine, vinorelbine, novantrone, teniposide, edatrexate, daunomycin, aminopterin, Xeloda, ibandronate, irinotecan, topoisomerase inhibitors, difluoromethylornithine (DMFO), retinoic acid, capecitabine, and pharmaceutically acceptable salts and derivatives thereof.

5 **[0081]** Alternatively, the antibody of the present invention can be administered in combination with an antitumor agent to produce a higher therapeutic effect. This approach is adaptable to a patient with a cancer expressing CAPRIN-1 either before or after surgical operation. This approach can be applied, particularly after surgery, to CAPRIN-1-expressing cancer, which has been treated conventionally with an antitumor agent alone, to produce higher prevention of cancer recurrence or prolongation of survival time.

10 **[0082]** Examples of the antitumor agent used in the combined administration with the antibody of the present invention include the following antitumor agents known by literatures, etc.: paclitaxel, doxorubicin, daunorubicin, cyclophosphamide, methotrexate, 5-fluorouracil, thiotepa, busulfan, improsulfan, piposulfan, benzodopa, carboquone, meturedopa, uredopa, altretamine, triethylenemelamine, triethylenephosphoramidate, triethylenethiophosphoramidate, trimethylolmelamine, bullatacin, bullatacinone, camptothecin, bryostatin, callistatin, cryptophycin 1, cryptophycin 8, dolastatin, duocarmycin, eleutherobin, pancratistatin, sarcodictyin, spongistatin, chlorambucil, chlornaphazine, cholophosphamide, estramustine, ifosfamide, mechlorethamine, mechlorethamine oxide hydrochloride, melphalan, novembichin, phenesterine, prednimustine, trofosfamide, uracil mustard, carmustine, chlorozotocin, fotemustine, lomustine, nimustine, ranimustine, calicheamicin, dynemicin, clodronate, esperamicin, aclacinomycin, actinomycin, authramycin, azaserine, bleomycin, cactinomycin, carabicin, carminomycin, carzinophilin, chromomycin, dactinomycin, detorbicin, 6-diazo-5-oxo-L-norleucine, Adriamycin, epirubicin, esorubicin, idarubicin, marcellomycin, mitomycin C, mycophenolic acid, nogalamycin, olivomycin, peplomycin, potfiromycin, puromycin, quelamycin, rodorubicin, streptonigrin, streptozocin, tubercidin, ubenimex, zinostatin, zorubicin, denopterin, pteropterin, trimetrexate, fludarabine, 6-mercaptopurine, thiamiprine, thioguanine, ancitabine, azacitidine, 6-azauridine, carmofur, cytarabine, dideoxyuridine, doxifluridine, encitabine, floxuridine, calusterone, dromostanolone propionate, epitiostanol, mepitiostane, testolactone, aminoglutethimide, mitotane, trilostane, frolinic acid, aceglatone, aldophosphamide glycoside, aminolevulinic acid, eniluracil, amsacrine, bestrabucil, bisantrene, edatrexate, defofamine, demecolcine, diaziquone, elfornithine, elliptinium acetate, epothilone, etoglucid, lentinan, lonidamine, maytansine, ansamitocin, mitoguazone, mitoxantrone, mopidanmol, nitraerine, pentostatin, phenamet, pirarubicin, losoxantrone, podophyllinic acid, 2-ethylhydrazide, procarbazine, razoxane, rhizoxin, schizophyllan, spirogermanium, tenuazonic acid, triaziquone, roridin A, anguidine, urethane, vindesine, dacarbazine, mannomustine, mitobronitol, mitolactol, pipobroman, gacytosine, docetaxel, chlorambucil, gemcitabine, 6-thioguanine, mercaptopurine, cisplatin, oxaliplatin, carboplatin, vinblastine, etoposide, ifosfamide, mitoxantrone, vincristine, vinorelbine, novantrone, teniposide, edatrexate, daunomycin, aminopterin, Xeloda, ibandronate, irinotecan, topoisomerase inhibitors, difluoromethylornithine (DMFO), retinoic acid, capecitabine, and pharmaceutically acceptable salts (known in the art) and derivatives (known in the art) thereof. Of these antitumor agents, cyclophosphamide, paclitaxel, docetaxel, or vinorelbine is particularly preferably used.

35 **[0083]** The antibody of the present invention may be bound to a radioisotope known by literatures, etc., such as ^{211}At , ^{131}I , ^{125}I , ^{90}Y , ^{186}Re , ^{188}Re , ^{153}Sm , ^{212}Bi , ^{32}P , ^{175}Lu , or ^{176}Lu . Preferably, a radioisotope effective for the treatment or diagnosis of tumor is used. Such a radioisotope is also included in the scope of the antitumor agent according to the present invention.

40 <Antitumor effect>

[0084] It is considered that the antitumor effect of the anti-CAPRIN-1 antibody to be used in the present invention on CAPRIN-1-expressing cancer cells is brought about by the following mechanism: Antibody-dependent effector cell-mediated cytotoxicity (ADCC) against the CAPRIN-1-expressing cancer cells and complement-dependent cytotoxicity (CDC) against the CAPRIN-1-expressing cells. However, the scope of the present invention is not intended to be limited by the mechanism.

50 **[0085]** The antitumor effect based on the mechanism is known to correlate with the number of antibody-binding target molecules expressed on the surface of cancer cells (Niwa R., Clinical Cancer Research (2005) Mar 15; 11 (6): 2327-2336). The number of target molecules expressed on the surface of cancer cells can be examined using an existing assay kit capable of measuring the number of molecules on cell surface. Specifically, the number of antibody-binding target molecules can be determined by: reacting cancer cells with, for example, antibodies against the target molecules as primary antibodies; reacting therewith fluorescently labeled antibodies against the primary antibodies, together with calibration curve beads with the preliminarily known number of molecules; measuring the mean fluorescence intensity of the samples; and determining the number of the target molecules on the basis of the obtained calibration curve.

55 **[0086]** Thus, the anti-CAPRIN-1 antibody to be used in the present invention can be assayed for its activity by determining *ex vivo* the ADCC activity or the CDC activity against CAPRIN-1-expressing cancer cells or by examining the number of CAPRIN-1 molecules expressed on the surface of cancer cells in the case of using the anti-CAPRIN-1 antibody

according to the present invention as a primary antibody as specifically shown below in Examples.

[0087] The anti-CAPRIN-1 antibody to be used in the present invention binds to CAPRIN-1 proteins on cancer cells and exhibits an antitumor effect through the activity. Thus, the anti-CAPRIN-1 antibody of the present invention is considered to be useful in the treatment or prevention of cancer. Specifically, the present invention provides a pharmaceutical composition for treatment and/or prevention of cancer, comprising the anti-CAPRIN-1 antibody as an active ingredient. The anti-CAPRIN-1 antibody to be used for the purpose of administration to human bodies (antibody therapy) is preferably a human antibody or a humanized antibody for reducing immunogenicity.

[0088] The anti-CAPRIN-1 antibody with higher binding affinity for a CAPRIN-1 protein on the surface of cancer cells exerts stronger antitumor activity. Thus, the antibody according to the present invention can be expected to have a stronger antitumor effect due to the high binding affinity for the CAPRIN-1 protein, and therefore it can be used as a pharmaceutical composition for use in the treatment and/or prevention of cancer. Preferably, the antibody according to the present invention has high binding affinity with association constant (affinity constant) K_a (k_{on}/k_{off}) of preferably at least $10^7 M^{-1}$, at least $10^8 M^{-1}$, at least $5 \times 10^8 M^{-1}$, at least $10^9 M^{-1}$, at least $5 \times 10^9 M^{-1}$, at least $10^{10} M^{-1}$, at least $5 \times 10^{10} M^{-1}$, at least $10^{11} M^{-1}$, at least $5 \times 10^{11} M^{-1}$, at least $10^{12} M^{-1}$, or at least $10^{13} M^{-1}$, as described above.

[0089] A larger number of CAPRIN-1 molecules that can bind to anti-CAPRIN-1 antibodies on the surface of cancer cells produces stronger antitumor activity. Desirably, in order to produce the expected antitumor effect, the number of CAPRIN-1 molecules to which the antibodies bind is 10^4 or more, preferably 10^5 or more CAPRIN-1 molecules per cancer cell, as measured using the anti-CAPRIN-1 antibody of the present invention. Tumor (cancer cells) having a large number of CAPRIN-1 molecules on its cell surface is particularly preferred as cancer subject to the administration of the antibody of the present invention.

<Binding to antigen-expressing cells>

[0090] The ability of the antibody to bind to CAPRIN-1 can be determined by use of binding assay using, for example, ELISA, Western blot, immunofluorescence, and flow cytometry analysis, as described in Examples.

<Immunohistochemical staining>

[0091] The antibody that recognizes CAPRIN-1 can be tested for its reactivity with CAPRIN-1 by an immunohistochemical method well known to those skilled in the art using a paraformaldehyde- or acetone-fixed frozen section or paraformaldehyde-fixed paraffin-embedded tissue section of a tissue obtained from a patient during surgical operation or from a xenograft tissue-carrying animal inoculated with a cell line expressing CAPRIN-1 either spontaneously or after transfection.

[0092] For immunohistochemical staining, the antibody reactive with CAPRIN-1 can be stained by various methods. For example, the antibody can be visualized through reaction with a horseradish peroxidase-conjugated goat anti-mouse antibody, goat anti-rabbit antibody, or goat anti-chicken antibody.

<Pharmaceutical composition, and means for treating and/or preventing cancer>

[0093] A target of the pharmaceutical composition for treatment and/or prevention of cancer of the present invention is not particularly limited as long as the target is cancer (cells) expressing a CAPRIN-1 gene.

[0094] The terms "tumor" and "cancer" used herein mean malignant neoplasm and are used interchangeably with each other.

[0095] The cancer targeted in the present invention is cancer expressing a CAPRIN-1 protein-encoding gene and is preferably breast cancer, kidney cancer, pancreatic cancer, colorectal cancer, lung cancer, brain tumor, gastric cancer, uterine cervix cancer, ovary cancer, prostate cancer, urinary bladder cancer, esophageal cancer, leukemia, lymphoma, fibrosarcoma, mastocytoma, or melanoma.

[0096] Specific examples of these cancers include, but not limited to, breast adenocarcinoma, complex-type breast adenocarcinoma, malignant mixed tumor of mammary gland, intraductal papillary adenocarcinoma, lung adenocarcinoma, squamous cell cancer, small-cell cancer, large-cell cancer, glioma which is tumor of neuroepithelial tissue, ventricular ependymoma, neuronal tumor, embryonal neuroectodermal tumor, neurilemmoma, neurofibroma, meningioma, chronic lymphocytic leukemia, lymphoma, gastrointestinal lymphoma, alimentary lymphoma, small to medium cell-type lymphoma, cecal cancer, ascending colon cancer, descending colon cancer, transverse colon cancer, sigmoid colon cancer, rectal cancer, epithelial ovarian cancer, germ cell tumor, stromal cell tumor, pancreatic ductal carcinoma, invasive pancreatic ductal carcinoma, pancreatic adenocarcinoma, acinar cell carcinoma, adenosquamous carcinoma, giant cell tumor, intraductal papillary-mucinous neoplasm, mucinous cystic neoplasm, pancreatoblastoma, serous cystadenocarcinoma, solid papillary tumor, gastrinoma, glucagonoma, insulinoma, multiple endocrine neoplasia type-1 (Wermer's syndrome), nonfunctional islet cell tumor, somatostatinoma, and VIPoma.

[0097] The subject (patient) as the recipient is preferably mammals, for example, mammals including primates, pet animals, livestock, and sport animals and particularly preferably humans, dogs, and cats.

[0098] When using the antibody of the present invention in a pharmaceutical composition, the pharmaceutical composition can be formulated by a method known to those skilled in the art. For example, the pharmaceutical composition can be used in the form of a parenteral injection of an aseptic solution or suspension with water or any other pharmaceutically acceptable liquid. For example, the pharmaceutical composition may be formulated with the antibody mixed in a unit dosage form required for generally accepted pharmaceutical practice, in combination with pharmacologically acceptable carriers or media, specifically, sterilized water, physiological saline, plant oil, an emulsifier, a suspending agent, a surfactant, a stabilizer, a flavoring agent, an excipient, a vehicle, a preservative, a binder, etc. as appropriate. The amount of the active ingredient in such a preparation is determined such that an appropriate dose within the indicated range can be achieved.

[0099] An aseptic composition for injection can be formulated according to conventional pharmaceutical practice using a vehicle such as injectable distilled water.

[0100] Examples of aqueous solutions for injection include physiological saline, isotonic solutions containing glucose and other adjuvants, for example, D-sorbitol, D-mannose, D-mannitol, and sodium chloride. These solutions may be used in combination with an appropriate solubilizer, for example, an alcohol (particularly, ethanol) or a polyalcohol (e.g., propylene glycol and polyethylene glycol), or a nonionic surfactant, for example, polysorbate 80 (TM) or HCO-60.

[0101] Examples of oily solutions include those using sesame oil or soybean oil. The solutions may be used in combination with a solubilizer such as benzyl benzoate or benzyl alcohol. A buffer (e.g., a phosphate buffer solution or a sodium acetate buffer solution), a soothing agent (e.g., procaine hydrochloride), a stabilizer (e.g., benzyl alcohol or phenol), or an antioxidant may be added to the solutions. The injection solutions thus prepared are generally charged into appropriate ampules.

[0102] The pharmaceutical composition of the present invention is administered orally or parenterally, preferably parenterally. Specific examples of its dosage forms include injections, intranasal administration agents, transpulmonary administration agents, and percutaneous administration agents. Examples of the injections include intravenous injection, intramuscular injection, intraperitoneal injection, and subcutaneous injection, through which the pharmaceutical composition can be administered systemically or locally.

[0103] Also, the administration method can be appropriately selected depending on the age, weight, sex, symptoms, etc. of a patient. The dose of a pharmaceutical composition containing the antibody or a polynucleotide encoding the antibody can be selected within a range of, for example, 0.0001 to 1000 mg/kg of body weight per dose. Alternatively, the dose can be selected within a range of, for example, 0.001 to 100000 mg/body of a patient, though the dose is not necessarily limited to these numeric values. Although the dose and the administration method vary depending on the weight, age, sex, symptoms, etc. of a patient, those skilled in the art can appropriately select the dose and the method.

[0104] The pharmaceutical composition including the antibody of the present invention or fragments thereof can be administered to a subject to treat and/or prevent cancer, preferably breast cancer, kidney cancer, pancreatic cancer, colorectal cancer, lung cancer, brain tumor, gastric cancer, uterine cervix cancer, ovary cancer, prostate cancer, urinary bladder cancer, esophageal cancer, leukemia, lymphoma, fibrosarcoma, mastocytoma, or melanoma.

[0105] The present invention further encompasses means for treating and/or preventing cancer, by administering the pharmaceutical composition of the present invention in combination with the antitumor agent as exemplified above or a pharmaceutical composition comprising the antitumor agent to a subject. The antibody of the present invention or the fragment thereof may be administered simultaneously with or separately from the antitumor agent to the subject. In the case of separately administering these pharmaceutical compositions, either one may be administered first or later. Their dosing intervals, doses, administration routes, and the number of doses can be appropriately selected by a specialist. The other pharmaceutical dosage forms to be administered simultaneously also include, for example, pharmaceutical compositions formulated by mixing the antibody of the present invention or the fragment thereof or the antitumor agent into a pharmacologically acceptable carrier (or medium). The above descriptions about composition, formulation, administration routes, doses, cancer, etc. as to the pharmaceutical compositions and dosage forms containing the antibody of the present invention are also applicable to any of the above-mentioned pharmaceutical compositions and dosage forms containing the antitumor agent.

[0106] Thus, the present invention also provides a pharmaceutical combination for treatment and/or prevention of cancer, comprising the pharmaceutical composition of the present invention and a pharmaceutical composition comprising the antitumor agent as exemplified above. The present invention also provides a pharmaceutical composition for treatment and/or prevention of cancer, comprising the antibody or the fragment thereof of the present invention and the antitumor agent together with a pharmacologically acceptable carrier.

<Polypeptide and DNA>

[0107] The present invention further provides a DNA encoding the antibody of the present invention or the fragment

(antibody-binding fragment) thereof. The DNA may be a DNA encoding the heavy and/or light chains of the antibody or may be a DNA encoding the heavy and/or light chain variable regions of the antibody. The DNA may also be a DNA encoding each or a combination of the complementarity determining regions of antibody. Such a DNA includes, for example, a heavy chain variable region-encoding DNA comprising nucleotide sequences encoding the amino acid sequences of SEQ ID NOs: 5, 6, and 7, and a light chain variable region-encoding DNA comprising nucleotide sequences encoding the amino acid sequences of SEQ ID NOs: 9, 10, and 11, in the case of the above-mentioned antibody (a).

[0108] The complementarity determining regions (CDRs) encoded by the DNA having these sequences serve as regions that determine the specificity of the antibody. Sequences encoding the other regions (i.e., constant regions and framework regions) of the antibody may therefore be sequences derived from other antibodies. In this context, "other antibodies" also include antibodies derived from non-human organisms, but are preferably those derived from humans from the viewpoint of reducing adverse reactions. Specifically, in the DNA of the present invention, regions encoding each framework region and each constant region in the heavy and light chains preferably comprise nucleotide sequences encoding corresponding human antibody-derived amino acid sequences.

[0109] Further examples of the DNA encoding the antibody of the present invention include a DNA encoding a heavy chain variable region comprising a nucleotide sequence encoding the amino acid sequence of SEQ ID NO: 8, and a DNA encoding a light chain variable region comprising a nucleotide sequence encoding the amino acid sequence of SEQ ID NO: 12. In this context, the nucleotide sequence encoding the amino acid sequence of SEQ ID NO: 8 is, for example, the nucleotide sequence of SEQ ID NO: 13. An example of nucleotide sequences encoding the amino acid sequence of SEQ ID NO: 12 is the nucleotide sequence of SEQ ID NO: 14. When such a DNA comprises regions encoding constant regions of the heavy and light chains, each of the regions preferably comprises a nucleotide sequence encoding a corresponding human antibody-derived amino acid sequence (amino acid sequence of each constant region of the heavy and light chains).

[0110] These antibody DNAs can be obtained, for example, by the methods described above, or the following method. First, total RNAs are prepared from hybridomas producing the antibody of the present invention using a commercially available RNA extraction kit, and cDNAs are synthesized therefrom using reverse transcriptase and random primers or the like. Subsequently, the antibody-encoding cDNAs are amplified by PCR using oligonucleotide primers for conserved sequences of variable regions in known mouse antibody heavy or light chain genes. Sequences encoding the constant regions can be obtained by PCR amplification of the known sequences. The nucleotide sequence of the DNA can be incorporated into a plasmid or a phage for sequencing, for example, and determined according to a conventional method.

[0111] The present invention further provides the following polypeptides and DNAs related to the above-mentioned antibody (a):

- (i) a polypeptide comprising any of amino acid sequences of SEQ ID NOs: 8 and 12, and a DNA encoding the polypeptide (e.g., a DNA comprising any of the nucleotide sequences of SEQ ID NOs: 13 and 14);
- (ii) heavy chain CDR polypeptides selected from the group consisting of amino acid sequences shown by SEQ ID NOs: 5, 6, and 7, and a DNA encoding the polypeptides; and
- (iii) light chain CDR polypeptides selected from amino acid sequences shown by SEQ ID NOs: 9, 10, and 11, and a DNA encoding the polypeptides.

[0112] These polypeptides and DNAs can be prepared using genetic engineering techniques as described above.

Examples

[0113] Hereinafter, the present invention will be described specifically with reference to Examples. However, the scope of the present invention is not intended to be limited by these specific examples.

Example 1 Analysis of CAPRIN-1 expression in each tissue

[0114] CAPRIN-1 gene expression in canine and human normal tissues and various cell lines was examined by RT-PCR according to Example 1(4) of WO2010/016526. As a result, strong expression was observed in the testis among the healthy canine tissues, whereas expression was observed in canine breast cancer and adenocarcinoma tissues. Further, as a result of examining the expression in human tissues, the expression was observed only in the testis among normal tissues, as with the canine CAPRIN-1 gene. By contrast, the expression was detected in many types of cancer cell lines, including 8 human breast cancer cell lines (ZR75-1, MCF7, T47D, SK-BR-3, MDA-MB-157, BT-20, MDA-MB-231V, and MRK-nu-1) and 4 pancreatic cancer cell lines (Capan-2, MIAPaCa-2, Panc-1, and BxPc-3), among cancer cells. These results demonstrated that CAPRIN-1 expression is not found in normal tissues other than the testis, whereas CAPRIN-1 is expressed in the breast cancer cell lines.

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Example 2 Preparation of mouse monoclonal antibody against CAPRIN-1

[0115] 100 μg of human CAPRIN-1 proteins (having the amino acid sequence of SEQ ID NO: 2) prepared in Example 3 of WO2010/016526 was mixed with an equal amount of MPL+TDM adjuvant (Sigma-Aldrich Corp.). This mixture was used as an antigen solution per mouse. The antigen solution was intraperitoneally administered to each 6-week-old Balb/c mouse (prepared by Japan SLC, Inc.). Then, 7 administrations were performed every 1 week to complete immunization. Three days after the final immunization, the spleen of each mouse was excised and ground between two sterilized glass slides. Procedures of washing with PBS(-) (manufactured by Nissui Pharmaceutical Co., Ltd.) and centrifuging at 1500 rpm for 10 minutes to remove the supernatant were repeated three times to obtain spleen cells. The obtained spleen cells were mixed with mouse myeloma cells SP2/0 (purchased from ATCC) at a ratio of 10:1. A PEG solution prepared by mixing 200 μl of an RPMI1640 medium containing 10% FBS, which was heated to 37°C, with 800 μl of PEG1500 (manufactured by Boehringer Ingelheim GmbH) was added to the cell mixture, and then it was left to stand for 5 minutes for cell fusion. After removal of the supernatant via centrifugation at 1700 rpm for 5 minutes, the cells were suspended in 150 ml of an RPMI1640 medium containing 15% FBS supplemented with 2% equivalent of a HAT solution (Gibco) (HAT selective medium). This suspension was seeded onto fifteen 96-well plates (Nunc) at 100 μl /well. The spleen cells and the myeloma cells were fused by culturing for 7 days at 37°C, 5% CO₂ to obtain hybridomas.

[0116] The prepared hybridomas were screened for the binding affinity of antibodies produced by the hybridomas against CAPRIN-1 proteins as an indicator. A 1 $\mu\text{g}/\text{ml}$ solution of the CAPRIN-1 protein prepared in Example 3 of WO2010/016526 was added to a 96-well plate at 100 $\mu\text{l}/\text{well}$ and left to stand at 4°C for 18 hours. Each well was washed three times with PBS-T. Then, a 0.5% bovine serum albumin (BSA) solution (manufactured by Sigma-Aldrich Corp.) was added thereto at 400 $\mu\text{l}/\text{well}$ and left to stand at room temperature for 3 hours. The solution in each well was removed, and each well was washed three times with 400 μl of PBS-T. Then, the culture supernatant of each hybridoma obtained above was added thereto at 100 $\mu\text{l}/\text{well}$ and left to stand at room temperature for 2 hours. Each well was washed three times with PBS-T. Then, HRP-labeled anti-mouse IgG (H+L) antibodies (manufactured by Invitrogen Corp.) diluted 5000-fold with PBS were added thereto at 100 $\mu\text{l}/\text{well}$ and left to stand at room temperature for 1 hour. Each well was washed three times with PBS-T. Then, a TMB substrate solution (manufactured by Thermo Fisher Scientific Inc.) was added thereto at 100 $\mu\text{l}/\text{well}$ and left to stand for 15 to 30 minutes to cause color reaction. After the color development, the reaction was terminated by the addition of 1N sulfuric acid at 100 $\mu\text{l}/\text{well}$. The absorbance was measured at 450 nm and 595 nm using an absorption spectrometer. As a result, several hybridomas producing antibodies having high absorbance were selected.

[0117] The selected hybridomas were added to a 96-well plate at 0.5 cells/well and cultured in the plate. One week later, hybridomas forming single colonies in the wells were observed. The cells in these wells were further cultured, and the cloned hybridomas were screened for the binding affinity of antibodies produced by the hybridomas to the CAPRIN-1 protein as an indicator. A 1 $\mu\text{g}/\text{ml}$ solution of the CAPRIN-1 protein prepared in Example 3 of WO2010/016526 was added to a 96-well plate at 100 $\mu\text{l}/\text{well}$ and left to stand at 4°C for 18 hours. Each well was washed three times with PBS-T. Then, a 0.5% BSA solution was added thereto at 400 $\mu\text{l}/\text{well}$ and left to stand at room temperature for 3 hours. The solution in each well was removed, and each well was washed three times with 400 μl of PBS-T. Then, the culture supernatant of each hybridoma obtained above was added thereto at 100 $\mu\text{l}/\text{well}$ and left to stand at room temperature for 2 hours. Each well was washed three times with PBS-T. Then, HRP-labeled anti-mouse IgG (H+L) antibodies (manufactured by Invitrogen Corp.) diluted 5000-fold with PBS were added thereto at 100 $\mu\text{l}/\text{well}$ and left to stand at room temperature for 1 hour. Each well was washed three times with PBS-T. Then, a TMB substrate solution (manufactured by Thermo Fisher Scientific Inc.) was added thereto at 100 $\mu\text{l}/\text{well}$ and left to stand for 15 to 30 minutes to cause color reaction. After the color development, the reaction was terminated by the addition of 1 N sulfuric acid at 100 $\mu\text{l}/\text{well}$. The absorbance was measured at 450 nm and 595 nm using an absorption spectrometer. As a result, 112 hybridoma lines producing monoclonal antibodies reactive with the CAPRIN-1 protein were obtained.

[0118] Next, these monoclonal antibodies were screened for antibodies reactive with the surface of breast cancer cells expressing CAPRIN-1. Specifically, 10⁶ cells of a human breast cancer cell line MDA-MB-231V were centrifuged in a 1.5-ml microcentrifuge tube. 100 μl of the culture supernatant of the hybridoma obtained above was added thereto and left to stand for 1 hour on ice. After washing with PBS, FITC-labeled goat anti-mouse IgG antibodies (manufactured by Invitrogen Corp.) diluted 500-fold with PBS containing 0.1% FBS were added thereto and left to stand for 1 hour on ice. After washing with PBS, the fluorescence intensity was measured using FACSCalibur (Becton, Dickinson and Company). On the other hand, the same operation as above was performed using the serum of each untreated 6-week-old Balb/c mouse diluted 500-fold with a medium for hybridoma culture, instead of the antibodies, to prepare a control. As a result, one monoclonal antibody (#1) having stronger fluorescence intensity than that of the control, i.e., reactive with the surface of the breast cancer cells, was selected.

Example 3 Characterization of selected monoclonal antibody

[0119] Amplification fragments of genes encoding the variable regions of the monoclonal antibodies obtained in Example 2 were obtained according to a method described in Example 5 of WO2010/016526 and analyzed for their gene sequences and amino acid sequences encoded thereby. As a result, the monoclonal antibody #1 had variable regions consisting of the heavy chain variable region of SEQ ID NO: 8 and the light chain variable region of SEQ ID NO: 12. The gene sequence encoding the heavy chain variable region of the obtained monoclonal antibody #1 is shown in SEQ ID NO: 13, and the amino acid sequence is shown in SEQ ID NO: 8. The gene sequence encoding the light chain variable region of the obtained monoclonal antibody #1 is shown in SEQ ID NO: 14, and the amino acid sequence is shown in SEQ ID NO: 12.

[0120] In other words, the monoclonal antibody #1 was found to comprise the heavy chain variable region of SEQ ID NO: 8 and the light chain variable region of SEQ ID NO: 12, wherein the heavy chain variable region had CDR1, CDR2, and CDR3 consisting of the amino acid sequences of SEQ ID NOS: 5, 6, and 7, respectively, and the light chain variable region had CDR1, CDR2, and CDR3 consisting of the amino acid sequences of SEQ ID NOS: 9, 10, and 11, respectively.

Example 4 Preparation of human-mouse chimeric monoclonal antibody

[0121] The gene amplification fragment prepared in Example 3 comprising the sequence (SEQ ID NO: 13) of the heavy chain variable region of the mouse monoclonal antibody #1 was treated at both ends with a restriction enzyme, then purified, and inserted according to a conventional method into a vector pcDNA4/myc-His (manufactured by Invitrogen Corp.) already having gene inserts of a mouse antibody-derived leader sequence and a human IgG₁ H chain constant region comprising the amino acid sequence of SEQ ID NO: 37. Also, the gene amplification fragment comprising the sequence (SEQ ID NO: 14) of the light chain variable region of the mouse monoclonal antibody #1 was treated at both ends with a restriction enzyme, then purified, and inserted according to a conventional method into a vector pcDNA3.1/myc-His (manufactured by Invitrogen Corp.) already having gene inserts of a mouse antibody-derived leader sequence and a human IgG₁ L chain constant region comprising the amino acid sequence of SEQ ID NO: 38.

[0122] Next, the recombinant vector having the insert of the heavy chain variable region (SEQ ID NO: 13) of the mouse monoclonal antibody #1 and the recombinant vector having the insert of the light chain variable region (SEQ ID NO: 14) of the mouse monoclonal antibody #1 were introduced into CHO-K1 cells (obtained from Riken Cell Bank). Specifically, 2×10^5 CHO-K1 cells were cultured in a Ham's F12 medium (manufactured by Invitrogen Corp.) containing 1 ml of 10% FBS per well in a 12-well culture plate, and washed with PBS(-). Then, a fresh Ham's F12 medium containing 1 ml of 10% FBS per well was added thereto. 250 ng each of the vectors in 30 μ l of OptiMEM (manufactured by Invitrogen Corp.) was mixed with 30 μ l of Polyfect transfection reagent (manufactured by Qiagen N.V.), and this mixture was added to each well. The CHO-K1 cells cotransfected with the recombinant vectors were cultured in a Ham's F12 medium containing 10% FBS supplemented with 200 μ g/ml Zeocin (manufactured by Invitrogen Corp.) and 200 μ g/ml Geneticin (manufactured by Roche Diagnostics K.K.) and then seeded onto a 96-well plate at 0.5 cells/well to prepare a cell line stably producing a human-mouse chimeric monoclonal antibody #1 (#1) having the variable regions of the mouse monoclonal antibody #1.

[0123] Each prepared cell line was cultured for 5 days in a 150-cm² flask at 5×10^5 cells/ml in 30 ml of a serum-free OptiCHO medium (manufactured by Invitrogen Corp.) to obtain culture supernatants containing the human-mouse chimeric monoclonal antibody #1.

[0124] Also, cell lines stably producing human-mouse chimeric comparative monoclonal antibodies 1 to 11 were prepared in the same way as above respectively, on the basis of the following anti-CAPRIN-1 mouse-derived monoclonal antibodies disclosed in WO2010/016526 as comparative antibodies: a comparative antibody 1 having the heavy chain variable region of SEQ ID NO: 15 and the light chain variable region of SEQ ID NO: 16; a comparative antibody 2 having the heavy chain variable region of SEQ ID NO: 17 and the light chain variable region of SEQ ID NO: 18; a comparative antibody 3 having the heavy chain variable region of SEQ ID NO: 19 and the light chain variable region of SEQ ID NO: 20; a comparative antibody 4 having the heavy chain variable region of SEQ ID NO: 21 and the light chain variable region of SEQ ID NO: 22; a comparative antibody 5 having the heavy chain variable region of SEQ ID NO: 23 and the light chain variable region of SEQ ID NO: 24; a comparative antibody 6 having the heavy chain variable region of SEQ ID NO: 25 and the light chain variable region of SEQ ID NO: 26; a comparative antibody 7 having the heavy chain variable region of SEQ ID NO: 27 and the light chain variable region of SEQ ID NO: 28; a comparative antibody 8 having the heavy chain variable region of SEQ ID NO: 29 and the light chain variable region of SEQ ID NO: 30; a comparative antibody 9 having the heavy chain variable region of SEQ ID NO: 31 and the light chain variable region of SEQ ID NO: 32; a comparative antibody 10 having the heavy chain variable region of SEQ ID NO: 33 and the light chain variable region of SEQ ID NO: 34; and a comparative antibody 11 having the heavy chain variable region of SEQ ID NO: 35 and the light chain variable region of SEQ ID NO: 36. Each prepared cell line was cultured for 5 days in a 150-cm² flask at 5×10^5 cells/ml in 30 ml of a serum-free OptiCHO medium (manufactured by Invitrogen Corp.) to obtain culture super-

natants containing respective human-mouse chimeric comparative antibodies 1 to 11.

Example 5 Expression analysis of CAPRIN-1 on surface of various cancer cells using anti-CAPRIN-1 antibody #1

5 **[0125]** Next, the human breast cancer cell lines (ZR75-1, MCF7, T47D, SK-BR-3, MDA-MB-157, BT-20, MDA-MB-231V, and MRK-nu-1), the kidney cancer cell lines (Caki-1, Caki-2, A498, and ACHN), the urinary bladder cancer cell line (T24), the ovary cancer cell line (SKOV3), the lung cancer cell lines (QG56 and A549), the pancreatic cancer cell lines (Capan-2 and MIAPaCa-2), the prostate cancer cell line (PC3), the uterine cervix cancer cell line (SW756), the fibrosarcoma cell line (HT1080), the brain tumor cell lines (T98G, U87MG, U251, SNB19, and U373), the gastric cancer cell lines (MNK28 and MNK45), the colorectal cancer cell lines (HT29, Lovo, CaCo2, SW480, and HCT116), the leukemia cell line (AML5), and the lymphoma cell line (Ramos) observed to have CAPRIN-1 gene expression were examined for their expression of CAPRIN-1 proteins on the cell surface using the culture supernatants containing #1 obtained in Example 2. 5×10^5 cells of each cell line were centrifuged in each 1.5-ml microcentrifuge tube. A culture supernatant (100 μ l) containing the antibody #1 was added to the tube and left to stand for 1 hour on ice. After washing with PBS, FITC-labeled goat anti-mouse IgG (H+L) antibodies (manufactured by Jackson ImmunoResearch Laboratories, Inc.) diluted with PBS containing 0.1% FBS were added thereto and left to stand at 4°C for 30 minutes. After washing with PBS, the fluorescence intensity was measured using FACSCalibur (Becton, Dickinson and Company). The negative control used was cells reacted only with secondary antibodies. As a result, the cells treated with the antibody #1 had fluorescence intensity at least 35% stronger than that of the negative control. This demonstrated that CAPRIN-1 proteins are expressed on the cell membrane surface of the human cancer cell lines. The rates of enhancement in the fluorescence intensity was expressed as the rates of increase in mean fluorescence intensity (MFI) in respective cell lines, which are calculated according to the following formula.

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$$\text{Rate of increase in mean fluorescence intensity (Rate of enhancement in fluorescence intensity) (\%)} = \frac{(\text{MFI of cells reacted with the anti-CAPRIN-1 antibodies}) - (\text{Control MFI})}{(\text{Control MFI})} \times 100$$

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Example 6 Antitumor effect (ADCC activity) of anti-CAPRIN-1 antibody on cancer cell

[0126] The anti-CAPRIN-1 human-mouse chimeric monoclonal antibody #1 obtained in Example 4 was examined for whether it has an ability to damage CAPRIN-1-expressing cancer cells by determining ADCC activity. The culture supernatant of a cell line producing #1 was purified using Hitrap Protein A Sepharose FF (manufactured by GE Healthcare BioSciences Ltd.). After replacement with PBS(-), the solution was filtered through a 0.22- μ m filter (manufactured by Millipore Corp.). The resulting antibody was used for activity assay. 10^6 cells each of the human breast cancer cell line MCF7, the human colorectal cancer cell line HCT-116, the human pancreatic cancer cell line MIAPaCa-2, the human kidney cancer cell line Caki-2, and the human lung cancer cell line QG56 observed to have CAPRIN-1 expression were collected into a 50-ml centrifuge tube, and 100 μ Ci of chromium 51 was then added thereto, followed by incubation at 37°C for 2 hours. Then, the cells were washed three times with an RPMI1640 medium containing 10% FBS and added at 2×10^3 cells/well to a 96-well V-bottom plate to prepare target cells. The purified antibody #1 and the human-mouse chimeric comparative antibodies 1 to 11 obtained in Example 4 were each added thereto at 1 μ g/well. A cell population containing human NK cells separated using a conventional method from human peripheral blood lymphocytes was added to the plate at 2×10^5 cells/well and cultured for 4 hours at 37°C, 5% CO₂. After the culture, the amount of chromium 51 released from damaged tumor cells was measured in the culture supernatant to calculate the cytotoxic activity of each anti-CAPRIN-1 antibody against the cancer cells. The negative control used was cells treated with isotype control antibodies. The cell population containing NK cells that was used in this evaluation was prepared as follows: human peripheral blood mononuclear cells separated from peripheral blood according to a conventional method using a specific gravity separation solution Histopaque for human peripheral blood mononuclear cell separation (Sigma-Aldrich Corp.) were reacted with various FITC fluorescent dye-labeled antibodies (anti-human CD3 antibody, anti-human CD20 antibody, anti-human CD19 antibody, anti-human CD11c antibody, and anti-HLA-DR antibody (Becton, and Dickinson and Company)); and a cell population unstained with the antibodies was separated therefrom using a cell sorter (FACS Vantage SE (Becton, and Dickinson and Company)), or a cell population was separated with human NK cell separation kit (manufactured by Miltenyi Biotec K.K.). As a result of evaluating cytotoxic activity against the cancer cells, the isotype control antibodies used and the comparative antibodies 1 to 11 used had cytotoxic activity less than 5% against all of the human breast cancer cell line MCF7, the human colorectal cancer cell line HCT-116, the human pancreatic cancer cell line MIAPaCa-2, the human kidney cancer cell line Caki-2, and the human lung cancer cell line QG56. By contrast,

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the antibody #1 exhibited cytotoxic activity of 26%, 17%, 29%, 23%, and 11% against the human breast cancer cell line MCF7, the human colorectal cancer cell line HCT-116, the human pancreatic cancer cell line MIAPaCa-2, the human kidney cancer cell line Caki-2, and the human lung cancer cell line QG56, respectively. Likewise, the isotype control antibodies used and the comparative antibodies 1 to 11 used had cytotoxic activity less than 4% against all other cancer cells, breast cancer cell lines ZR75-1, T47D, Hs578T, BT-20, SK-BR-3, MDA-MB-231V, and MRK-nu-1, glioma cell lines T98G and U373, a lung cancer cell line A549, kidney cancer cell lines Caki-1 and ACHN, a uterine cervix cancer cell line SW756, a urinary bladder cancer cell line T24, gastric cancer cell lines MKN28 and MKN45, a colorectal cancer cell line SW480, a leukemia cell line AML5, and a lymphoma cell line Ramos. By contrast, the antibody #1 was observed to have 10% or higher cytotoxic activity against these cell lines. These results showed that the obtained monoclonal antibody #1 against CAPRIN-1 damages CAPRIN-1-expressing cancer cells through their ADCC activity, and it was demonstrated that the antibody #1 exhibits stronger cytotoxic activity against human cancer cells than that of the comparative antibodies 1 to 11.

[0127] These results were obtained via determination of cytotoxic activity by, as described above, mixing the anti-CAPRIN-1 antibody used in the present invention, lymphocytes (cell population containing NK cells), and 2×10^3 cells of each cancer cell line with incorporated chromium 51, culturing the cells for 4 hours; after the culture, measuring the amount of chromium 51 released into the medium; and calculating the cytotoxic activity against each cancer cell line according to the following formula*.

$$\text{*Expression: Cytotoxic activity (\%)} = \frac{\text{[Amount of chromium 51 released from the target cells treated with the antibody against CAPRIN-1 and lymphocytes (cell population containing NK cells)]}}{\text{[Amount of chromium 51 released from target cells treated with 1 N hydrochloric acid]}} \times 100$$

[0128] Next, the human-mouse chimeric monoclonal antibody #1 obtained in Example 4 was evaluated for its antitumor effect in cancer-bearing mice *in vivo*. The antibody #1 used was column-purified from the culture supernatant of each cell line producing the antibody #1. Similarly, the anti-CAPRIN-1 human-mouse chimeric comparative monoclonal antibodies 1 to 11 prepared in Example 4 were also evaluated for their antitumor effects in cancer-bearing mice *in vivo*.

[0129] Specifically, the antibody #1 was examined for its antitumor effect using cancer-bearing mice in which a CAPRIN-1-expressing human-derived cancer cell line was transplanted. Human pancreatic cancer cell line Capan-2 cells (purchased from ATCC) were subcutaneously transplanted at 2×10^6 cells per mouse into the backs of 65 Balb/c nude mice (manufactured by Japan SLC, Inc.) and grown until the size of tumor became approximately 5 mm in diameter. The antibody #1 and the human-mouse chimeric comparative antibodies 1 to 11 were each intraperitoneally administered at a dose of 200 μg (200 μl)/mouse to 5 animals (per antibody) of the cancer-bearing mouse. Then, each antibody was intraperitoneally administered to the cancer-bearing mice at the same dose as above a total of three times for 2 days. The size of tumor was measured every day to assay the antitumor effect. On the other hand, PBS(-) was administered instead of the antibodies to the remaining 5 animals of the cancer-bearing mouse, as a control group. The size of tumor (volume) was calculated according to the formula: $0.5 \times (\text{Major axis} \times \text{Minor axis} \times \text{Minor axis})$.

[0130] As a result of assay of the antitumor effect, in the test group that received the antibody #1 against CAPRIN-1, tumor growth was suppressed to 68% at day 29 after the antibody administration relative to the control group in terms of tumor size at the same date (defined as 100%). By contrast, in the mice that received the human-mouse chimeric comparative antibodies 1 to 11, tumor growth was suppressed to approximately 85%. These results demonstrated that the obtained anti-CAPRIN-1 antibody #1 exerts *in vivo* an antitumor effect on CAPRIN-1-expressing cancer cells. The results also demonstrated that the antibody #1 exerts *in vivo* a stronger antitumor effect than that of the comparative antibodies 1 to 11.

Example 7 The number of CAPRIN-1 molecules on surface of various cancer cells recognized by anti-CAPRIN-1 antibody #1

[0131] Human breast cancer cell lines (ZR75-1, MCF7, T47D, SK-BR-3, MDA-MB-157, BT-20, MDA-MB-231V, and MRK-nu-1), kidney cancer cell lines (Caki-1, Caki-2, A498, and ACHN), a urinary bladder cancer cell line (T24), an ovary cancer cell line (SKOV3), lung cancer cell lines (QG56 and A549), pancreatic cancer cell lines (MIAPaCa-2 and Capan-2), a prostate cancer cell line (PC3), a uterine cervix cancer cell line (SW756), a fibrosarcoma cell line (HT1080), brain tumor cell lines (T98G, U87MG, U251, SNB19, and U373), gastric cancer cell lines (MKN28 and MKN45), colorectal cancer cell lines (HT29, Lovo, CaCo2, SW480, and HCT116), a leukemia cell line (AML5), and a lymphoma cell line

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(Ramos) were examined using QIFIKIT, an assay kit for the number of molecules (manufactured by Dako Japan Inc.) for the number of CAPRIN-1 molecules on their cell surface recognized by the anti-CAPRIN-1 antibody #1. Similarly, the number of CAPRIN-1 molecules on the surface of these various cancer cells was also examined using the comparative antibodies 1 to 11, which are anti-CAPRIN-1 monoclonal antibodies prepared in Example 4.

5 **[0132]** According to the protocol attached to the kit, the antibody #1 and comparative antibodies 1 to 11 were diluted into 5 µg/ml at final concentration with PBS, and this dilution was added to each cell line and reacted for 30 minutes. After washing with PBS, fluorescently labeled anti-mouse IgG antibodies attached to the kit were added as secondary antibodies, together with calibration beads attached to the kit, to each cell line and left to stand for 45 minutes on ice. 10 Each cell line and the calibration beads were washed with PBS. Then, the fluorescence intensity was measured using FACSCalibur (Becton, Dickinson and Company) to obtain a mean fluorescence intensity value (mean). Further, the fluorescence intensity was also measured using comparative antibodies similarly as above to obtain a mean. The negative control used was cells reacted with isotype control antibodies, and a mean was also obtained. Each mean fluorescence intensity value (mean) was used to calculate the number of molecules according to the protocol attached to the kit. As 15 a result, the number of CAPRIN-1 molecules on the surface of various cancer cells recognized by the antibody #1 was 10^5 or more per cell for all the examined human cancer cell lines. On the other hand, the number of molecules recognized by the comparative monoclonal antibodies 1 to 11 was less than 10^5 per cell.

Industrial Applicability

20 **[0133]** The antibody of the present invention is useful in the treatment and/or prevention of cancer.

SEQUENCE LISTING

[0134]

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<110> Toray Industries, Inc.

<120> Pharmaceutical Composition for Treatment and Prevention of Cancer

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<130> PH-5300-PCT

<150> JP 2011-171332

<151> 2011-08-04

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	Lys Leu Val Asp		Pro Glu Arg Asp Met Ser		Leu Arg Leu Asn Glu Gln		195 200 205
15	tat gaa cat gcc tcc att cac ctg tgg gac ctg ctg gaa ggg aag gaa						855
	Tyr Glu His		Ala Ser Ile His Leu Trp Asp		Leu Leu Glu Gly Lys Glu		210 215 220
20	aaa cct gta tgt gga acc acc tat aaa gtt cta aag gaa att gtt gag						903
	Lys Pro Val Cys Gly Thr Thr Tyr Lys Val Leu Lys Glu Ile Val Glu						225 230 235
25	cgt gtt ttt cag tca aac tac ttt gac agc acc cac aac cac cag aat						951
	Arg Val Phe Gln Ser Asn Tyr Phe Asp Ser Thr His Asn His Gln Asn						240 245 250
30	ggg ctg tgt gag gaa gaa gag gca gcc tca gca cct gca gtt gaa gac						999
	Gly Leu Cys Glu Glu Glu Glu Ala Ala Ser Ala Pro Ala Val Glu Asp						255 260 265 270
35	cag gta cct gaa gct gaa cct gag cca gca gaa gag tac act gag caa						1047
	Gln Val Pro Glu Ala Glu Pro Glu Pro Ala Glu Glu Tyr Thr Glu Gln						275 280 285
40	agt gaa gtt gaa tca aca gag tat gta aat aga cag ttc atg gca gaa						1095
	Ser Glu Val Glu Ser Thr Glu Tyr Val Asn Arg Gln Phe Met Ala Glu						290 295 300
45	aca cag ttc acc agt ggt gaa aag gag cag gta gat gag tgg aca gtt						1143
	Thr Gln Phe Thr Ser Gly Glu Lys Glu Gln Val Asp Glu Trp Thr Val						305 310 315
50	gaa acg gtt gag gtg gta aat tca ctc cag cag caa cct cag gct gca						1191
	Glu Thr Val Glu Val Val Asn Ser Leu Gln Gln Gln Pro Gln Ala Ala						320 325 330
55	tcc cct tca gta cca gag ccc cac tct ttg act cca gtg gct cag gca						1239
	Ser Pro Ser Val Pro Glu Pro His Ser Leu Thr Pro Val Ala Gln Ala						335 340 345 350
60	gat ccc ctt gtg aga aga cag cga gta caa gac ctt atg gca caa atg						1287
	Asp Pro Leu Val Arg Arg Gln Arg Val Gln Asp Leu Met Ala Gln Met						355 360 365
65	cag ggt ccc tat aat ttc ata cag gat tca atg ctg gat ttt gaa aat						1335
	Gln Gly Pro Tyr Asn Phe Ile Gln Asp Ser Met Leu Asp Phe Glu Asn						370 375 380
70	cag aca ctt gat cct gcc att gta tct gca cag cct atg aat cca aca						1383
	Gln Thr Leu Asp Pro Ala Ile Val Ser Ala Gln Pro Met Asn Pro Thr						385 390 395
75	caa aac atg gac atg ccc cag ctg gtt tgc cct cca gtt cat tct gaa						1431
	Gln Asn Met Asp Met Pro Gln Leu Val Cys Pro Pro Val His Ser Glu						400 405 410
80	tct aga ctt gct cag cct aat caa gtt cct gta caa cca gaa gcg aca						1479

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	Ser	Arg	Leu	Ala	Gln	Pro	Asn	Gln	Val	Pro	Val	Gln	Pro	Glu	Ala	Thr	
	415					420					425					430	
5	cag	gtt	cct	ttg	gta	tca	tcc	aca	agt	gag	ggg	tac	aca	gca	tct	caa	1527
	Gln	Val	Pro	Leu	Val	Ser	Ser	Thr	Ser	Glu	Gly	Tyr	Thr	Ala	Ser	Gln	
					435					440					445		
10	ccc	ttg	tac	cag	cct	tct	cat	gct	aca	gag	caa	cga	cca	cag	aag	gaa	1575
	Pro	Leu	Tyr	Gln	Pro	Ser	His	Ala	Thr	Glu	Gln	Arg	Pro	Gln	Lys	Glu	
				450				455						460			
15	cca	att	gat	cag	att	cag	gca	aca	atc	tct	tta	aat	aca	gac	cag	act	1623
	Pro	Ile	Asp	Gln	Ile	Gln	Ala	Thr	Ile	Ser	Leu	Asn	Thr	Asp	Gln	Thr	
			465				470						475				
20	aca	gca	tca	tca	tcc	ctt	cct	gct	gcg	tct	cag	cct	caa	gta	ttt	cag	1671
	Thr	Ala	Ser	Ser	Ser	Leu	Pro	Ala	Ala	Ser	Gln	Pro	Gln	Val	Phe	Gln	
		480				485					490						
25	gct	ggg	aca	agc	aaa	cct	tta	cat	agc	agt	gga	atc	aat	gta	aat	gca	1719
	Ala	Gly	Thr	Ser	Lys	Pro	Leu	His	Ser	Ser	Gly	Ile	Asn	Val	Asn	Ala	
		495			500					505					510		
30	gct	cca	ttc	caa	tcc	atg	caa	acg	gtg	ttc	aat	atg	aat	gcc	cca	gtt	1767
	Ala	Pro	Phe	Gln	Ser	Met	Gln	Thr	Val	Phe	Asn	Met	Asn	Ala	Pro	Val	
				515					520					525			
35	cct	cct	gtt	aat	gaa	cca	gaa	act	tta	aaa	cag	caa	aat	cag	tac	cag	1815
	Pro	Pro	Val	Asn	Glu	Pro	Glu	Thr	Leu	Lys	Gln	Gln	Asn	Gln	Tyr	Gln	
				530				535						540			
40	gcc	agt	tat	aac	cag	agc	ttt	tct	agt	cag	cct	cac	caa	gta	gaa	caa	1863
	Ala	Ser	Tyr	Asn	Gln	Ser	Phe	Ser	Ser	Gln	Pro	His	Gln	Val	Glu	Gln	
			545				550						555				
45	aca	gag	ctt	cag	caa	gaa	cag	ctt	caa	aca	gtg	ggt	ggc	act	tac	cat	1911
	Thr	Glu	Leu	Gln	Gln	Glu	Gln	Leu	Gln	Thr	Val	Val	Gly	Thr	Tyr	His	
		560				565					570						
50	ggg	tcc	cca	gac	cag	tcc	cat	caa	gtg	act	ggg	aac	cac	cag	cag	cct	1959
	Gly	Ser	Pro	Asp	Gln	Ser	His	Gln	Val	Thr	Gly	Asn	His	Gln	Gln	Pro	
		575			580						585				590		
55	cct	cag	cag	aac	act	gga	ttt	cca	cgt	agc	aat	cag	ccc	tat	tac	aat	2007
	Pro	Gln	Gln	Asn	Thr	Gly	Phe	Pro	Arg	Ser	Asn	Gln	Pro	Tyr	Tyr	Asn	
				595				600						605			
60	agt	cgt	ggg	gtg	tct	cgt	gga	ggc	tcc	cgt	ggt	gct	aga	ggc	ttg	atg	2055
	Ser	Arg	Gly	Val	Ser	Arg	Gly	Gly	Ser	Arg	Gly	Ala	Arg	Gly	Leu	Met	
				610				615						620			
65	aat	gga	tac	cgg	ggc	cct	gcc	aat	gga	ttc	aga	gga	gga	tat	gat	ggg	2103
	Asn	Gly	Tyr	Arg	Gly	Pro	Ala	Asn	Gly	Phe	Arg	Gly	Gly	Tyr	Asp	Gly	
			625				630						635				
70	tac	cgc	cct	tca	ttc	tct	aac	act	cca	aac	agt	ggt	tat	aca	cag	tct	2151
	Tyr	Arg	Pro	Ser	Phe	Ser	Asn	Thr	Pro	Asn	Ser	Gly	Tyr	Thr	Gln	Ser	
		640				645						650					
75	cag	ttc	agt	gct	ccc	cgg	gat	tac	tct	ggc	tat	caa	cgg	gat	gga	tat	2199
	Gln	Phe	Ser	Ala	Pro	Arg	Asp	Tyr	Ser	Gly	Tyr	Gln	Arg	Asp	Gly	Tyr	
				655		660				665						670	

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Met Pro Ser Ala Thr Ser His Ser Gly Ser Gly Ser Lys Ser Ser Gly
1 5 10 15

5

Pro Pro Pro Pro Ser Gly Ser Ser Gly Ser Glu Ala Ala Ala Gly Ala

10

15

20

25

30

35

40

45

50

55

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	20					25					30					
5	Gly	Ala	Ala	Ala	Pro	Ala	Ser	Gln	His	Pro	Ala	Thr	Gly	Thr	Gly	Ala
			35					40					45			
10	Val	Gln	Thr	Glu	Ala	Met	Lys	Gln	Ile	Leu	Gly	Val	Ile	Asp	Lys	Lys
		50					55					60				
15	Leu	Arg	Asn	Leu	Glu	Lys	Lys	Lys	Gly	Lys	Leu	Asp	Asp	Tyr	Gln	Glu
	65					70					75					80
20	Arg	Met	Asn	Lys	Gly	Glu	Arg	Leu	Asn	Gln	Asp	Gln	Leu	Asp	Ala	Val
					85					90					95	
25	Ser	Lys	Tyr	Gln	Glu	Val	Thr	Asn	Asn	Leu	Glu	Phe	Ala	Lys	Glu	Leu
				100					105					110		
30	Gln	Arg	Ser	Phe	Met	Ala	Leu	Ser	Gln	Asp	Ile	Gln	Lys	Thr	Ile	Lys
			115					120					125			
35	Lys	Thr	Ala	Arg	Arg	Glu	Gln	Leu	Met	Arg	Glu	Glu	Ala	Glu	Gln	Lys
		130					135					140				
40	Arg	Leu	Lys	Thr	Val	Leu	Glu	Leu	Gln	Tyr	Val	Leu	Asp	Lys	Leu	Gly
	145					150					155					160
45	Asp	Asp	Glu	Val	Arg	Thr	Asp	Leu	Lys	Gln	Gly	Leu	Asn	Gly	Val	Pro
					165					170					175	
50	Ile	Leu	Ser	Glu	Glu	Glu	Leu	Ser	Leu	Leu	Asp	Glu	Phe	Tyr	Lys	Leu
				180					185					190		
55	Val	Asp	Pro	Glu	Arg	Asp	Met	Ser	Leu	Arg	Leu	Asn	Glu	Gln	Tyr	Glu
			195					200					205			
60	His	Ala	Ser	Ile	His	Leu	Trp	Asp	Leu	Leu	Glu	Gly	Lys	Glu	Lys	Pro
		210					215					220				
65	Val	Cys	Gly	Thr	Thr	Tyr	Lys	Val	Leu	Lys	Glu	Ile	Val	Glu	Arg	Val
	225					230					235					240
70	Phe	Gln	Ser	Asn	Tyr	Phe	Asp	Ser	Thr	His	Asn	His	Gln	Asn	Gly	Leu
					245					250					255	
75	Cys	Glu	Glu	Glu	Glu	Ala	Ala	Ser	Ala	Pro	Ala	Val	Glu	Asp	Gln	Val
				260					265					270		

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Pro Glu Ala Glu Pro Glu Pro Ala Glu Glu Tyr Thr Glu Gln Ser Glu
 275 280 285

5
 Val Glu Ser Thr Glu Tyr Val Asn Arg Gln Phe Met Ala Glu Thr Gln
 290 295 300

10
 Phe Thr Ser Gly Glu Lys Glu Gln Val Asp Glu Trp Thr Val Glu Thr
 305 310 315 320

15
 Val Glu Val Val Asn Ser Leu Gln Gln Gln Pro Gln Ala Ala Ser Pro
 325 330 335

20
 Ser Val Pro Glu Pro His Ser Leu Thr Pro Val Ala Gln Ala Asp Pro
 340 345 350

25
 Leu Val Arg Arg Gln Arg Val Gln Asp Leu Met Ala Gln Met Gln Gly
 355 360 365

30
 Pro Tyr Asn Phe Ile Gln Asp Ser Met Leu Asp Phe Glu Asn Gln Thr
 370 375 380

35
 Leu Asp Pro Ala Ile Val Ser Ala Gln Pro Met Asn Pro Thr Gln Asn
 385 390 395 400

40
 Met Asp Met Pro Gln Leu Val Cys Pro Pro Val His Ser Glu Ser Arg
 405 410 415

45
 Leu Ala Gln Pro Asn Gln Val Pro Val Gln Pro Glu Ala Thr Gln Val
 420 425 430

50
 Pro Leu Val Ser Ser Thr Ser Glu Gly Tyr Thr Ala Ser Gln Pro Leu
 435 440 445

55
 Tyr Gln Pro Ser His Ala Thr Glu Gln Arg Pro Gln Lys Glu Pro Ile
 450 455 460

60
 Asp Gln Ile Gln Ala Thr Ile Ser Leu Asn Thr Asp Gln Thr Thr Ala
 465 470 475 480

65
 Ser Ser Ser Leu Pro Ala Ala Ser Gln Pro Gln Val Phe Gln Ala Gly
 485 490 495

70
 Thr Ser Lys Pro Leu His Ser Ser Gly Ile Asn Val Asn Ala Ala Pro
 500 505 510

75
 Phe Gln Ser Met Gln Thr Val Phe Asn Met Asn Ala Pro Val Pro Pro
 515 520 525

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Val Asn Glu Pro Glu Thr Leu Lys Gln Gln Asn Gln Tyr Gln Ala Ser
530 535 540

5 Tyr Asn Gln Ser Phe Ser Ser Gln Pro His Gln Val Glu Gln Thr Glu
545 550 555 560

10 Leu Gln Gln Glu Gln Leu Gln Thr Val Val Gly Thr Tyr His Gly Ser
565 570 575

15 Pro Asp Gln Ser His Gln Val Thr Gly Asn His Gln Gln Pro Pro Gln
580 585 590

Gln Asn Thr Gly Phe Pro Arg Ser Asn Gln Pro Tyr Tyr Asn Ser Arg
595 600 605

20 Gly Val Ser Arg Gly Gly Ser Arg Gly Ala Arg Gly Leu Met Asn Gly
610 615 620

25 Tyr Arg Gly Pro Ala Asn Gly Phe Arg Gly Gly Tyr Asp Gly Tyr Arg
625 630 635 640

30 Pro Ser Phe Ser Asn Thr Pro Asn Ser Gly Tyr Thr Gln Ser Gln Phe
645 650 655

Ser Ala Pro Arg Asp Tyr Ser Gly Tyr Gln Arg Asp Gly Tyr Gln Gln
660 665 670

35 Asn Phe Lys Arg Gly Ser Gly Gln Ser Gly Pro Arg Gly Ala Pro Arg
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40 Gly Asn Ile Leu Trp Trp
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Ala Tyr Ser Met His
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<400> 6

EP 2 740 793 B1

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5 Gly

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<212> PRT

10 <213> Mus musculus

<400> 7

15 Arg Ile Tyr Tyr Phe Gly Arg Gly Gly Phe Asp
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<210> 8

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20 <213> Mus musculus

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

35 Thr Pro Gly Lys Gly Leu Lys Trp Leu Gly Trp Ile Asn Thr Glu Thr
 35 40 45

Gly Glu Pro Thr Tyr Thr Asp Asp Phe Lys Gly Arg Phe Thr Phe Ser
 50 55 60

40 Leu Glu Thr Ser Ala Arg Ile Ala Tyr Leu Gln Ile Asn Asp Leu Lys
 65 70 75 80

45 Asn Glu Asp Thr Ala Thr Tyr Phe Cys Ala Arg Arg Ile Tyr Tyr Phe
 85 90 95

Gly Arg Gly Gly Phe Asp Tyr Trp Gly Gln Gly Thr Thr Val Thr Val
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50 Ser Ser

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EP 2 740 793 B1

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Lys Val Ser Asn Arg Phe Ser
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Phe Gln Gly Ser His Val Pro Tyr Thr
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Pro Ala Ser Ser Ser Asp Val Leu Met Thr Gln Thr Pro Leu Ser Leu
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35 Pro Val Arg Leu Gly Asp Gln Ser Ser Ile Ser Cys Arg Ser Ser Gln
 20 25 30

40 Ser Ile Val His Ser Asn Gly Asn Thr Tyr Leu Glu Trp Tyr Leu Gln
 35 40 45

45 Lys Pro Gly Gln Ser Pro Lys Leu Leu Ile Tyr Lys Val Ser Asn Arg
 50 55 60

Phe Ser Gly Val Pro Asp Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp
 65 70 75 80

50 Phe Thr Leu Lys Ile Ser Arg Val Glu Pro Glu Asp Leu Gly Val Tyr
 85 90 95

55 Tyr Cys Phe Gln Gly Ser His Val Pro Tyr Thr Ser Glu Gly Asp Gln
 100 105 110

Ala Glu Ile Lys Leu Ala
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 10 accttcacag cctattcaat gcactgggtg aagcagactc caggaaaggg tttaaagtgg 120
 ctgggctgga taaacactga gactggtgag ccaacatata cagatgactt caagggacgg 180
 15 tttacottct ctttggaac ctctgccagg attgcctatt tgcagatcaa cgacctcaaa 240
 aacgaggaca cggctacata tttctgtgct agaaggatct attacttcgg tagaggtggg 300
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 acctatntag aatggtacct gcagaaacca ggccagtctc caaagctcct gatctacaaa 180
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 35 ttcaactca agatcagcag agtggagcct gaggatctgg gagtttatta ctgctttcag 300
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Met Glu Trp Ser Gly Val Phe Ile Phe Leu Leu Ser Gly Thr Ala Gly
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 5 Val Leu Ser Glu Val Gln Leu His Gln Phe Gly Ala Glu Leu Val Lys
 20 25 30
 10 Pro Gly Ala Ser Val Lys Ile Ser Cys Lys Ala Ser Gly Tyr Thr Phe
 35 40 45
 15 Thr Asp Tyr Asn Met Asp Trp Val Lys Gln Ser His Gly Lys Ser Leu
 50 55 60
 20 Glu Trp Ile Gly Asp Ile Asn Pro Asn Tyr Asp Ser Thr Ser Tyr Asn
 65 70 75 80
 25 Gln Lys Phe Lys Gly Lys Ala Thr Leu Thr Val Asp Lys Ser Ser Ser
 85 90 95
 30 Thr Ala Tyr Met Glu Leu Arg Ser Leu Thr Ser Glu Asp Thr Ala Val
 100 105 110
 35 Tyr Tyr Cys Ala Arg Ser Arg Ser Tyr Asp Tyr Glu Gly Phe Ala Tyr
 115 120 125
 40 Trp Gly Gln Gly Thr Leu Val Thr Val Ser Ala Ala Lys Thr Thr Pro
 130 135 140
 45 Pro Ser Val Tyr
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Ile Gln Leu Thr Gln Ser Pro Ser Ser Leu Ala Val Thr Ala Gly Glu
 20 25 30
 5
 Lys Val Thr Met Ser Cys Lys Ser Ser Gln Ser Leu Leu Trp Ser Val
 35 40 45
 10
 Asn Gln Lys Asn Tyr Leu Ser Trp Tyr Gln Gln Lys Gln Arg Gln Pro
 50 55 60
 15
 Pro Lys Leu Leu Ile Tyr Gly Ala Ser Ile Arg Glu Ser Trp Val Pro
 65 70 75 80
 20
 Asp Arg Phe Thr Gly Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr Ile
 85 90 95
 25
 Ser Asn Val His Ala Glu Asp Leu Ala Val Tyr Tyr Cys Gln His Asn
 100 105 110
 30
 His Gly Ser Phe Leu Pro Ser Arg Ser Glu Gln Val Pro Ser Trp Arg
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 Ser Asn Asn Arg
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 20 25 30
 50
 Pro Gly Ala Ser Val Lys Ile Ser Cys Lys Ala Ser Gly Tyr Thr Phe
 35 40 45
 55
 Thr Asp Tyr Asn Met Asp Trp Val Lys Gln Ser His Gly Lys Ser Leu
 50 55 60
 Glu Trp Ile Gly Asp Ile Asn Pro Asn Tyr Asp Ser Thr Ser Tyr Asn
 65 70 75 80
 Gln Lys Phe Lys Gly Lys Ala Thr Leu Thr Val Asp Lys Ser Ser Ser
 85 90 95

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Thr Ala Tyr Met Glu Leu Arg Ser Leu Thr Ser Glu Asp Thr Ala Val
 100 105 110
 5
 Tyr Tyr Cys Ala Arg Ser Arg Ser Tyr Asp Tyr Glu Gly Phe Ala Tyr
 115 120 125
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 Pro Ser Val Tyr
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 20 25 30
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 35 40 45
 35
 Gly Lys Ser Pro Gln Leu Leu Val Tyr Asn Ala Lys Thr Leu Ala Asp
 50 55 60
 40
 Gly Val Pro Ser Arg Phe Ser Gly Ser Gly Ser Gly Thr Gln Tyr Ser
 65 70 75 80
 45
 Leu Lys Ile Asn Ser Leu Gln Pro Glu Asp Phe Gly Ser Tyr Tyr Cys
 85 90 95
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 Gln His Phe Trp Ser Thr Leu Thr Phe Gly Gly Gly Thr Lys Leu Glu
 100 105 110
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 Ile Lys Gln Ser Asp
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 <210> 21
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EP 2 740 793 B1

Glu Thr Glu Asp Phe Gly Met Tyr Phe Cys Gln Gln Ser Asn Ser Trp
 65 70 75 80

5 Pro Tyr Thr Phe Gly Ala Gly Thr Lys Leu Glu Ile Lys Gln
 85 90

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10 <212> PRT

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<400> 23

15 Met Glu Trp Ser Gly Val Phe Ile Phe Leu Leu Ser Gly Thr Ala Gly
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20 Val Leu Ser Glu Val Gln Leu His Gln Phe Gly Ala Glu Leu Val Lys
 20 25 30

25 Pro Gly Ala Ser Val Lys Ile Ser Cys Lys Ala Ser Gly Tyr Thr Phe
 35 40 45

Thr Asp Tyr Asn Met Asp Trp Val Lys Gln Ser His Gly Lys Ser Leu
 50 55 60

30 Glu Trp Ile Gly Asp Ile Asn Pro Asn Tyr Asp Ser Thr Ser Tyr Asn
 65 70 75 80

35 Gln Lys Phe Lys Gly Lys Ala Thr Leu Thr Val Asp Lys Ser Ser Ser
 85 90 95

Thr Ala Tyr Met Glu Leu Arg Ser Leu Thr Ser Glu Asp Thr Ala Val
 100 105 110

40 Tyr Tyr Cys Ala Arg Ser Arg Ser Tyr Asp Tyr Glu Gly Phe Ala Tyr
 115 120 125

45 Trp Gly Gln Gly Thr Leu Val Thr Val Ser Ala Ala Lys Thr Thr Pro
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50 Pro Ser Val Tyr
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55 <212> PRT

<213> Mus musculus

<400> 24

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 5 Trp Val Lys Gln Ser His Gly Lys Asn Leu Glu Trp Ile Gly Leu Ile
 20 25 30
 10 Asn Pro Tyr Asn Gly Gly Thr Ser Tyr Asn Gln Lys Phe Lys Gly Lys
 35 40 45
 15 Ala Thr Leu Thr Val Asp Lys Ser Ser Ser Thr Ala Tyr Met Glu Leu
 50 55 60
 20 Leu Ser Leu Thr Ser Glu Asp Ser Ala Val Tyr Tyr Cys Ala Arg Trp
 65 70 75 80
 25 Gly Val Trp Ser Ala Met Asp Tyr Trp Gly Gln Gly Thr Thr Val Thr
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 Val Ser Ser Lys
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<210> 26

<211> 90

<212> PRT

30 <213> Mus musculus

<400> 26

Asp Arg Val Ser Ile Thr Cys Lys Ala Ser Gln Asn Val Arg Thr Ala
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 35 Val Ala Trp Tyr Gln Gln Lys Pro Arg Gln Ser Pro Lys Ala Leu Ile
 20 25 30
 40 Tyr Leu Ala Ser Asn Arg Asp Thr Gly Leu Pro Asp Arg Phe Pro Gly
 35 40 45
 45 Arg Gly Ser Gly Thr Asp Phe Thr Leu Asn Ile Thr Asn Val Gln Ser
 50 55 60
 50 Glu Asp Leu Glu Asp Tyr Phe Cys Leu Gln His Cys Asn Tyr Pro Asn
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 55 Glu Phe Arg Gly Cys Thr Lys Val Pro Ile
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<211> 116

<212> PRT

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<213> Mus musculus

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10 Leu Ser Cys Lys Ala Ser Gly Tyr Thr Phe Thr Ser Tyr Trp Met Gln
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15 Trp Val Lys Gln Arg Pro Gly Gln Gly Leu Glu Trp Ile Gly Ala Ile
 35 40 45

20 Tyr Pro Gly Asp Gly Asp Thr Arg Tyr Thr Gln Lys Phe Lys Gly Lys
 50 55 60

25 Ala Thr Leu Thr Ala Asp Lys Ser Ser Ser Thr Ala Tyr Met Gln Leu
 65 70 75 80

30 Ser Ser Leu Ala Ser Glu Asp Ser Ala Val Tyr Tyr Cys Ala Arg Gly
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35 Glu Tyr Gly Asn Tyr Phe Ala Tyr Trp Gly Gln Gly Thr Thr Val Thr
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40 Val Ser Ser Asn
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<210> 28

35 <211> 100

<212> PRT

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<400> 28

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Thr Ser Asp Ala Ser Leu Gly Glu Arg Val Thr Ile Thr Cys Lys Ala
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 5 Ser Gln Asp Ile Asn Ser Tyr Leu Ser Trp Phe Gln Gln Lys Pro Gly
 20 25 30
 10 Lys Ser Pro Lys Thr Leu Ile Tyr Arg Ala Asn Arg Leu Val Asp Gly
 35 40 45
 15 Val Pro Ser Arg Phe Ser Gly Ser Gly Ser Gly Gln Asp Tyr Ser Leu
 50 55 60
 20 Thr Ile Ser Ser Leu Glu Tyr Glu Asp Met Gly Ile Tyr Tyr Cys Leu
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 35 40 45
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25 Gly Val Pro Ala Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe Thr
 50 55 60

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50 55 60

20 Leu Ser Ser Val Val Thr Val Pro Ser Ser Ser Leu Gly Thr Gln Thr
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25 Tyr Ile Cys Asn Val Asn His Lys Pro Ser Asn Thr Lys Val Asp Lys
85 90 95

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50 Tyr Val Asp Gly Val Glu Val His Asn Ala Lys Thr Lys Pro Arg Glu
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Claims

- 5 1. An antibody or a fragment thereof, wherein the antibody or the fragment thereof has immunological reactivity with a CAPRIN-1 protein and comprises a heavy chain variable region comprising complementarity determining regions of SEQ ID NOs: 5, 6, and 7 and a light chain variable region comprising complementarity determining regions of SEQ ID NOs: 9, 10, and 11.
- 10 2. The antibody or the fragment thereof according to claim 1, wherein the antibody is a human antibody, a humanized antibody, a chimeric antibody, a single-chain antibody, or a multispecific antibody.
- 15 3. The antibody or the fragment thereof according to claim 1 or 2, wherein the antibody or the fragment thereof is conjugated with an antitumor agent.
- 20 4. The antibody or the fragment thereof according to any preceding claim, for use in a method for treating and/or preventing cancer.
- 25 5. The antibody or the fragment thereof for use of claim 4, wherein the cancer is breast cancer, kidney cancer, pancreatic cancer, colorectal cancer, lung cancer, brain tumor, gastric cancer, uterine cervix cancer, ovary cancer, prostate cancer, urinary bladder cancer, esophageal cancer, leukemia, lymphoma, fibrosarcoma, mastocytoma, or melanoma.
- 30 6. A pharmaceutical composition, comprising the antibody or the fragment thereof according to any one of claims 1 to 3 as an active ingredient.
- 35 7. The pharmaceutical composition according to claim 6, for use in a method for treating and/or preventing cancer.
- 40 8. The pharmaceutical composition for use of claim 7, wherein the cancer is breast cancer, kidney cancer, pancreatic cancer, colorectal cancer, lung cancer, brain tumor, gastric cancer, uterine cervix cancer, ovary cancer, prostate cancer, urinary bladder cancer, esophageal cancer, leukemia, lymphoma, fibrosarcoma, mastocytoma, or melanoma.
- 45 9. A DNA encoding the antibody or the fragment thereof according to claim 1 or 2.

Patentansprüche

- 40 1. Antikörper oder Fragment davon, wobei der Antikörper oder das Fragment davon eine immunologische Reaktivität mit einem CAPRIN-1-Protein aufweist und eine variable Schwerekettenregion, umfassend Komplementaritätsbestimmende Regionen von Seq.-ID Nr. 5, 6 und 7, und eine variable Leichtkettenregion, umfassend Komplementaritätsbestimmende Regionen von Seq.-ID Nr. 9, 10 und 11, umfasst.
- 45 2. Antikörper oder Fragment davon nach Anspruch 1, wobei der Antikörper ein menschlicher Antikörper, ein humanisierter Antikörper, ein chimärer Antikörper, ein Einzelketten-Antikörper oder ein multispezifischer Antikörper ist.
- 50 3. Antikörper oder Fragment davon nach Anspruch 1 oder 2, wobei der Antikörper oder das Fragment davon an ein Antitumormittel konjugiert ist.
- 55 4. Antikörper oder Fragment davon nach einem der vorangegangenen Ansprüche zur Verwendung in einem Verfahren zur Behandlung und/oder Prävention von Krebs.
5. Antikörper oder Fragment davon zur Verwendung nach Anspruch 4, wobei der Krebs Brustkrebs, Nierenkrebs, Pankreaskrebs, Kolorektalkrebs, Lungenkrebs, ein Gehirntumor, Magenkrebs, Gebärmutterhalskrebs, Eierstockkrebs, Prostatakrebs, Blasenkrebs, Speiseröhrenkrebs, Leukämie, ein Lymphom, ein Fibrosarkom, ein Mastozytom oder ein Melanom ist.
6. Pharmazeutische Zusammensetzung, umfassend einen Antikörper oder ein Fragment davon nach einem der Ansprüche 1 bis 3 als Wirkstoff.

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7. Pharmazeutische Zusammensetzung nach Anspruch 6 zur Verwendung in einem Verfahren zur Behandlung und/oder Prävention von Krebs.
8. Pharmazeutische Zusammensetzung zur Verwendung nach Anspruch 7, wobei der Krebs Brustkrebs, Nierenkrebs, Pankreaskrebs, Kolorektalkrebs, Lungenkrebs, ein Gehirntumor, Magenkrebs, Gebärmutterhalskrebs, Eierstockkrebs, Prostatakrebs, Blasenkrebs, Speiseröhrenkrebs, Leukämie, ein Lymphom, ein Fibrosarkom, ein Mastozytom oder ein Melanom ist.
9. DNA, die für einen Antikörper oder ein Fragment davon nach Anspruch 1 oder 2 kodiert.

Revendications

1. Anticorps ou fragment de celui-ci, lequel anticorps ou fragment de celui-ci présente une réactivité immunologique avec une protéine CAPRIN-1 et comprend une région variable de chaîne lourde comprenant des régions déterminant la complémentarité de SEQ ID NOs: 5, 6, et 7 et une région variable de chaîne légère comprenant des régions déterminant la complémentarité de SEQ ID NOs: 9, 10, et 11.
2. Anticorps ou fragment de celui-ci selon la revendication 1, lequel anticorps est un anticorps humain, un anticorps humanisé, un anticorps chimérique, un anticorps simple chaîne, ou un anticorps multispécifique.
3. Anticorps ou fragment de celui-ci selon la revendication 1 ou 2, lequel anticorps ou fragment de celui-ci est conjugué à un agent antitumoral.
4. Anticorps ou fragment de celui-ci selon n'importe quelle revendication précédente, pour utilisation dans une méthode de traitement et/ou de prévention du cancer.
5. Anticorps ou fragment de celui-ci pour utilisation selon la revendication 4, où le cancer est un cancer du sein, un cancer du rein, un cancer du pancréas, un cancer colorectal, un cancer du poumon, une tumeur cérébrale, un cancer de l'estomac, un cancer du col de l'utérus, un cancer de l'ovaire, un cancer de la prostate, un cancer de la vessie, un cancer de l'oesophage, une leucémie, un lymphome, un fibrosarcome, un mastocytome, ou un mélanome.
6. Composition pharmaceutique, comprenant l'anticorps ou le fragment de celui-ci selon l'une quelconque des revendications 1 à 3 en tant qu'ingrédient actif.
7. Composition pharmaceutique selon la revendication 6, pour utilisation dans une méthode de traitement et/ou de prévention du cancer.
8. Composition pharmaceutique pour utilisation selon la revendication 7, où le cancer est un cancer du sein, un cancer du rein, un cancer du pancréas, un cancer colorectal, un cancer du poumon, une tumeur cérébrale, un cancer de l'estomac, un cancer du col de l'utérus, un cancer de l'ovaire, un cancer de la prostate, un cancer de la vessie, un cancer de l'oesophage, une leucémie, un lymphome, un fibrosarcome, un mastocytome, ou un mélanome.
9. ADN codant l'anticorps ou le fragment de celui-ci selon la revendication 1 ou 2.

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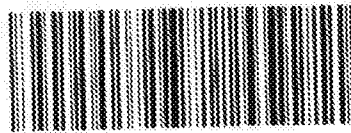
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GYÓGYSZERKÉSZÍTMÉNY RÁK KEZELÉSÉRE ÉS/VAGY MEGELŐZÉSÉRE

Szabadalmi igénypontok

1. Antitest vagy annak fragmense, ahol az antitest vagy fragmense immunológiai reaktivitással rendelkezik egy CAPRIN-1 fehérje felé, és tartalmaz olyan nehézlánc variábilis régiót, amely tartalmazza a SEQ ID NO: 5, 6 és 7 (azaz 5-ös, 6-os és 7-es azonosítási számú szekvencia) szerinti komplementaritás-meghatározó régiókat, és olyan könnyűlánc variábilis régiót, amely tartalmazza a SEQ ID NO: 9, 10 és 11 szerinti komplementaritás-meghatározó régiókat.
2. Az 1. igénypont szerinti antitest vagy fragmense, ahol az antitest humán antitest, humanizált antitest, kiméra antitest, egyláncú antitest vagy multispecifikus antitest.
3. Az 1. vagy 2. igénypont szerinti antitest vagy fragmense, ahol az antitest vagy fragmense tumorelleses ágenssel van konjugálva.
4. Az előző igénypontok bármelyike szerinti antitest vagy fragmense rák kezelésére és/vagy megelőzésére szolgáló eljárásban történő alkalmazásra.
5. Az antitest vagy fragmense alkalmazásra a 4. igénypont szerint, ahol a rák mellrák, veserák, hasnyálmirigyrák, kolorektális rák, tüdőrák, agytumor, gyomorrák, méhnyakrák, petefészekrák, prosztatatarák, húgyhólyagrák, nyelöcsőrák, leukémia, limfóma, fibroszarkóma, masztocitóma vagy melanóma.
6. Gyógyászati készítmény, amely hatóanyagként tartalmazza az 1-3. igénypontok bármelyike szerinti antitestet vagy fragmensét.

7. A 6. igénypont szerinti gyógyászati készítmény rák kezelésére és/vagy megelőzésére szolgáló eljárásban történő alkalmazásra.
8. A gyógyászati készítmény alkalmazásra a 7. igénypont szerint, ahol a rák mellrák, veserák, hasnyálmirigyrák, kolorektális rák, tüdőrák, agytumor, gyomorrák, méhnyakrák, petefészekrák, prosztatatarák, húgyhólyagrák, nyelvöcsörák, leukémia, limfóma, fibroszarkóma, masztocitóma vagy melanóma.
9. DNS, amely kódolja az 1. vagy 2. igénypont szerinti antitestet vagy fragmensét.