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**STUART W HICKS ET AL: "Abstract #37: Novel Antibody-Drug Conjugates Targeting ADAM9-expressing Solid Tumors Demonstrate Potent Preclinical Activity Introduction", PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR CANCER RESEARCH ANNUAL MEETING 2017, vol. 77, no. 13 Suppl, 1 April 2017 (2017-04-01), XP055464251, DOI: 10.1158/1538-7445.AM2017-37 -& STUART W HICKS ET AL: "Abstract 37: Novel antibody-drug conjugates targeting ADAM9-expressing solid tumors demonstrate potent preclinical activity | Cancer Research", PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR CANCER RESEARCH ANNUAL**

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**JUNIPER A. SCRIBNER ET AL: "Abstract 38: Target validation, antibody discovery and preclinical data supporting ADAM9 as an antibody-drug conjugate therapeutic target for solid tumors", CANCER RESEARCH, vol. 77, no. 13 Supplement, 1 April 2017 (2017-04-01), pages 38-38, XP055464265, US ISSN: 0008-5472, DOI: 10.1158/1538-7445.AM2017-38 -& STUART W HICKS ET AL: "Abstract 38: Target validation, antibody discovery and preclinical data supporting ADAM9 as an antibody-drug conjugate therapeutic target for solid tumors | Cancer Research", PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR CANCER RESEARCH ANNUAL MEETING 2017, vol. 77, no. 13 Suppl, 1 July 2017 (2017-07-01), XP055464262, DOI: 10.1158/1538-7445.AM2017-38**

# DESCRIPTION

## FIELD OF THE INVENTION

**[0001]** The present invention is directed to immunoconjugates comprising an antibody or fragment thereof capable of specifically binding to "Disintegrin and Metalloproteinase Domain-containing Protein 9" ("**ADAM9**") conjugated to at least one pharmacological agent. The invention particularly concerns such immunoconjugates that are cross-reactive with human ADAM9 and the ADAM9 of a non-human primate (such as a cynomolgus monkey). The invention additionally pertains to all such immunoconjugates that comprise a Light Chain Variable (VL) Domain and/or a Heavy Chain Variable (VH) Domain that has been humanized and optionally deimmunized so as to exhibit reduced immunogenicity upon administration of such immunoconjugates to a recipient subject. The invention is also directed to pharmaceutical compositions that contain any of such immunoconjugates, and to immunoconjugates and pharmaceutical compositions for use in the treatment of a disease or condition associated with, or characterized by, the expression of ADAM9 (such as cancer).

## BACKGROUND OF THE INVENTION

**[0002]** ADAM is a family of proteins involved in various physiologic and pathologic processes (Amendola, R.S. et al. (2015) "ADAM9 Disintegrin Domain Activates Human Neutrophils Through An Autocrine Circuit Involving Integrins And CXCR2," J. Leukocyte Biol. 97(5):951-962; Edwards, D.R. et al. (2008) "The ADAM Metalloproteases," Molec. Aspects Med. 29:258-289). At least 40 gene members of the family have been identified, and at least 21 of such members are believed to be functional in humans (Li, J. et al. (2016) "Overexpression of ADAM9 Promotes Colon Cancer Cells Invasion," J. Invest. Surg. 26(3):127-133; Duffy, M.J. et al. (2011) "The ADAMs Family Of Proteases: New Biomarkers And Therapeutic Targets For Cancer?," Clin. Proteomics 8:9:1-13; see also US Patent Publication No. 2013/0045244).

**[0003]** ADAM family members have a well-conserved structure with 8 domains, among which are a metalloprotease domain and an integrin-binding (disintegrin) domain (Duffy, M.J. et al. (2009) "The Role Of ADAMs In Disease Pathophysiology," Clin. Chim. Acta 403:31-36). The ADAM metalloprotease domain acts as a sheddase and has been reported to modulate a series of biologic processes by cleaving transmembrane proteins, which then can act as soluble ligands and regulate cellular signaling (Amendola, R.S. et al. (2015) "ADAM9 Disintegrin Domain Activates Human Neutrophils Through An Autocrine Circuit Involving Integrins And CXCR2," J. Leukocyte Biol. 97(5):951-962; Ito, N. et al. (2004) "ADAMs, A Disintegrin And Metalloproteinases, Mediate Shedding Of Oxytocinase," Biochem. Biophys. Res. Commun. 314 (2004) 1008-1013).

**[0004]** ADAM9 is a member of the ADAM family of molecule. It is synthesized as an inactive form which is proteolytically cleaved to generate an active enzyme. Processing at the upstream site is particularly important for activation of the proenzyme. ADAM9 is expressed in fibroblasts (Zigrino,

P. et al. (2011) "The Disintegrin-Like And Cysteine-Rich Domains Of ADAM-9 Mediate Interactions Between Melanoma Cells And Fibroblasts," J. Biol. Chem. 286:6801-6807), activated vascular smooth muscle cells (Sun, C. et al. (2010) "ADAM15 Regulates Endothelial Permeability And Neutrophil Migration Via Src/ERK1/2 Signalling," Cardiovasc. Res. 87:348-355), monocytes (Namba, K. et al. (2001) "Involvement Of ADAM9 In Multinucleated Giant Cell Formation Of Blood Monocytes," Cell. Immunol. 213:104-113), activated macrophages (Oksala, N. et al. (2009) "ADAM-9, ADAM-15, And ADAM-17 Are Upregulated In Macrophages In Advanced Human Atherosclerotic Plaques In Aorta And Carotid And Femoral Arteries - Tampere Vascular Study," Ann. Med. 41:279-290).

**[0005]** ADAM9's metalloprotease activity participates in the degradation of matrix components, to thereby allow migration of tumor cells (Amendola, R.S. et al. (2015) "ADAM9 Disintegrin Domain Activates Human Neutrophils Through An Autocrine Circuit Involving Integrins And CXCR2," J. Leukocyte Biol. 97(5):951-962). Its disintegrin domain, which is highly homologous to many snake-venom disintegrins, allows the interaction between ADAM9 and integrins, and enables ADAM9 to modulate, positively or negatively, cell adhesion events (Zigrino, P. et al. (2011) "The Disintegrin-Like And Cysteine-Rich Domains Of ADAM-9 Mediate Interactions Between Melanoma Cells And Fibroblasts," J. Biol. Chem. 286:6801-6807; Karadag, A. et al. (2006) "ADAM-9 (MDC-9/Meltrigamma), A Member Of The A Disintegrin And Metalloproteinase Family, Regulates Myeloma-Cell-Induced Interleukin-6 Production In Osteoblasts By Direct Interaction With The Alpha(v)Beta5 Integrin," Blood 107:3271-3278; Cominetti, M.R. et al. (2009) "Inhibition Of Platelets And Tumor Cell Adhesion By The Disintegrin Domain Of Human ADAM9 To Collagen I Under Dynamic Flow Conditions," Biochimie, 91:1045-1052). The ADAM9 disintegrin domain has been shown to interact with the  $\alpha 6 \beta 1$ ,  $\alpha 6 \beta 4$ ,  $\alpha v \beta 5$  and  $\alpha 9 \beta 1$  integrins.

**[0006]** The expression of ADAM9 has been found to be relevant to disease, especially cancer. ADAM9 has been found to cleave and release a number of molecules with important roles in tumorigenesis and angiogenesis, such as TEK, KDR, EPHB4, CD40, VCAM1 and CDH5. ADAM9 is expressed by many types of tumor cells, including tumor cells of breast cancers, colon cancers, gastric cancers, gliomas, liver cancers, non-small cell lung cancers, melanomas, myelomas, pancreatic cancers and prostate cancers (Yoshimasu, T. et al. (2004) "Overexpression Of ADAM9 In Non-Small Cell Lung Cancer Correlates With Brain Metastasis," Cancer Res. 64:4190-4196; Peduto, L. et al. (2005) "Critical Function For ADAM9 In Mouse Prostate Cancer," Cancer Res. 65:9312-9319; Zigrino, P. et al. (2005) "ADAM-9 Expression And Regulation In Human Skin Melanoma And Melanoma Cell Lines," Int. J. Cancer 116:853-859; Fritzsche, F.R. et al. (2008) "ADAM9 Is Highly Expressed In Renal Cell Cancer And Is Associated With Tumour Progression," BMC Cancer 8:179:1-9; Fry, J.L. et al. (2010) "Secreted And Membrane-Bound Isoforms Of Protease ADAM9 Have Opposing Effects On Breast Cancer Cell Migration," Cancer Res. 70, 8187-8198; Chang, L. et al. (2016) "Combined Rnai Targeting Human Stat3 And ADAM9 As Gene Therapy For Non-Small Cell Lung Cancer," Oncology Letters 11:1242-1250; Fan, X. et al. (2016) "ADAM9 Expression Is Associate with Glioma Tumor Grade and Histological Type, and Acts as a Prognostic Factor in Lower-Grade Gliomas," Int. J. Mol. Sci. 17:1276:1-11).

**[0007]** Significantly, increased ADAM9 expression has been found to correlate positively with tumor malignancy and metastatic potential (Amendola, R.S. et al. (2015) "ADAM9 Disintegrin



Domain Activates Human Neutrophils Through An Autocrine Circuit Involving Integrins And CXCR2," J. Leukocyte Biol. 97(5):951-962; Fan, X. et al. (2016) "ADAM9 Expression Is Associate with Glioma Tumor Grade and Histological Type, and Acts as a Prognostic Factor in Lower-Grade Gliomas," Int. J. Mol. Sci. 17:1276:1-11; Li, J. et al. (2016) "Overexpression of ADAM9 Promotes Colon Cancer Cells Invasion," J. Invest. Surg. 26(3):127-133). Additionally, ADAM9 and its secreted soluble isoform seem to be crucial for cancer cells to disseminate (Amendola, R.S. et al. (2015) "ADAM9 Disintegrin Domain Activates Human Neutrophils Through An Autocrine Circuit Involving Integrins And CXCR2," J. Leukocyte Biol. 97(5):951-962; Fry, J.L. et al. (2010) "Secreted And Membrane-Bound Isoforms Of Protease ADAM9 Have Opposing Effects On Breast Cancer Cell Migration," Cancer Res. 70, 8187-8198; Mazzocca, A. (2005) "A Secreted Form Of ADAM9 Promotes Carcinoma Invasion Through Tumor-Stromal Interactions," Cancer Res. 65:4728-4738; see also US Patent Nos. 9,150,656; 7,585,634; 7,829,277; 8,101,361; and 8,445,198 and US Patent Publication No. 2009/0023149).

**[0008]** A number of studies have thus identified ADAM9 as a potential target for anticancer therapy (Peduto, L. (2009) "ADAM9 As A Potential Target Molecule In Cancer," Curr. Pharm. Des. 15:2282-2287; Duffy, M.J. et al. (2009) "Role Of ADAMs In Cancer Formation And Progression" Clin. Cancer Res. 15:1140-1144; Duffy, M.J. et al. (2011) "The ADAMs Family Of Proteases: New Biomarkers And Therapeutic Targets For Cancer?," Clin. Proteomics 8:9:1-13; Josson, S. et al. (2011) "Inhibition of ADAM9 Expression Induces Epithelial Phenotypic Alterations and Sensitizes Human Prostate Cancer Cells to Radiation and Chemotherapy," Prostate 71(3):232-240; see also US Patent Publication Nos. 2016/0138113, 2016/0068909, 2016/0024582, 2015/0368352, 2015/0337356, 2015/0337048, 2015/0010575, 2014/0342946, 2012/0077694, 2011/0151536, 2011/0129450, 2010/0291063, 2010/0233079, 2010/0112713, 2009/0203051, 2004/0092466, 2003/0091568, and 2002/0068062, and PCT Publication Nos. WO 2016/077505, WO 2014/205293, WO 2014/186364, WO 2014/124326, WO 2014/108480, WO 2013/119960, WO 2013/098797, WO 2013/049704, and WO 2011/100362). US2009/0285840A1 describes compositions and methods that inhibit expression of Adam9 gene products, such as ADAM9 mRNA and/or ADAM9 polypeptides, as a therapeutic approach for the treatment of pathological neovascularization and conditions associated with angiogenesis. DE10337368A1 describes diagnosis of pancreatic cancer by detecting expression of ADAM9 protein using specific antibodies and also the therapeutic use of these antibodies and of ADAM9-specific nucleic acids. Additionally, the expression of ADAM9 has also been found to be relevant to pulmonary disease and inflammation (see, e.g., US Patent Publication Nos. 2016/0068909; 2012/0149595; 2009/0233300; 2006/0270618; and 2009/0142301). Antibodies that bind to ADAM9 are commercially available from Abcam, Thermofisher, Sigma-Aldrich, and other companies.

**[0009]** However, despite all prior advances, a need remains for high affinity ADAM9 targeting immunoconjugates that exhibit minimal binding to normal tissues and are capable binding to human and non-human ADAM9 with similar high affinity. The present invention addresses this need and the need for improved therapeutics for cancer.

## SUMMARY OF THE INVENTION

**[0010]** According to an aspect of the invention there is provided immunoconjugates comprising an antibody or fragment thereof capable of specifically binding to "Disintegrin and Metalloproteinase Domain-containing Protein 9" ("**ADAM9**") conjugated to at least one pharmacological agent as defined in claim 1. The immunoconjugates are cross-reactive with human ADAM9 and the ADAM9 of a non-human primate (a cynomolgus monkey). The immunoconjugates comprise a Light Chain Variable (VL) Domain and/or a Heavy Chain Variable (VH) Domain that have been humanized (and optionally deimmunized) so as to exhibit reduced immunogenicity upon administration of such immunoconjugates to a recipient subject. According to further aspects of the invention there are provided a pharmaceutical composition as defined in claim 15, and an immunoconjugate or pharmaceutical composition for use in the treatment of a disease or condition associated with, or characterized by, the expression of ADAM9 (such as cancer) as defined in claims 16 and 17..

**[0011]** In detail, the present invention provides an immunoconjugate comprising a humanized anti-ADAM9 antibody or ADAM9-binding fragment thereof that specifically binds to human ADAM9 and cyno ADAM9:

1. (I) wherein said humanized anti-ADAM9 antibody or ADAM9-binding fragment thereof is conjugated to a pharmacological agent; and
2. (II) wherein said humanized anti-ADAM9 antibody or ADAM9-binding fragment thereof comprises a Light Chain Variable (VL) Domain and a Heavy Chain Variable (VH) Domain, wherein said Heavy Chain Variable Domain comprises a CDR<sub>H1</sub> Domain, a CDR<sub>H2</sub> Domain and a CDR<sub>H3</sub> Domain, and said Light Chain Variable Domain comprises a CDR<sub>L1</sub> Domain, a CDR<sub>L2</sub> Domain, and a CDR<sub>L3</sub> Domain, wherein:
  1. (A) said CDR<sub>H1</sub> Domain comprises the amino acid sequence of SEQ ID NO:8 or SEQ ID NO:34; and
  2. (B) said CDR<sub>H2</sub> Domain comprises the amino acid sequence of SEQ ID NO: 9, SEQ ID NO:35 or SEQ ID NO:36; and
  3. (C) said CDR<sub>H3</sub> Domain comprises amino acid sequence of any one of SEQ ID NO:37, SEQ ID NO:38, SEQ ID NO:39, SEQ ID NO:40, SEQ ID NO:41, SEQ ID NO:42, SEQ ID NO:43, SEQ ID NO:44, SEQ ID NO:45 or SEQ ID NO:46; and
 wherein:
  1. (A) said CDR<sub>L1</sub> Domain has the amino acid sequence of SEQ ID NO:12, SEQ ID NO:62, SEQ ID NO:63, or SEQ ID NO:64; and
  2. (B) said CDR<sub>L2</sub> Domain has the amino acid sequence of SEQ ID NO: 13; and
  3. (C) said CDR<sub>L3</sub> Domain has the amino acid sequence of SEQ ID NO: 14 or SEQ ID NO:65.

**[0012]** In certain embodiments, the Heavy Chain Variable (VH) Domain of the optimized variant of MAB-A is selected from the group consisting of:

(5) hMAB-A VH(2A) (**SEQ ID NO:20**);

(6) hMAB-A VH(2B) (**SEQ ID NO:21**);

- (7) hMAB-A VH(2C) (SEQ ID NO:22);
- (8) hMAB-A VH(2D) (SEQ ID NO:23);
- (9) hMAB-A VH(2E) (SEQ ID NO:24);
- (10) hMAB-A VH(2F) (SEQ ID NO:25);
- (11) hMAB-A VH(2G) (SEQ ID NO:26);
- (12) hMAB-A VH(2H) (SEQ ID NO:27);
- (13) hMAB-A VH(2I) (SEQ ID NO:28); and
- (14) hMAB-A VH(2J) (SEQ ID NO:29).

**[0013]** In certain embodiments, the Light Chain Variable (VL) Domain of the optimized variant of MAB-A is selected from the group consisting of:

- 1. (1) hMAB-A VL(1) (SEQ ID NO:54);
- 2. (2) hMAB-A VL(2) (SEQ ID NO:55);
- 3. (3) hMAB-A VL(3) (SEQ ID NO:56);
- 4. (4) hMAB-A VL(4) (SEQ ID NO:57).

**[0014]** In certain embodiments, the CDR<sub>H1</sub> Domain comprises the amino acid sequence SYWMH (SEQ ID NO:8), the CDR<sub>H2</sub> Domain comprises the amino acid sequence E I I P I FGHTNYNEKFKS (SEQ ID NO:35), and the CDR<sub>H3</sub> Domain comprises the amino acid sequence GGYYYYPRQGFLDY (SEQ ID NO:45)

**[0015]** In certain embodiments, the CDR<sub>L1</sub> Domain comprises the amino acid sequence KASQSVDYSGDSYMN (SEQ ID NO:62), the CDR<sub>L2</sub> Domain comprises the amino acid sequence AASDLES (SEQ ID NO:13), and the CDR<sub>L3</sub> Domain comprises the amino acid sequence QQSHEDPFT (SEQ ID NO:14).

**[0016]** In certain embodiments, the immunoconjugate comprises:

- 1. (A) the Heavy Chain Variable (VH) Domain of hMAB-A (2I.2) (SEQ ID NO:28); or
- 2. (B) the Light Chain Variable (VL) Domain of hMAB-A (2I.2) (SEQ ID NO:55); or
- 3. (C) the Heavy Chain Variable (VH) Domain of hMAB-A (2I.2) (SEQ ID NO:28) and the Light Chain Variable (VL) Domain of hMAB-A (2I.2) (SEQ ID NO:55)

**[0017]** In certain embodiments, the immunoconjugate comprises an Fc Region. In some embodiments, the Fc Region is a variant Fc Region that comprises: (a) one or more amino acid

modification(s) that reduce(s) the affinity of the variant Fc Region for an FcγR; and/or (b) one or more amino acid modification(s) that introduces a cysteine residue. In some embodiments, the one or more amino acid modification(s) that reduce(s) the affinity of the variant Fc Region for an FcγR comprise: (A) L234A; (B) L235A; or (C) L234A and L235A; wherein said numbering is that of the EU index as in Kabat. In some embodiments, the one or more amino acid modification(s) that introduces a cysteine residue comprises S442C, wherein said numbering is that of the EU index as in Kabat.

**[0018]** The immunoconjugate of the present invention comprises a humanized anti-ADAM9 antibody or ADAM9-binding fragment thereof that specifically binds to human ADAM9 and cyno ADAM9, wherein the humanized anti-ADAM9 antibody or ADAM9-binding fragment thereof is conjugated to the pharmacological agent.

**[0019]** In certain embodiments, the humanized anti-ADAM9 antibody or ADAM9-binding fragment thereof is optimized to have at least a 100-fold enhancement in binding affinity to cyno ADAM9 and retains high affinity binding to human ADAM9 as compared to the chimeric or murine parental antibody.

**[0020]** In certain embodiments, the anti-ADAM9 antibody or ADAM9-binding fragment thereof comprises a CDR<sub>H1</sub> domain, a CDR<sub>H2</sub> domain, and a CDR<sub>H3</sub> domain and a CDR<sub>L1</sub> domain, a CDR<sub>L2</sub> domain, and a CDR<sub>L3</sub> domain having the sequences selected from the group consisting of:

1. (a) SEQ ID NOs: 8, 35, and 37 and SEQ ID NOs: 62, 13, 14, respectively;
2. (b) SEQ ID NOs: 8, 35, and 38 and SEQ ID NOs: 62, 13, 14, respectively;
3. (c) SEQ ID NOs: 8, 35, and 39 and SEQ ID NOs: 62, 13, 14, respectively;
4. (d) SEQ ID NOs: 8, 35, and 40 and SEQ ID NOs: 62, 13, 14, respectively;
5. (e) SEQ ID NOs: 8, 35, and 41 and SEQ ID NOs: 62, 13, 14, respectively;
6. (f) SEQ ID NOs: 8, 35, and 42 and SEQ ID NOs: 62, 13, 14, respectively;
7. (g) SEQ ID NOs: 8, 35, and 43 and SEQ ID NOs: 62, 13, 14, respectively;
8. (h) SEQ ID NOs: 8, 35, and 44 and SEQ ID NOs: 62, 13, 14, respectively;
9. (i) SEQ ID NOs: 8, 35, and 45 and SEQ ID NOs: 62, 13, 14, respectively; and
10. (j) SEQ ID NOs: 8, 35, and 46 and SEQ ID NOs: 62, 13, 14, respectively.

**[0021]** In certain embodiments, the humanized anti-ADAM9 antibody or ADAM9-binding fragment thereof comprises a heavy chain variable domain (VH) and a light chain variable domain (VL) having sequences that are at least 90%, at least 95%, or at least 99% identical to sequences selected from the group consisting of:

1. (a) SEQ ID NO:20 and SEQ ID NO:55, respectively;
2. (b) SEQ ID NO:21 and SEQ ID NO:55, respectively;
3. (c) SEQ ID NO:22 and SEQ ID NO:55, respectively;
4. (d) SEQ ID NO:23 and SEQ ID NO:55, respectively;
5. (e) SEQ ID NO:24 and SEQ ID NO:55, respectively;

6. (f) SEQ ID NO:25 and SEQ ID NO:55, respectively;
7. (g) SEQ ID NO:26 and SEQ ID NO:55, respectively;
8. (h) SEQ ID NO:27 and SEQ ID NO:55, respectively;
9. (i) SEQ ID NO:28 and SEQ ID NO:55, respectively; and
10. (j) SEQ ID NO:29 and SEQ ID NO:55, respectively.

**[0022]** In certain embodiments, the humanized anti-ADAM9 antibody or ADAM9-binding fragment thereof comprises a heavy chain variable domain (VH) and a light chain variable domain (VL) having the sequences selected from the group consisting of:

1. (a) SEQ ID NO:20 and SEQ ID NO:55, respectively;
2. (b) SEQ ID NO:21 and SEQ ID NO:55, respectively;
3. (c) SEQ ID NO:22 and SEQ ID NO:55, respectively;
4. (d) SEQ ID NO:23 and SEQ ID NO:55, respectively;
5. (e) SEQ ID NO:24 and SEQ ID NO:55, respectively;
6. (f) SEQ ID NO:25 and SEQ ID NO:55, respectively;
7. (g) SEQ ID NO:26 and SEQ ID NO:55, respectively;
8. (h) SEQ ID NO:27 and SEQ ID NO:55, respectively;
9. (i) SEQ ID NO:28 and SEQ ID NO:55, respectively; and
10. (j) SEQ ID NO:29 and SEQ ID NO:55, respectively.

**[0023]** In certain embodiments, the humanized anti-ADAM9 antibody is a full length antibody comprising an Fc region. In some embodiments, the Fc region is a variant Fc region that comprises: (a) one or more amino acid modification(s) that reduces(s) the affinity of the variant Fc region for an FcγR selected from the group consisting of: L234A, L235A, and L234A and L235A; and/or (b) an amino acid modification that introduces a cysteine residue at S442, wherein said numbering is that of the EU index as in Kabat.

**[0024]** In some embodiments, the humanized anti-ADAM9 antibody comprises a heavy chain and a light chain having the sequences selected from the group consisting of:

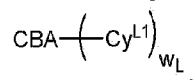
1. (a) SEQ ID NO:51 and SEQ ID NO:68, respectively; and
2. (b) SEQ ID NO:52 and SEQ ID NO:68, respectively.

**[0025]** In certain embodiments, the humanized anti-ADAM9 antibody comprises a heavy chain and a light chain having the sequences selected from the group consisting of:

1. (a) SEQ ID NO:141 and SEQ ID NO:68, respectively;
2. (b) SEQ ID NO:142 and SEQ ID NO:68, respectively;
3. (c) SEQ ID NO:143 and SEQ ID NO:68, respectively;
4. (d) SEQ ID NO:151 and SEQ ID NO:68, respectively;

5. (e) SEQ ID NO:152 and SEQ ID NO:68, respectively;
6. (f) SEQ ID NO:153 and SEQ ID NO:68, respectively; and
7. (g) SEQ ID NO:154 and SEQ ID NO:68, respectively.

**[0026]** In certain embodiments, the immunoconjugate of the present invention is represented by the following formula:

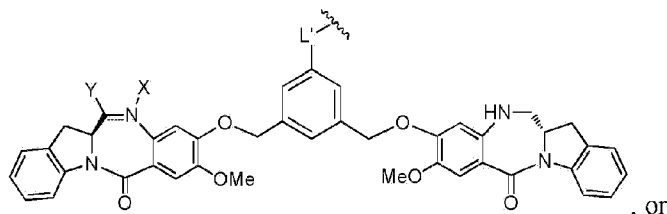


wherein:

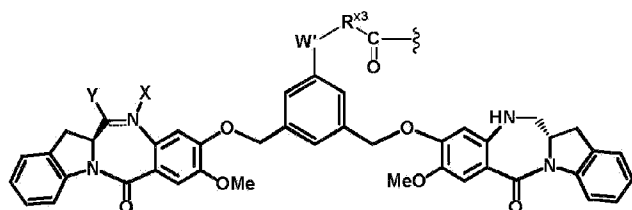
CBA is an anti-ADAM9 antibody or ADAM9-binding fragment thereof as described herein that is covalently linked to  $\text{Cy}^{\text{L1}}$  through a lysine residue;

$\text{W}_\text{L}$  is an integer from 1 to 20; and

$\text{Cy}^{\text{L1}}$  is represented by the following formula:



, or



or a pharmaceutically acceptable salt thereof, wherein:

the double line



between N and C represents a single bond or a double bond, provided that when it is a double bond, X is absent and Y is -H or a  $(\text{C}_1\text{-C}_4)$ alkyl; and when it is a single bond, X is -H or an amine protecting moiety, and Y is -OH or  $-\text{SO}_3\text{H}$  or a pharmaceutically acceptable salt thereof;

W is  $-\text{NR}^{\text{e'}}$ ,

$\text{R}^{\text{e'}}$  is  $-(\text{CH}_2\text{-CH}_2\text{-O})_n\text{-R}^{\text{k}}$ ;

n is an integer from 2 to 6;

$\text{R}^{\text{k}}$  is -H or -Me;

$\text{R}^{\text{x3}}$  is a  $(\text{C}_1\text{-C}_6)$ alkyl;

L' is represented by the following formula:

- $\text{NR}_5\text{-P-C(=O)-(CR}_a\text{R}_b)_m\text{-C(=O)-}$  (B1'); or
- $\text{NR}_5\text{-P-C(=O)-(CR}_a\text{R}_b)_m\text{-S-Z}^{\text{S1}}\text{-}$  (B2');

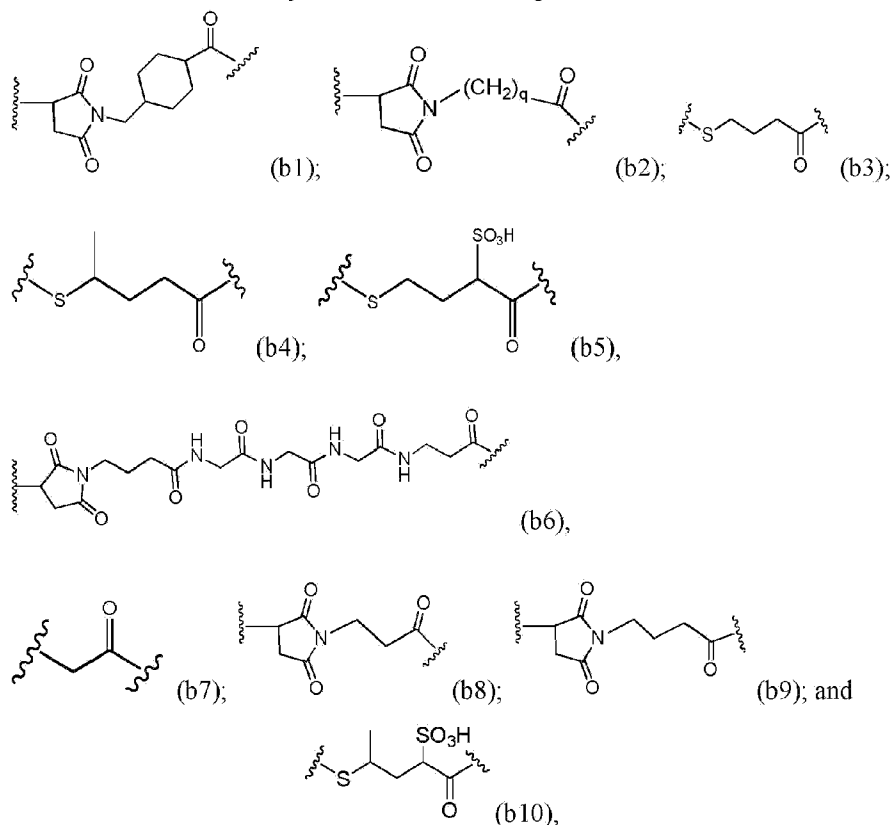
$\text{R}_5$  is -H or a  $(\text{C}_1\text{-C}_3)$ alkyl;

P is an amino acid residue or a peptide containing between 2 to 20 amino acid residues;

$\text{R}_a$  and  $\text{R}_b$ , for each occurrence, are each independently -H,  $(\text{C}_1\text{-C}_3)$ alkyl, or a charged substituent or an ionizable group Q;

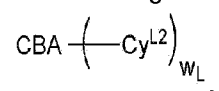
m is an integer from 1 to 6; and

$\text{Z}^{\text{S1}}$  is selected from any one of the following formulas:



wherein q is an integer from 1 to 5.

**[0027]** In certain embodiments, the immunoconjugate of the present invention is represented by the following formula:

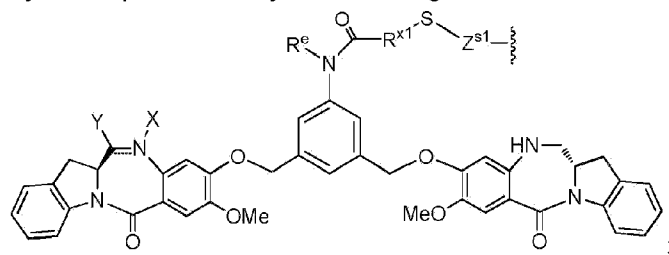


wherein:

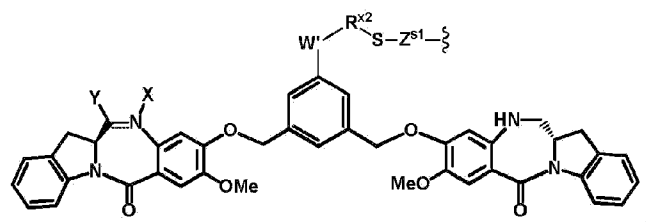
CBA is an anti-ADAM9 antibody or ADAM9-binding fragment thereof as described herein that is covalently linked to  $\text{Cy}^{\text{L2}}$  through a lysine residue;

$W_L$  is an integer from 1 to 20; and

$Cy^{L2}$  is represented by the following formula:



or



or a pharmaceutically acceptable salt thereof, wherein:

the double line

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between N and C represents a single bond or a double bond, provided that when it is a double bond, X is absent and Y is -H or a (C<sub>1</sub>-C<sub>4</sub>)alkyl; and when it is a single bond, X is -H or an amine protecting moiety, and Y is -OH or -SO<sub>3</sub>H;

$R^{x1}$  and  $R^{x2}$  are independently (C<sub>1</sub>-C<sub>6</sub>)alkyl;

$R^e$  is -H or a (C<sub>1</sub>-C<sub>6</sub>)alkyl;

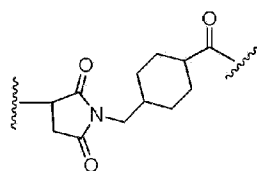
W is -NR<sup>e'</sup>,

$R^{e'}$  is -(CH<sub>2</sub>-CH<sub>2</sub>-O)<sub>n</sub>-R<sup>k</sup>;

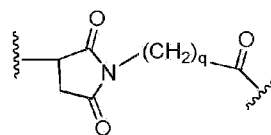
n is an integer from 2 to 6;

R<sup>k</sup> is -H or -Me;

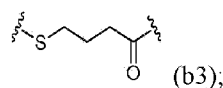
$Z^{s1}$  is selected from any one of the following formulas:



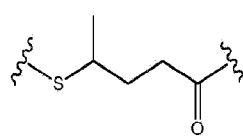
(b1),



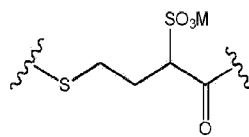
(b2),



(b3);

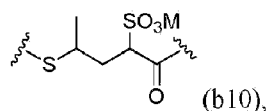
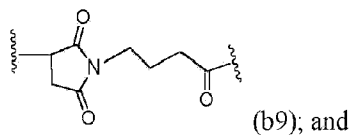
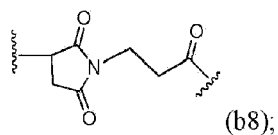
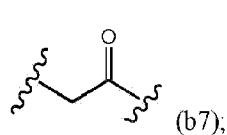
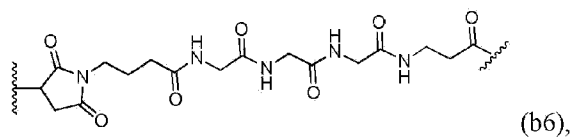


(b4);



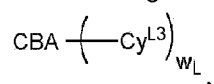
(b5),





wherein q is an integer from 1 to 5.

**[0028]** In certain embodiments, the immunoconjugate of the present invention is represented by the following formula:

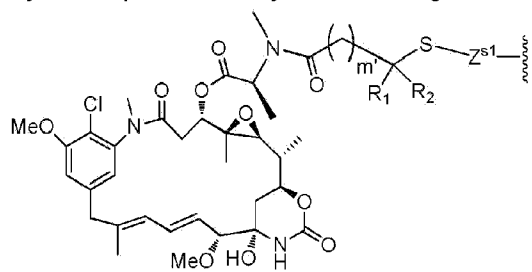


wherein:

CBA is an anti-ADAM9 antibody or ADAM9-binding fragment thereof as described herein that is covalently linked to  $\text{Cy}^{\text{L3}}$  through a lysine residue;

$\text{W}_\text{L}$  is an integer from 1 to 20;

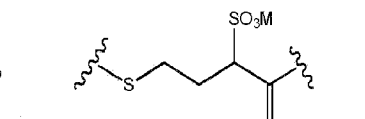
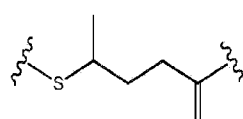
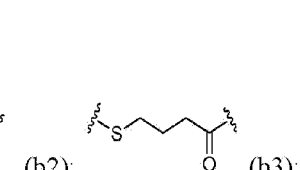
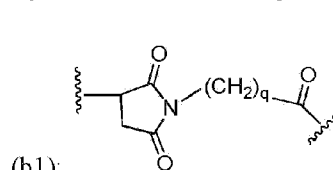
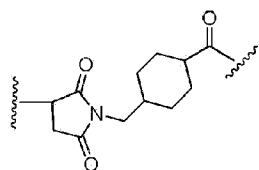
$\text{Cy}^{\text{L3}}$  is represented by the following formula:



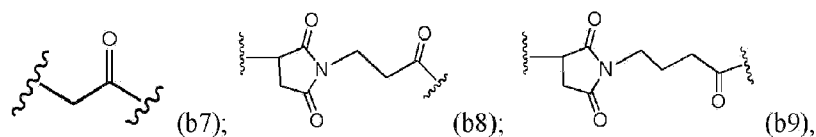
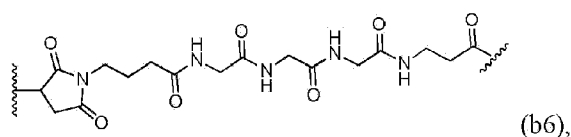
$m'$  is 1 or 2;

$\text{R}_1$  and  $\text{R}_2$ , are each independently H or a  $(\text{C}_1\text{--C}_3)\text{alkyl}$ ; and

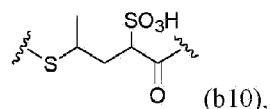
$\text{Z}^{\text{S1}}$  is selected from any one of the following formulas:



○ (b4);                      ○ (b5),



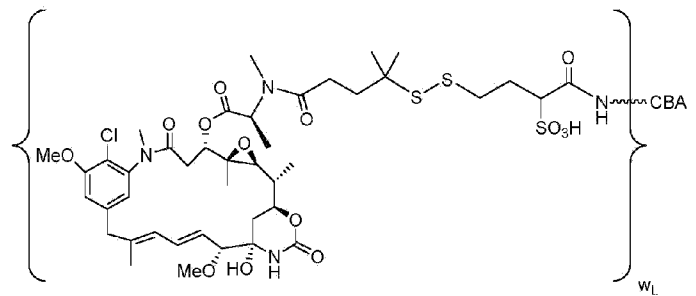
and



wherein q is an integer from 1 to 5.

**[0029]** In certain embodiments, the immunoconjugate of the present invention comprises an humanized anti-ADAM9 antibody or ADAM9-binding fragment thereof linked to the maytansinoid DM4 via *N*-succinimidyl-4-(2-pyridyldithio)2-sulfo butanoate (sulfo-SPDB), wherein an humanized anti-ADAM9 antibody or ADAM9-binding fragment thereof comprising a CDR<sub>H1</sub> domain, a CDR<sub>H2</sub> domain, and a CDR<sub>H3</sub> domain and a CDR<sub>L1</sub> domain, a CDR<sub>L2</sub> domain, and a CDR<sub>L3</sub> domain having the sequences of SEQ ID NOs: 8, 35, and 45 and SEQ ID NOs: 62, 13, 14, respectively. In certain embodiments, the humanized anti-ADAM9 antibody or ADAM9-binding fragment thereof comprises a heavy chain variable domain (VH) and a light chain variable domain (VL) having sequences of SEQ ID NO:28 and SEQ ID NO:55, respectively. In some embodiments, the humanized anti-ADAM9 antibody comprises a heavy chain and a light chain having the sequences of SEQ ID NO:52 and SEQ ID NO:68, respectively. In some embodiments, the humanized anti-ADAM9 antibody comprises a heavy chain and a light chain having the sequences of SEQ ID NO: 151 and SEQ ID NO:68, respectively. In some embodiments, X in SEQ ID NO:52 or SEQ ID NO:151 is lysine. In some embodiments, X in SEQ ID NO:52 or SEQ ID NO:151 is absent.

**[0030]** In certain embodiments, the immunoconjugate of the present invention is represented by the following formula:



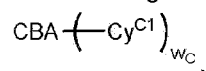
or a pharmaceutically acceptable salt thereof, wherein:

$W_L$  is an integer from 1 to 10;

**[0031]** CBA is an humanized anti-ADAM9 antibody or ADAM9-binding fragment thereof comprising a CDR<sub>H1</sub> domain, a CDR<sub>H2</sub> domain, and a CDR<sub>H3</sub> domain and a CDR<sub>L1</sub> domain, a

CDR<sub>L2</sub> domain, and a CDR<sub>L3</sub> domain having the sequences of SEQ ID NOs: 8, 35, and 45 and SEQ ID NOs: 62, 13, 14, respectively. In certain embodiments, the humanized anti-ADAM9 antibody or ADAM9-binding fragment thereof comprises a heavy chain variable domain (VH) and a light chain variable domain (VL) having sequences of SEQ ID NO:28 and SEQ ID NO:55, respectively. In some embodiments, the humanized anti-ADAM9 antibody comprises a heavy chain and a light chain having the sequences of SEQ ID NO:52 and SEQ ID NO:68, respectively. In some embodiments, the humanized anti-ADAM9 antibody comprises a heavy chain and a light chain having the sequences of SEQ ID NO: 151 and SEQ ID NO:68, respectively. In some embodiments, In some embodiments, X in SEQ ID NO:52 or SEQ ID NO:151 is lysine. In some embodiments, In some embodiments, X in SEQ ID NO:52 or SEQ ID NO:151 is absent. In some embodiments, the DAR value for a composition (e.g., pharmaceutical compositions) comprising the immunoconjugate is in the range of 1.0 to 5.0, 1.0 to 4.0, 1.0 to 3.4, 1.0 to 3.0, 1.5 to 2.5, 2.0 to 2.5, or 1.8 to 2.2. In some embodiments, the DAR is less than 4.0, less than 3.8, less than 3.6, less than 3.5, less than 3.0 or less than 2.5.

**[0032]** In certain embodiments, the immunoconjugate of the present invention is represented by the following formula:

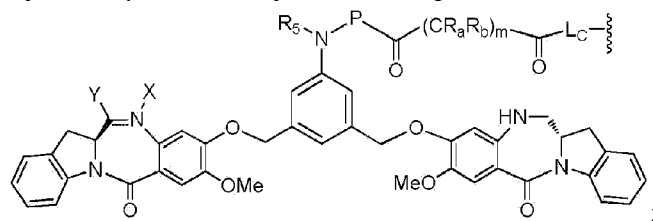


wherein:

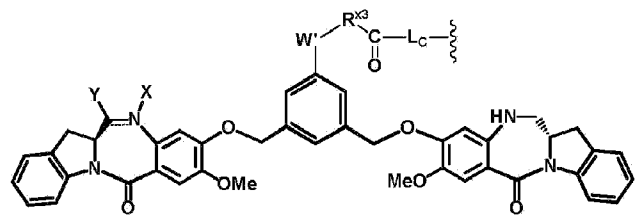
CBA is an anti-ADAM9 antibody or ADAM9-binding fragment thereof as described herein covalently linked to Cy<sup>C1</sup> through a cysteine residue;

W<sub>C</sub> is 1 or 2;

Cy<sup>C1</sup> is represented by the following formula:



or



or a pharmaceutically acceptable salt thereof, wherein:

the double line

==

between N and C represents a single bond or a double bond, provided that when it is a double bond, X is absent and Y is -H or a (C<sub>1</sub>-C<sub>4</sub>)alkyl; and when it is a single bond, X is -H or an amine protecting moiety, Y is -OH or -SO<sub>3</sub>H or a pharmaceutically acceptable salt thereof;

$R_5$  is -H or a  $(C_1-C_3)$ alkyl;

P is an amino acid residue or a peptide containing 2 to 20 amino acid residues;

$R_a$  and  $R_b$ , for each occurrence, are independently -H,  $(C_1-C_3)$ alkyl, or a charged substituent or an ionizable group Q;

W is  $-NR^{e'}$ ,

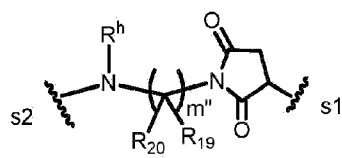
$R^{e'}$  is  $-(CH_2-CH_2-O)_n-R^k$ ;

n is an integer from 2 to 6;

$R^k$  is -H or -Me;

$R^{x3}$  is a  $(C_1-C_6)$ alkyl; and,

$L_C$  is represented by

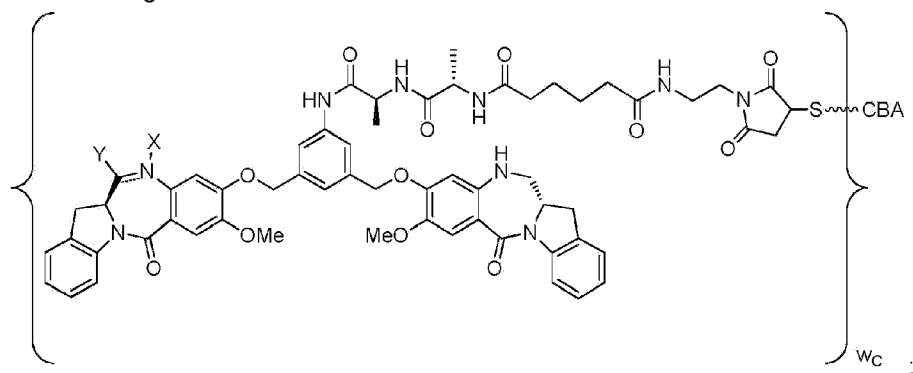


s1 is the site covalently linked to CBA, and s2 is the site covalently linked to the  $-C(=O)-$  group on  $Cy^{C1}$ ; wherein:  $R_{19}$  and  $R_{20}$ , for each occurrence, are independently -H or a  $(C_1-C_3)$ alkyl;

$m''$  is an integer between 1 and 10; and

$R^h$  is -H or a  $(C_1-C_3)$ alkyl.

**[0033]** In certain embodiments, the immunoconjugate of the present invention is represented by the following formula:



or a pharmaceutically acceptable salt thereof, wherein:

the double line

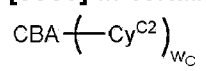
$\equiv$

between N and C represents a single bond or a double bond, provided that when it is a double

bond, X is absent and Y is -H, and when it is a single bond, X is -H, and Y is -SO<sub>3</sub>H or a pharmaceutically acceptable salt thereof;

**[0034]** CBA is an humanized anti-ADAM9 antibody or ADAM9-binding fragment thereof comprising a CDR<sub>H1</sub> domain, a CDR<sub>H2</sub> domain, and a CDR<sub>H3</sub> domain and a CDR<sub>L1</sub> domain, a CDR<sub>L2</sub> domain, and a CDR<sub>L3</sub> domain having the sequences of SEQ ID NOs: 8, 35, and 45 and SEQ ID NOs: 62, 13, 14, respectively. In certain embodiments, the humanized anti-ADAM9 antibody or ADAM9-binding fragment thereof comprises a heavy chain variable domain (VH) and a light chain variable domain (VL) having sequences of SEQ ID NO:28 and SEQ ID NO:55, respectively. In some embodiments, humanized anti-ADAM9 antibody comprises a heavy chain and a light chain having the sequences of SEQ ID NO: 142 and SEQ ID NO:68, respectively. In some embodiments, X in SEQ ID NO:142 is lysine. In some embodiments, the humanized anti-ADAM9 antibody comprises a heavy chain and a light chain having the sequences of SEQ ID NO:152 and SEQ ID NO:68, respectively. In some embodiments, X in SEQ ID NO:142 or SEQ ID NO:152 is lysine. In some embodiments, X in SEQ ID NO:142 or SEQ ID NO:152 is absent.

**[0035]** In certain embodiments, the immunoconjugate is represented by the following formula:

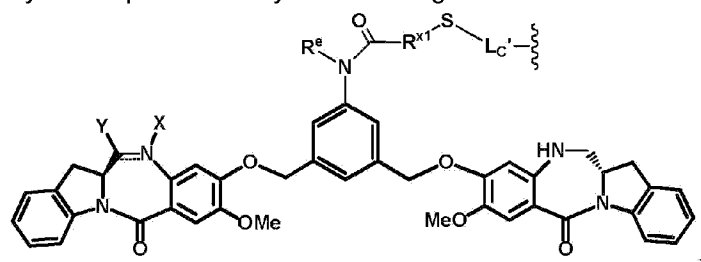


wherein:

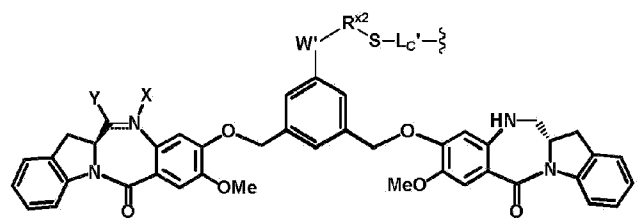
CBA is an anti-ADAM9 antibody or ADAM9-binding fragment thereof as described herein covalently linked to Cy<sup>C2</sup> through a cysteine residue;

W<sub>C</sub> is 1 or 2;

Cy<sup>C2</sup> is represented by the following formula:



or



or a pharmaceutically acceptable salt thereof, wherein:

the double line

==

between N and C represents a single bond or a double bond, provided that when it is a double bond, X is absent and Y is -H or a (C<sub>1</sub>-C<sub>4</sub>)alkyl; and when it is a single bond, X is -H or an amine

protecting moiety, Y is -OH or -SO<sub>3</sub>H or a pharmaceutically acceptable salt thereof;

R<sup>x1</sup> is a (C<sub>1</sub>-C<sub>6</sub>)alkyl;

R<sup>e</sup> is -H or a (C<sub>1</sub>-C<sub>6</sub>)alkyl;

W is -NR<sup>e'</sup>;

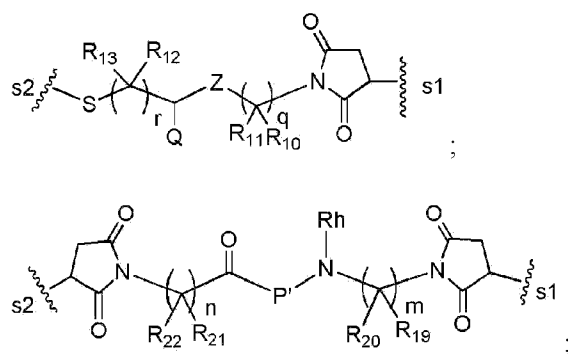
R<sup>e'</sup> is -(CH<sub>2</sub>-CH<sub>2</sub>-O)<sub>n</sub>-R<sup>k</sup>;

n is an integer from 2 to 6;

R<sup>k</sup> is -H or -Me;

R<sup>x2</sup> is a (C<sub>1</sub>-C<sub>6</sub>)alkyl;

L<sub>C</sub>' is represented by the following formula:



wherein:

s1 is the site covalently linked to the CBA and s2 is the site covalently linked to -S-group on Cy<sup>C2</sup>;

Z is -C(=O)-NR<sub>9</sub>-, or -NR<sub>9</sub>-C(=O)-;

Q is -H, a charged substituent, or an ionizable group;

R<sub>9</sub>, R<sub>10</sub>, R<sub>11</sub>, R<sub>12</sub>, R<sub>13</sub>, R<sub>19</sub>, R<sub>20</sub>, R<sub>21</sub> and R<sub>22</sub>, for each occurrence, are independently -H or a (C<sub>1</sub>-C<sub>3</sub>)alkyl;

q and r, for each occurrence, are independently an integer between 0 and 10;

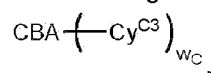
m and n are each independently an integer between 0 and 10;

R<sup>h</sup> is -H or a (C<sub>1</sub>-C<sub>3</sub>)alkyl; and

P' is an amino acid residue or a peptide containing 2 to 20 amino acid residues.

**[0036]** In certain embodiments, the immunoconjugate of the present invention is represented by

the following formula:

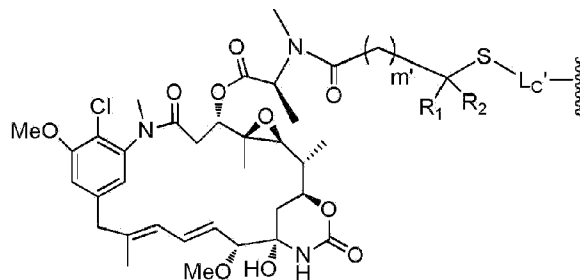


wherein:

CBA is an anti-ADAM9 antibody or ADAM9-binding fragment as described herein covalently linked to  $\text{Cy}^{\text{C3}}$  through a cysteine residue;

$W_C$  is 1 or 2;

$\text{Cy}^{\text{C3}}$  is represented by the following formula:

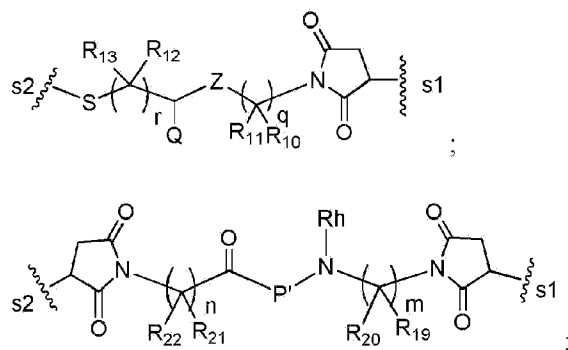


wherein:

$m'$  is 1 or 2;

$R_1$  and  $R_2$ , are each independently -H or a ( $\text{C}_1\text{-C}_3$ )alkyl;

$L_C'$  is represented by the following formula:



wherein:

$s_1$  is the site covalently linked to the CBA and  $s_2$  is the site covalently linked to -S-group on  $\text{Cy}^{\text{C3}}$ ;

$Z$  is  $-\text{C}(=\text{O})\text{-NR}_9\text{-}$ , or  $-\text{NR}_9\text{-C}(=\text{O})\text{-}$ ;

$Q$  is H, a charged substituent, or an ionizable group;

$R_9$ ,  $R_{10}$ ,  $R_{11}$ ,  $R_{12}$ ,  $R_{13}$ ,  $R_{19}$ ,  $R_{20}$ ,  $R_{21}$  and  $R_{22}$ , for each occurrence, are independently -H or a ( $\text{C}_1\text{-C}_3$ )alkyl;

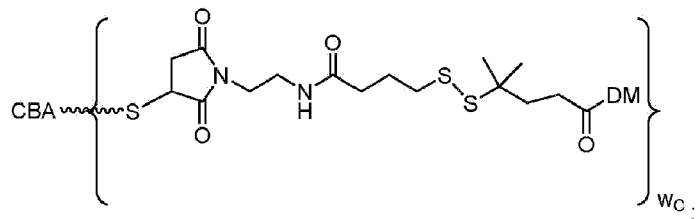
$q$  and  $r$ , for each occurrence, are independently an integer between 0 and 10;

$m$  and  $n$  are each independently an integer between 0 and 10;

$R^h$  is -H or a  $(C_1-C_3)$ alkyl; and

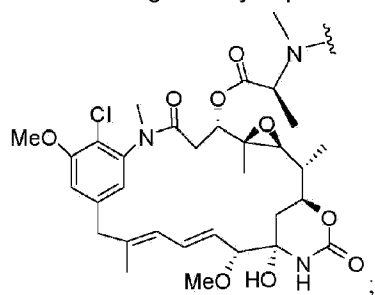
P' is an amino acid residue or a peptide containing 2 to 20 amino acid residues.

**[0037]** In certain embodiments, the immunoconjugate of the present invention is represented by the following formula:



or a pharmaceutically acceptable salt thereof, wherein:

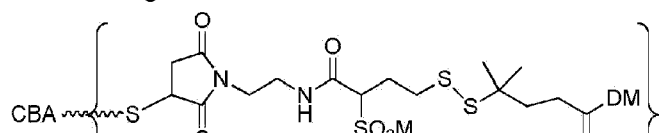
DM is a drug moiety represented by the following formula:



$W_C$  is 1 or 2;

**[0038]** CBA is an humanized anti-ADAM9 antibody or ADAM9-binding fragment thereof comprising a CDR<sub>H1</sub> domain, a CDR<sub>H2</sub> domain, and a CDR<sub>H3</sub> domain and a CDR<sub>L1</sub> domain, a CDR<sub>L2</sub> domain, and a CDR<sub>L3</sub> domain having the sequences of SEQ ID NOs: 8, 35, and 45 and SEQ ID NOs: 62, 13, 14, respectively. In certain embodiments, the humanized anti-ADAM9 antibody or ADAM9-binding fragment thereof comprises a heavy chain variable domain (VH) and a light chain variable domain (VL) having sequences of SEQ ID NO:28 and SEQ ID NO:55, respectively. In some embodiments, the humanized anti-ADAM9 antibody comprises a heavy chain and a light chain having the sequences of SEQ ID NO: 142 and SEQ ID NO:68, respectively. In some embodiments, the humanized anti-ADAM9 antibody comprises a heavy chain and a light chain having the sequences of SEQ ID NO: 152 and SEQ ID NO:68, respectively. In some embodiments, X in SEQ ID NO:142 or SEQ ID NO: 152 is lysine. In some embodiments, X in SEQ ID NO:142 or SEQ ID NO: 152 is absent. In some embodiments,  $W_C$  is 2.

**[0039]** In certain embodiments, the immunoconjugate of the present invention is represented by the following formula:

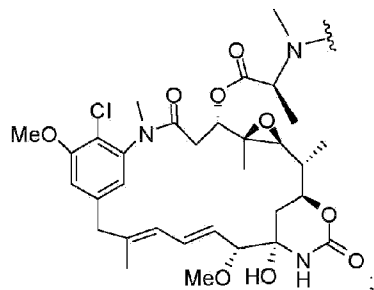






or a pharmaceutically acceptable salt thereof, wherein:

DM is a drug moiety represented by the following formula:



CBA is an humanized anti-ADAM9 antibody or ADAM9-binding fragment thereof comprising a CDR<sub>H1</sub> domain, a CDR<sub>H2</sub> domain, and a CDR<sub>H3</sub> domain and a CDR<sub>L1</sub> domain, a CDR<sub>L2</sub> domain, and a CDR<sub>L3</sub> domain having the sequences of SEQ ID NOs: 8, 35, and 45 and SEQ ID NOs: 62, 13, 14, respectively. In certain embodiments, the humanized anti-ADAM9 antibody or ADAM9-binding fragment thereof comprises a heavy chain variable domain (VH) and a light chain variable domain (VL) having sequences of SEQ ID NO:28 and SEQ ID NO:55, respectively. In some embodiments, the humanized anti-ADAM9 antibody comprises a heavy chain and a light chain having the sequences of SEQ ID NO: 142 and SEQ ID NO:68, respectively. In some embodiments, the humanized anti-ADAM9 antibody comprises a heavy chain and a light chain having the sequences of SEQ ID NO: 152 and SEQ ID NO:68, respectively; and

Wc is 1 or 2. In some embodiments, Wc is 2.

**[0040]** Another aspect of the present invention is set out in claim 15 and provides a pharmaceutical composition comprising an effective amount of the immunoconjugate as described herein and a pharmaceutically acceptable carrier, excipient or diluent.

**[0041]** Another aspect of the present invention is set out in claim 16 and provides the immunoconjugate or the pharmaceutical composition for use in a method for treating a disease or condition associated with, or characterized by, the expression of ADAM9 in a subject comprising administering to said subject an effective amount of the immunoconjugate or the pharmaceutical composition.

**[0042]** In certain embodiments, the disease or condition associated with, or characterized by, the expression of ADAM9 is cancer. In some embodiments, the cancer is selected from the group consisting of non-small-cell lung cancer, colorectal cancer, gastric cancer, pancreatic cancer, renal cell carcinoma, prostate cancer, esophageal cancer, breast cancer, head and neck cancer, ovarian cancer, liver cancer, cervical cancer, thyroid cancer, testicular cancer, myeloid cancer, melanoma, and lymphoid cancer. In certain embodiments, the non-small-cell lung cancer is squamous cell carcinoma, adenocarcinoma, or large-cell undifferentiated carcinoma. In certain embodiments, the colorectal cancer is adenocarcinoma, gastrointestinal carcinoid tumors,

gastrointestinal stromal tumors, primary colorectal lymphoma, leiomyosarcoma, or squamous cell carcinoma.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0043]** In the following examples, immunoconjugates comprising chMAB-A or hMAB-A(2.2) are shown for illustration purposes only and do not form part of the presently-claimed invention.

**FIGs. 1A-1C** present the results of an immunohistochemistry (IHC) studies and show the ability of MAB-A to specifically label a variety of non-small cell lung cancer types (**FIG. 1A**), breast cancer cells, prostate cancer cells, gastric cancer cells (**FIG. 1B**), and colon cancer cells (**FIG. 1C**) while the isotype control failed to specifically label any of these cancer cell types (**FIGs. 1A-1C**).

**FIG. 2** presents the results of cell staining studies and show that MAB-A binds to human ADAM9, and to a lesser extent, cynomolgus monkey ADAM9, transiently expressed on the surface of 293-FT and CHO-K cells (top and bottom panels respectively).

**FIGs. 3A-3B** depict the amino acid sequences of the murine anti-ADAM9-VH Domain aligned with several humanized/optimized variants of MAB-A (**FIG. 3A, SEQ ID NOs:7, 16, 17, 18,19, 21, 22, 23 and 28**) and the murine anti-ADAM9-VL Domain aligned with several humanized/optimized variants of MAB-A (**FIG. 3B, SEQ ID NOs:11, 51, 52, 53 and 54**). Positions substituted within the CDRs during the initial optimization are underlined as follows: potential deamidation and isomerization sites are indicated with a single underline, lysine residues are indicated with double underline, additional labile residues are indicated with a double dashed underline. **FIGs. 4A-4B** present the ELISA binding curves of the ten selected optimized hMAB-A clones comprising CDR<sub>H3</sub> variants, the parental hMAB-A (2.2), and an isotype control antibody. **FIG. 4A** presents the binding curves for cynoADAM9 and **FIG. 4B** presents the binding curves for huADAM9.

**FIGs. 5A-5B** present the ELISA binding curves of the Fc variants. **FIG. 5A** presents the binding curves for cynoADAM9 and **FIG. 5B** presents the binding curves for huADAM9.

**FIGs. 6A-6B** show ADAM9 IHC membrane staining in a 20 carcinoma tissue microarray and ADAM IHC membrane and cytoplasmic staining in eight selected indications, respectively.

**FIGs. 7A-7B** show pulse internalization and continuous internalization of various anti-ADAM9 antibody conjugates.

**FIGs. 8A-8D** show FACS binding curves of chMAB-A, hMAB-A(2.2), hMAB-A(2C.2), and hMAB-A(2I.2) antibodies and their corresponding immunoconjugates.

**FIGs. 9A-9H** show *in vitro* cytotoxicity of various anti-ADAM9 immunoconjugates (hMAB-A(2.2)-sSPDB-DM4, hMAB-A(2I.2)-sSPDB-DM4, hMAB-A(2.2)-DGN549, and hMAB-A(2I.2)-S442C-DGN549) on a broad panel of ADAM9 positive tumor cell lines. The non-targeting IgG1 based conjugates are included as negative controls.

**FIG. 10** shows the anti-tumor activity of hMAB-A(2.2)-sSPDB-DM4 (1.25 mg/kg, 2.5 mg/kg, 5 mg/kg, by antibody) and chMAB-A-DGN549 (10µg/kg, by payload) in the Calu-3 human non-small

cell lung adenocarcinoma xenograft model.

**FIG. 11** shows the anti-tumor activity of hMAB-A(2I.2)-S442C-DGN549 (0.5µg/kg, 1µg/kg, 3µg/kg, and 10µg/kg, by payload) in the Calu-3 human non-small cell lung adenocarcinoma xenograft model.

**FIG. 12** shows the anti-tumor activity of hMAB-A(2.2)-sSPDB-DM4 (1.25 mg/kg, 2.5 mg/kg, 5 mg/kg, by antibody) in the H1703 non-small cell lung squamous cell carcinoma xenograft model.

**FIG. 13** shows the anti-tumor activity of chMAB-A-sSPDB-DM4 (1.25 mg/kg, 2.5 mg/kg, 5 mg/kg) in the Detroit562 head and neck squamous cell carcinoma model (tumor volume 95.76 to 450.83 mm<sup>3</sup>).

**FIG. 14** shows the anti-tumor activity of chMAB-A-sSPDB-DM4 (1.25 mg/kg and 5 mg/kg) in the Detroit562 head and neck squamous cell carcinoma model (tumor volume 277.51 to 503.49 mm<sup>3</sup>).

**FIG. 15** shows the anti-tumor activity of huMAB-A(2I.2)-S442C-DGN549 in the SNU-5 gastric carcinoma xenograft model.

**FIG. 16** shows the anti-tumor activity of huMAB-A(2.2)-sSPDB-DM4 in the SNU-5 gastric carcinoma xenograft model.

**FIG. 17** shows the anti-tumor activity of huMAB-A(2I.2)-S442C-DGN549 in the SW48 colorectal cancer xenograft model.

**FIG. 18** shows the anti-tumor activity of huMAB-A(2.2)-sSPDB-DM4 in the SW48 colorectal cancer xenograft model.

**FIG. 19A** shows the binding of 250nM & 1000nM huFcRn to captured anti-ADAM9 antibodies with and without the YTE mutation at pH 6.0.

**FIG. 19B** shows the binding of 25nM & 100nM anti-ADAM9 antibodies with and without the YTE mutation to immobilized FcRn at pH 6.0.

**FIG. 20** shows the antibody-drug conjugate PK data for hMAB-A(2I.2)-sSPDB-DM4 and hMAB-A(2I.2)-YTE-sSPDB-DM4 in cynomolgus monkey at both 4 mg/kg and 12 mg/kg (antibody dose).

## DETAILED DESCRIPTION OF THE INVENTION

**[0044]** The present invention is directed to immunoconjugates comprising an antibody or fragment thereof capable of specifically binding to "Disintegrin and Metalloproteinase Domain-containing Protein 9" ("**ADAM9**") conjugated to at least one pharmacological agent as defined in claim 1. The immunoconjugates are cross-reactive with human ADAM9 and the ADAM9 of a non-human primate (a cynomolgus monkey). The immunoconjugates comprise a Light Chain Variable (VL) Domain and/or a Heavy Chain Variable (VH) Domain that has been humanized (and optionally deimmunized) so as to exhibit reduced immunogenicity upon administration of such

immunoconjugates to a recipient subject. The invention is also directed to pharmaceutical compositions as defined in claim 15 that contain any of such immunoconjugates, and to immunoconjugates or pharmaceutical compositions for use in the treatment of a disease or condition associated with, or characterized by, the expression of ADAM9 (such as cancer) as defined in claims 16 and 17.

## I. Antibodies and Their Binding Domains

**[0045]** The immunoconjugates of the present invention comprise an antibody that binds to ADAM9 or an ADAM9-binding fragment thereof. **"Antibodies"** are immunoglobulin molecules capable of specific binding to a target, such as a carbohydrate, polynucleotide, lipid, polypeptide, *etc.*, through at least one antigen recognition site, located in the **Variable Domain** of the immunoglobulin molecule. As used herein, the terms **"antibody"** and **"antibodies"** refer to monoclonal antibodies, multispecific antibodies, human antibodies, humanized antibodies, synthetic antibodies, chimeric antibodies, polyclonal antibodies, camelized antibodies, single-chain Fvs (scFv), single-chain antibodies, Fab fragments, F(ab') fragments, intrabodies, and epitope-binding fragments of any of the above. In particular, the term "antibody" includes immunoglobulin molecules and immunologically active fragments of immunoglobulin molecules, *i.e.*, molecules that contain an epitope-binding site. Immunoglobulin molecules can be of any type (*e.g.*, IgG, IgE, IgM, IgD, IgA and IgY), class (*e.g.*, IgG<sub>1</sub>, IgG<sub>2</sub>, IgG<sub>3</sub>, IgG<sub>4</sub>, IgA<sub>1</sub> and IgA<sub>2</sub>) or subclass. The last few decades have seen a revival of interest in the therapeutic potential of antibodies, and antibodies have become one of the leading classes of biotechnology-derived drugs (Chan, C.E. et al. (2009) "The Use Of Antibodies In The Treatment Of Infectious Diseases," Singapore Med. J. 50(7):663-666). In addition to their use in diagnostics, antibodies have been shown to be useful as therapeutic agents. Over 200 antibody-based drugs have been approved for use or are under development.

**[0046]** Antibodies are capable of **"immunospecifically binding"** to a polypeptide or protein or a non-protein molecule due to the presence on such molecule of a particular domain or moiety or conformation (an **"epitope"**). An epitope-containing molecule may have immunogenic activity, such that it elicits an antibody production response in an animal; such molecules are termed **"antigens."** As used herein, an antibody is said to **"immunospecifically"** bind a region of another molecule (*i.e.*, an epitope) if it reacts or associates more frequently, more rapidly, with greater duration and/or with greater affinity with that epitope relative to alternative epitopes. For example, an antibody that immunospecifically binds to a viral epitope is an antibody that binds that viral epitope with greater affinity, avidity, more readily, and/or with greater duration than it immunospecifically binds to other viral epitopes or to non-viral epitopes. It is also understood by reading this definition that, for example, an antibody (or moiety or epitope) that immunospecifically binds to a first target may or may not specifically or preferentially bind to a second target. As such, "immunospecific binding" to a particular epitope does not necessarily require (although it can include) exclusive binding to that epitope. Generally, but not necessarily, reference to binding means "immunospecific" binding. Two molecules are said to be capable of binding to one another in a **"physiospecific"** manner, if such binding exhibits the specificity with which receptors bind to their respective ligands.

**[0047]** The term "**monoclonal antibody**" refers to a homogeneous antibody population wherein the monoclonal antibody is comprised of amino acids (naturally occurring or non-naturally occurring) that are involved in the selective binding of an antigen. Monoclonal antibodies are highly specific, being directed against a single epitope (or antigenic site). The term "monoclonal antibody" encompasses not only intact monoclonal antibodies and full-length monoclonal antibodies, but also fragments thereof (such as Fab, Fab', F(ab')<sub>2</sub> Fv), single-chain (scFv), mutants thereof, fusion proteins comprising an antibody portion, humanized monoclonal antibodies, chimeric monoclonal antibodies, and any other modified configuration of the immunoglobulin molecule that comprises an antigen recognition site of the required specificity and the ability to bind to an antigen. The term is not intended to be limited as regards to the source of the antibody or the manner in which it is made (e.g., by hybridoma, phage selection, recombinant expression, transgenic animals, *etc.*). The term includes whole immunoglobulins as well as the fragments *etc.* described above under the definition of "antibody." Methods of making monoclonal antibodies are known in the art. One method which may be employed is the method of Kohler, G. et al. (1975) "Continuous Cultures Of Fused Cells Secreting Antibody Of Predetermined Specificity," *Nature* 256:495-497, or a modification thereof. Typically, monoclonal antibodies are developed in mice, rats or rabbits. The antibodies are produced by immunizing an animal with an immunogenic amount of cells, cell extracts, or protein preparations that contain the desired epitope. The immunogen can be, but is not limited to, primary cells, cultured cell lines, cancerous cells, proteins, peptides, nucleic acids, or tissue. Cells used for immunization may be cultured for a period of time (e.g., at least 24 hours) prior to their use as an immunogen. Cells may be used as immunogens by themselves or in combination with a non-denaturing adjuvant, such as Ribi (see, e.g., Jennings, V.M. (1995) "Review of Selected Adjuvants Used in Antibody Production," *ILAR J.* 37(3):119-125). In general, cells should be kept intact and preferably viable when used as immunogens. Intact cells may allow antigens to be better detected than ruptured cells by the immunized animal. Use of denaturing or harsh adjuvants, e.g., Freund's adjuvant, may rupture cells and therefore is discouraged. The immunogen may be administered multiple times at periodic intervals such as, bi weekly, or weekly, or may be administered in such a way as to maintain viability in the animal (e.g., in a tissue recombinant). Alternatively, existing monoclonal antibodies and any other equivalent antibodies that are immunospecific for a desired pathogenic epitope can be sequenced and produced recombinantly by any means known in the art. In one embodiment, such an antibody is sequenced and the polynucleotide sequence is then cloned into a vector for expression or propagation. The sequence encoding the antibody of interest may be maintained in a vector in a host cell and the host cell can then be expanded and frozen for future use. The polynucleotide sequence of such antibodies may be used for genetic manipulation to generate an affinity optimized, a chimeric antibody, a humanized antibody, and/or a caninized antibody, to improve the affinity, or other characteristics of the antibody, as well as the immunoconjugates of the invention. The general principle in humanizing an antibody involves retaining the basic sequence of the antigen-binding portion of the antibody, while swapping the non-human remainder of the antibody with human antibody sequences.

**[0048]** Natural antibodies (such as natural IgG antibodies) are composed of two "**Light Chains**" complexed with two "**Heavy Chains**." Each Light Chain contains a Variable Domain ("**VL**") and a Constant Domain ("**CL**"). Each Heavy Chain contains a Variable Domain ("**VH**"), three Constant

Domains ("**CH1**," "**CH2**" and "**CH3**"), and a "**Hinge**" Region ("**H**") located between the **CH1** and **CH2** Domains. In contrast, scFvs are single chain molecules made by linking Light and Heavy Chain Variable Domains together via a short linking peptide.

**[0049]** The basic structural unit of naturally occurring immunoglobulins (e.g., IgG) is thus a tetramer having two light chains and two heavy chains, usually expressed as a glycoprotein of about 150,000 Da. The amino-terminal ("**N-terminal**") portion of each chain includes a Variable Domain of about 100 to 110 or more amino acids primarily responsible for antigen recognition. The carboxy-terminal ("**C-terminal**") portion of each chain defines a constant region, with light chains having a single Constant Domain and heavy chains usually having three Constant Domains and a Hinge Region. Thus, the structure of the light chains of an IgG molecule is n-VL-CL-c and the structure of the IgG heavy chains is n-VH-CH1-H-CH2-CH3-c (where n and c represent, respectively, the N-terminus and the C-terminus of the polypeptide).

#### A. Characteristics of Antibody Variable Domains

**[0050]** The Variable Domains of an IgG molecule consist of 1, 2, and most commonly 3, complementarity determining regions ("**CDR**", i.e., **CDR1**, **CDR2** and **CDR3**, respectively), which contain the residues in contact with epitope, and non-CDR segments, referred to as **framework regions ("FR")**, which in general maintain the structure and determine the positioning of the CDR regions so as to permit such contacting (although certain framework residues may also contact the epitope). Thus, the VL and VH Domains typically have the structure: **n-FR1-CDR1-FR2-CDR2-FR3-CDR3-FR4-c** (where "n" denotes the N-terminus and "c" denotes the C-terminus). Polypeptides that are (or may serve as) the first, second, third, and fourth FR of the Light Chain of an antibody are herein respectively designated as: **FR<sub>L</sub>1 Domain**, **FR<sub>L</sub>2 Domain**, **FR<sub>L</sub>3 Domain**, and **FR<sub>L</sub>4 Domain**. Similarly, polypeptides that are (or may serve as) the first, second, third and fourth FR of the Heavy Chain of an antibody are herein respectively designated as: **FR<sub>H</sub>1 Domain**, **FR<sub>H</sub>2 Domain**, **FR<sub>H</sub>3 Domain** and **FR<sub>H</sub>4 Domain**. Polypeptides that are (or may serve as) the first, second and third CDR of the Light Chain of an antibody are herein respectively designated as: **CDR<sub>L</sub>1 Domain**, **CDR<sub>L</sub>2 Domain**, and **CDR<sub>L</sub>3 Domain**. Similarly, polypeptides that are (or may serve as) the first, second and third CDR of the Heavy Chain of an antibody are herein respectively designated as: **CDR<sub>H</sub>1 Domain**, **CDR<sub>H</sub>2 Domain**, and **CDR<sub>H</sub>3 Domain**. Thus, the terms CDR<sub>L</sub>1 Domain, CDR<sub>L</sub>2 Domain, CDR<sub>L</sub>3 Domain, CDR<sub>H</sub>1 Domain, CDR<sub>H</sub>2 Domain, and CDR<sub>H</sub>3 Domain are directed to polypeptides that when incorporated into an antibody causes the antibody to be able to bind to a specific epitope.

**[0051]** Throughout the present specification, the numbering of the residues in the Variable Domains of the mature heavy and light chains of immunoglobulins are designated by the position of an amino acid in the chain. Kabat described numerous amino acid sequences for antibodies, identified an amino acid consensus sequence for each subgroup, and assigned a residue number to each amino acid, and the CDRs are identified as defined by Kabat (it will be understood that CDR<sub>H</sub>1 as defined by Chothia, C. & Lesk, A. M. ((1987) "Canonical structures for the hypervariable regions of immunoglobulins," J. Mol. Biol. 196:901-917) begins five residues

earlier). Kabat's numbering scheme is extendible to antibodies not included in his compendium by aligning the antibody in question with one of the consensus sequences in Kabat by reference to conserved amino acids. This method for assigning residue numbers has become standard in the field and readily identifies amino acids at equivalent positions in different antibodies, including chimeric or humanized variants. For example, an amino acid at position 50 of a human antibody light chain occupies the equivalent position to an amino acid at position 50 of a mouse antibody light chain.

**[0052]** The ability of an antibody to bind an epitope of an antigen depends upon the presence and amino acid sequence of the antibody's VL and VH Domains. Interaction of an antibody's Light Chain and Heavy Chain and, in particular, interaction of its VL and VH Domains forms one of the two epitope-binding sites of a natural antibody, such as an IgG. Natural antibodies are capable of binding to only one epitope species (*i.e.*, they are monospecific), although they can bind multiple copies of that epitope species (*i.e.*, exhibiting bivalency or multivalency).

**[0053]** Accordingly, as used herein, the term "**epitope-binding fragment**" means a fragment of an antibody capable of immunospecifically binding to an epitope, and the term "**epitope-binding site**" refers to a portion of a molecule comprising an epitope-binding fragment. An epitope-binding fragment may contain any 1, 2, 3, 4, or 5 the CDR Domains of an antibody, or may contain all 6 of the CDR Domains of an antibody and, although capable of immunospecifically binding to such epitope, may exhibit an immunospecificity, affinity or selectivity toward such epitope that differs from that of such antibody. Preferably, however, an epitope-binding fragment will contain all 6 of the CDR Domains of such antibody. An epitope-binding fragment of an antibody may be a single polypeptide chain (*e.g.*, an scFv), or may comprise two or more polypeptide chains, each having an amino terminus and a carboxy terminus (*e.g.*, a Fab fragment, an Fab<sub>2</sub> fragment, *etc.*). Unless specifically noted, the order of domains of the protein molecules described herein is in the "**N-terminal to C-terminal**" direction.

**[0054]** The invention also encompasses immunoconjugates comprising single-chain Variable Domain fragments ("**scFv**") comprising an anti-ADAM9-VL and/or VH Domain of the invention. Single-chain Variable Domain fragments comprise VL and VH Domains that are linked together using a short "Linker" peptide. Such Linkers can be modified to provide additional functions, such as to permit the attachment of a drug or to permit attachment to a solid support. The single-chain variants can be produced either recombinantly or synthetically. For synthetic production of scFv, an automated synthesizer can be used. For recombinant production of scFv, a suitable plasmid containing polynucleotide that encodes the scFv can be introduced into a suitable host cell, either eukaryotic, such as yeast, plant, insect or mammalian cells, or prokaryotic, such as *E. coli*. Polynucleotides encoding the scFv of interest can be made by routine manipulations such as ligation of polynucleotides. The resultant scFv can be isolated using standard protein purification techniques known in the art.

**[0055]** The term "**humanized**" antibody refers to a chimeric molecule having an epitope-binding site of an immunoglobulin from a non-human species and a remaining immunoglobulin structure that is based upon the structure and /or sequence of a human immunoglobulin. Humanized antibodies are generally prepared using recombinant techniques. The immunoconjugates of the

present invention may comprise humanized, chimeric or caninized variants of an antibody that is designated herein as "**MAB-A**." The polynucleotide sequences that encode the Variable Domains of MAB-A may be used for genetic manipulation to generate MAB-A derivatives possessing improved or altered characteristics (*e.g.*, affinity, cross-reactivity, specificity, *etc.*). The general principle in humanizing an antibody involves retaining the basic sequence of the epitope-binding portion of the antibody, while swapping the non-human remainder of the antibody with human antibody sequences. There are four general steps to humanize a monoclonal antibody. These are: (1) determining the nucleotide and predicted amino acid sequence of the starting antibody light and heavy variable domains; (2) designing the humanized antibody or caninized antibody, *i.e.*, deciding which antibody framework region to use during the humanizing or canonizing process; (3) employing the actual humanizing or caninizing methodologies/techniques; and (4) transfecting and expressing the humanized antibody. See, for example, U.S. Patent Nos. 4,816,567; 5,807,715; 5,866,692; and 6,331,415. The term "**optimized**" antibody refers to an antibody having at least one amino acid which is different from the parent antibody in at least one complementarity determining region (CDR) in the light or heavy chain variable region, which confers a higher binding affinity, (*e.g.*, a 2-fold or more fold) higher binding affinity, to human ADAM9 and/or cynomolgus monkey ADAM9 as compared to the parental antibody. It will be understood from the teaching provided herein that the antibodies of the invention are humanized, and optionally optimized.

**[0056]** The epitope-binding site may comprise either a complete Variable Domain fused to one or more Constant Domains or only the CDRs of such Variable Domain grafted to appropriate framework regions. Epitope-binding sites may be wild-type or may be modified by one or more amino acid substitutions, insertions or deletions. Such action partially or completely eliminates the ability of the Constant Region to serve as an immunogen in recipients (*e.g.*, human individuals), however, the possibility of an immune response to the foreign Variable Domain remains (LoBuglio, A.F. et al. (1989) "Mouse/Human Chimeric Monoclonal Antibody In Man: Kinetics And Immune Response," *Proc. Natl. Acad. Sci. (U.S.A.)* 86:4220-4224). Another approach focuses not only on providing human-derived constant regions, but on modifying the Variable Domains as well so as to reshape them as closely as possible to a form found in human immunoglobulins. It is known that the Variable Domains of both the Heavy and Light Chains of antibodies contain three CDRs which vary in response to the antigens in question and determine binding capability, flanked by the four framework regions, which are relatively conserved in a given species and which putatively provide a scaffolding for the CDRs. When non-human antibodies are prepared with respect to a particular antigen, the variable domains can be "reshaped" or "humanized" by grafting CDRs derived from non-human antibody on the FRs present in the human antibody to be modified. Application of this approach to various antibodies has been reported by Sato, K. et al. (1993) *Cancer Res* 53:851-856; Riechmann, L. et al. (1988) "Reshaping Human Antibodies for Therapy," *Nature* 332:323-327; Verhoeyen, M. et al. (1988) "Reshaping Human Antibodies: Grafting An Antilysozyme Activity," *Science* 239:1534-1536; Kettleborough, C. A. et al. (1991) "Humanization Of A Mouse Monoclonal Antibody By CDR-Grafting: The Importance Of Framework Residues On Loop Conformation," *Protein Engineering* 4:773-783; Maeda, H. et al. (1991) "Construction Of Reshaped Human Antibodies With HIV-Neutralizing Activity," *Human Antibodies Hybridoma* 2:124-134; Gorman, S. D. et al. (1991) "Reshaping A Therapeutic CD4 Antibody," *Proc. Natl. Acad. Sci. (U.S.A.)* 88:4181-4185; Tempest, P.R. et al. (1991) "Reshaping A Human Monoclonal Antibody To



Inhibit Human Respiratory Syncytial Virus Infection in vivo," Bio/Technology 9:266-271; Co, M. S. et al. (1991) "Humanized Antibodies For Antiviral Therapy," Proc. Natl. Acad. Sci. (U.S.A.) 88:2869-2873; Carter, P. et al. (1992) "Humanization Of An Anti-p185her2 Antibody For Human Cancer Therapy," Proc. Natl. Acad. Sci. (U.S.A.) 89:4285-4289; and Co, M.S. et al. (1992) "Chimeric And Humanized Antibodies With Specificity For The CD33 Antigen," J. Immunol. 148:1149-1154. According to the claimed invention, the humanized antibodies have one or more CDRs (one, two, three, four, or five) that differ in sequence relative to the CDRs of the original antibody.

**[0057]** A number of humanized antibody molecules comprising an epitope-binding site derived from a non-human immunoglobulin have been described, including chimeric antibodies having rodent or modified rodent Variable Domain and their associated complementarity determining regions (CDRs) fused to human constant domains (see, for example, Winter et al. (1991) "Man-made Antibodies," Nature 349:293-299; Lobuglio et al. (1989) "Mouse/Human Chimeric Monoclonal Antibody In Man: Kinetics And Immune Response," Proc. Natl. Acad. Sci. (U.S.A.) 86:4220-4224; Shaw et al. (1987) "Characterization Of A Mouse/Human Chimeric Monoclonal Antibody (17-1A) To A Colon Cancer Tumor-Associated Antigen," J. Immunol. 138:4534-4538; and Brown et al. (1987) "Tumor-Specific Genetically Engineered Murine/Human Chimeric Monoclonal Antibody," Cancer Res. 47:3577-3583). Other references describe rodent CDRs grafted into a human supporting framework region (FR) prior to fusion with an appropriate human antibody Constant Domain (see, for example, Riechmann, L. et al. (1988) "Reshaping Human Antibodies for Therapy," Nature 332:323-327; Verhoeyen, M. et al. (1988) "Reshaping Human Antibodies: Grafting An Antilysozyme Activity," Science 239:1534-1536; and Jones et al. (1986) "Replacing The Complementarity-Determining Regions In A Human Antibody With Those From A Mouse," Nature 321:522-525). Another reference describes rodent CDRs supported by recombinantly veneered rodent framework regions (see, for example, European Patent Publication No. 519,596). These "humanized" molecules are designed to minimize unwanted immunological response towards rodent anti-human antibody molecules, which limits the duration and effectiveness of therapeutic applications of those moieties in human recipients. Other methods of humanizing antibodies that may also be utilized are disclosed by Daugherty et al. (1991) "Polymerase Chain Reaction Facilitates The Cloning, CDR-Grafting, And Rapid Expression Of A Murine Monoclonal Antibody Directed Against The CD18 Component Of Leukocyte Integrins," Nucl. Acids Res. 19:2471-2476 and in U.S. Patent Nos. 6,180,377; 6,054,297; 5,997,867; and 5,866,692.

## **B. Characteristics of Antibody Constant Domains**

**[0058]** Throughout the present specification, the numbering of the residues in the constant region of an IgG heavy chain is that of the EU index as in Kabat et al., SEQUENCES OF PROTEINS OF IMMUNOLOGICAL INTEREST, 5th Ed. Public Health Service, NH1, MD (1991) ("Kabat"). The term **"the EU index as set forth in Kabat"** refers to the numbering of the Constant Domains of human IgG1 EU antibody provided in Kabat. This method for assigning residue numbers has become standard in the field and readily identifies amino acids at equivalent positions in the constant regions of different antibody isotypes.

## 1. Constant Regions of the Light Chain

**[0059]** As indicated above, each Light Chain of an antibody contains a Variable Domain ("VL") and a Constant Domain ("CL").

**[0060]** A preferred CL Domain is a human IgG CL Kappa Domain. The amino acid sequence of an exemplary human CL Kappa Domain is **(SEQ ID NO:69)**:

```
RTVAAPSVFI FPPSDEQLKS GTASVVCLLN NFYPREAKVQ WKVDNALQSG
NSQESVTEQD SKDSTYSLSS TLTLKADYE KHKVYACEVT HQGLSSPVTK
SFNRGEC
```

**[0061]** Alternatively, an exemplary CL Domain is a human IgG CL Lambda Domain. The amino acid sequence of an exemplary human CL Lambda Domain is **(SEQ ID NO:70)**:

```
QPKAAPSVTL FPPSSEELQA NKATLVCLIS DFYPGAVTVA WKADSSPVKA
GVETTPSKQS NNKYAASSYL SLTPEQWKSH RSYSCQVTHE GSTVEKTVAP
TECS
```

## 2. Constant Regions of the Heavy Chain

### a. Naturally-Occurring Fc Regions

**[0062]** As provided herein, the immunoconjugates of the invention may comprise an Fc Region. The Fc Region of such immunoconjugates the invention may be of any isotype (e.g., IgG1, IgG2, IgG3, or IgG4). The immunoconjugates of the invention may further comprise a CH1 Domain and/or a Hinge Region. When present, the CH1 Domain and/or Hinge Region may be of any isotype (e.g., IgG1, IgG2, IgG3, or IgG4), and is preferably of the same isotype as the desired Fc Region.

**[0063]** The Fc Region of the Fc Region-containing immunoconjugates of the present invention may be either a complete Fc Region (e.g., a complete IgG Fc Region) or only a fragment of an Fc Region. Optionally, the Fc Region of the Fc Region-containing immunoconjugates of the present invention lacks the C-terminal lysine amino acid residue.

**[0064]** The CH1 Domains of the two heavy chains of an antibody complex with the antibody's Light Chain's "CL" constant region, and are attached to the heavy chains CH2 Domains via an intervening Hinge Domain.

**[0065]** An exemplary CH1 Domain is a human IgG1 CH1 Domain. The amino acid sequence of an exemplary human IgG1 CH1 Domain is **(SEQ ID NO:71)**:

```
ASTKGPSVFP LAPSSKSTSG GTAALGCLVK DYFPEPVTVS WNSGALTSGV
HTFPAVLOSS GLYSLSSVVT VPSSSLGTOT YICNVNHKPS NTKVDKRV
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[0066] An exemplary CH1 Domain is a human IgG2 CH1 Domain. The amino acid sequence of an exemplary human IgG2 CH1 Domain is (SEQ ID NO:72):

ASTKGPSVFP LAPCSRSTSE STAALGCLVK DYFPEPVTVS WNSGALTSGV  
HTFPAVLQSS GLYSLSSVVT VPSSNFGTQT YTCNVDPKPS NTKVDKTV

[0067] An exemplary CH1 Domain is a human IgG4 CH1 Domain. The amino acid sequence of an exemplary human IgG4 CH1 Domain is (SEQ ID NO:73):

ASTKGPSVFP LAPCSRSTSE STAALGCLVK DYFPEPVTVS WNSGALTSGV  
HTFPAVLQSS GLYSLSSVVT VPSSSLGTKT YTCNVDPKPS NTKVDKRV

[0068] One exemplary Hinge Region is a human IgG1 Hinge Region. The amino acid sequence of an exemplary human IgG1 Hinge Region is (SEQ ID NO:74): EPKSCDKTHTCPPCP.

[0069] Another exemplary Hinge Region is a human IgG2 Hinge Region. The amino acid sequence of an exemplary human IgG2 Hinge Region is (SEQ ID NO:75): ERKCCVECPPCP.

[0070] Another exemplary Hinge Region is a human IgG4 Hinge Region. The amino acid sequence of an exemplary human IgG4 Hinge Region is (SEQ ID NO:76): ESKYGPPCPSPC. As described above, an IgG4 Hinge Region may comprise a stabilizing mutation, such as the S228P substitution. The amino acid sequence of an exemplary stabilized IgG4 Hinge Region is (SEQ ID NO:77): ESKYGPPCPPCP.

[0071] The CH2 and CH3 Domains of the two Heavy Chains of an antibody interact to form an "Fc Region," which is a domain that is recognized by cellular "Fc Receptors," including but not limited to Fc gamma Receptors ("FcyRs"). As used herein, the term "Fc Region" is used to define the C-terminal region of an IgG Heavy Chain that comprises the CH2 and CH3 Domains of that chain. An Fc Region is said to be of a particular IgG isotype, class or subclass if its amino acid sequence is most homologous to that isotype, relative to other IgG isotypes.

[0072] The amino acid sequence of the CH2-CH3 Domain of an exemplary human IgG1 is (SEQ ID NO:1)

231	240	250	260	270	280
APELLGGPSV FLFPPKPKDT LMISRTPEVT CVVVDVSHED PEVKFNWYVD					
290	300	310	320	330	
GVEVHNAKTK PREEQYNSTY RVVSVLTVLH QDWLNGKEYK CKVSNKALPA					
340	350	360	370	380	
PIEKTISKAK GQPREPQVYT LPFSREEMTK NQVSLTCLVK GFYPSDIAVE					
390	400	410	420	430	
WESNGQPENN YKTTTPVLDS DGSFFLYSKL TVDKSRWQQG NVFSCSVME					
440	447				
ALHNHYTQKS LSLSPGX					

as numbered by the EU index as set forth in Kabat, wherein X is a lysine (K) or is absent.

**[0073]** The amino acid sequence of the CH2-CH3 Domain of an exemplary human IgG2 is (SEQ ID NO:2):

```

231      240      250      260      270      280
APPVA-GPSV FLFPPKPKDT LMISRTPEVT CVVVDVSHED PEVQFNWYVD

      290      300      310      320      330
GVEVHNAKTK PREEQFNSTF RVVSVLTVVH QDWLNGKEYK CKVSNKGLPA

      340      350      360      370      380
PIEKTISKTK GQPREPQVYT LPPSREEMTK NQVSLTCLVK GFYPSDISVE

      390      400      410      420      430
WESNGQPENN YKTTTPMLDS DGSFFLYSKL TVDKSRWQQG NVFSCSVME

      440      447
ALHNHYTQKS LSLSPGX

```

as numbered by the EU index as set forth in Kabat, wherein X is a lysine (K) or is absent.

**[0074]** The amino acid sequence of the CH2-CH3 Domain of an exemplary human IgG3 is (SEQ ID NO:3):

```

231      240      250      260      270      280
APELLGGPSV FLFPPKPKDT LMISRTPEVT CVVVDVSHED PEVQFKWYVD

      290      300      310      320      330
GVEVHNAKTK PREEQYNSTF RVVSVLTVLH QDWLNGKEYK CKVSNKALPA

      340      350      360      370      380
PIEKTISKTK GQPREPQVYT LPPSREEMTK NQVSLTCLVK GFYPSDIAVE

      390      400      410      420      430
WESSGQPENN YNTTTPMLDS DGSFFLYSKL TVDKSRWQQG NIFSCSVME

      440      447
ALHNRTQKS LSLSPGX

```

as numbered by the EU index as set forth in Kabat, wherein X is a lysine (K) or is absent.

**[0075]** The amino acid sequence of the CH2-CH3 Domain of an exemplary human IgG4 is (SEQ ID NO:4):

```

231      240      250      260      270      280
APEFLGGPSV FLFPPKPKDT LMISRTPEVT CVVVDVSQED PEVQFNWYVD

      290      300      310      320      330
GVEVHNAKTK PREEQFNSTY RVVSVLTVLH QDWLNGKEYK CKVSNKGLPS

      340      350      360      370      380
SIEKTISKAK GQPREPQVYT LPPSQEEMTK NQVSLTCLVK GFYPSDIAVE

      390      400      410      420      430
WESNGQPENN YKTTTPVLDS DGSFFLYSRL TVDKSRWQEG NVFSCSVME

      440      447
ALHNHYTQKS LSLSLGX

```

as numbered by the EU index as set forth in Kabat, wherein X is a lysine (K) or is absent.

**[0076]** Polymorphisms have been observed at a number of different positions within antibody constant regions (e.g., Fc positions, including but not limited to positions 270, 272, 312, 315, 356, and 358 as numbered by the EU index as set forth in Kabat), and thus slight differences between the presented sequence and sequences in the prior art can exist. Polymorphic forms of human immunoglobulins have been well-characterized. At present, 18 Gm allotypes are known: G1m (1, 2, 3, 17) or G1m (a, x, f, z), G2m (23) or G2m (n), G3m (5, 6, 10, 11, 13, 14, 15, 16, 21, 24, 26, 27, 28) or G3m (b1, c3, b3, b0, b3, b4, s, t, g1, c5, u, v, g5) (Lefranc, et al., "The Human IgG Subclasses: Molecular Analysis of Structure, Function And Regulation." Pergamon, Oxford, pp. 43-78 (1990); Lefranc, G. et al., 1979, Hum. Genet.: 50, 199-211). It is specifically contemplated that the antibodies of the present invention may incorporate any allotype, isoallotype, or haplotype of any immunoglobulin gene, and are not limited to the allotype, isoallotype or haplotype of the sequences provided herein. Furthermore, in some expression systems the C-terminal amino acid residue (bolded above) of the CH3 Domain may be post-translationally removed. Accordingly, the C-terminal residue of the CH3 Domain is an optional amino acid residue in the immunoconjugates of the invention. Specifically encompassed by the instant invention are immunoconjugates lacking the C-terminal residue of the CH3 Domain. Also specifically encompassed by the instant invention are such constructs comprising the C-terminal lysine residue of the CH3 Domain.

#### **b. Fcγ Receptors (FcγRs)**

**[0077]** In traditional immune function, the interaction of antibody-antigen complexes with cells of the immune system results in a wide array of responses, ranging from effector functions such as antibody dependent cytotoxicity, mast cell degranulation, and phagocytosis to immunomodulatory signals such as regulating lymphocyte proliferation and antibody secretion. All of these interactions are initiated through the binding of the Fc Region of antibodies or immune complexes to specialized cell surface receptors on hematopoietic cells, and particularly to receptors (singularly referred to as an **"Fc gamma receptor"** **"FcγR,"** and collectively as **"FcγRs"**) found on the surfaces of multiple types of immune system cells (e.g., B lymphocytes, follicular dendritic cells, natural killer cells, macrophages, neutrophils, eosinophils, basophils and mast cells).

**[0078]** The diversity of cellular responses triggered by antibodies and immune complexes results from the structural heterogeneity of the three Fc receptors: FcγRI (CD64), FcγRII (CD32), and FcγRIII (CD16). FcγRI (CD64), FcγRIIA (CD32A) and FcγRIII (CD16) are activating (*i.e.*, immune system enhancing) receptors; FcγRIIB (CD32B) is an inhibiting (*i.e.*, immune system dampening) receptor. In addition, interaction with the neonatal Fc Receptor (FcRn) mediates the recycling of IgG molecules from the endosome to the cell surface and release into the blood. The amino acid sequence of exemplary wild-type IgG1 (**SEQ ID NO:1**), IgG2 (**SEQ ID NO:2**), IgG3 (**SEQ ID NO:3**), and IgG4 (**SEQ ID NO:4**) are presented above.

**[0079]** The ability of the different FcγRs to mediate diametrically opposing functions reflects structural differences among the different FcγRs, and in particular reflects whether the bound FcγR possesses an Immunoreceptor Tyrosine-Based Activation Motif (**"ITAM"**) or an

Immunoreceptor Tyrosine-Based Inhibitory Motif ("ITIM"). The recruitment of different cytoplasmic enzymes to these structures dictates the outcome of the FcγR-mediated cellular responses. ITAM-containing FcγRs include FcγRI, FcγRIIA, FcγRIIIA, and activate the immune system when bound to Fc Regions (e.g., aggregated Fc Regions present in an immune complex). FcγRIIB is the only currently known natural ITIM-containing FcγR; it acts to dampen or inhibit the immune system when bound to aggregated Fc Regions. Human neutrophils express the FcγRIIA gene. FcγRIIA clustering via immune complexes or specific antibody cross-linking serves to aggregate ITAMs with receptor-associated kinases which facilitate ITAM phosphorylation. ITAM phosphorylation serves as a docking site for Syk kinase, the activation of which results in the activation of downstream substrates (e.g., PI<sub>3</sub>K). Cellular activation leads to release of pro-inflammatory mediators. The FcγRIIB gene is expressed on B lymphocytes; its extracellular domain is 96% identical to FcγRIIA and binds IgG complexes in an indistinguishable manner. The presence of an ITIM in the cytoplasmic domain of FcγRIIB defines this inhibitory subclass of FcγR. Recently the molecular basis of this inhibition was established. When co-ligated along with an activating FcγR, the ITIM in FcγRIIB becomes phosphorylated and attracts the SH2 domain of the inositol polyphosphate 5'-phosphatase (SHIP), which hydrolyzes phosphoinositol messengers released as a consequence of ITAM-containing FcγR-mediated tyrosine kinase activation, consequently preventing the influx of intracellular Ca<sup>++</sup>. Thus cross-linking of FcγRIIB dampens the activating response to FcγR ligation and inhibits cellular responsiveness. B-cell activation, B-cell proliferation and antibody secretion is thus aborted.

### c. Variant Fc Regions

**[0080]** Modification of the Fc Region may lead to an altered phenotype, for example altered serum half-life, altered stability, altered susceptibility to cellular enzymes or altered effector function. It may therefore be desirable to modify an Fc Region-containing molecule of the present invention with respect to effector function, for example, so as to enhance the effectiveness of such molecule in treating cancer. Reduction or elimination of effector function is desirable in certain cases, for example in the case of antibodies whose mechanism of action involves blocking or antagonism, but not killing of the cells bearing a target antigen. Increased effector function is generally desirable when directed to undesirable cells, such as tumor and foreign cells, where the FcγRs are expressed at low levels, for example, tumor-specific B cells with low levels of FcγRIIB (e.g., non-Hodgkin's lymphoma, CLL, and Burkitt's lymphoma). Immunoconjugates of the invention possessing such conferred or altered effector function activity are useful for the treatment and/or prevention of a disease, disorder or infection in which an enhanced efficacy of effector function activity is desired.

**[0081]** Accordingly, in certain embodiments, the Fc Region of the Fc Region-containing immunoconjugates of the present invention may be an engineered variant Fc Region. Although the Fc Region of immunoconjugates of the present invention may possess the ability to bind to one or more Fc receptors (e.g., FcγR(s)), more preferably such variant Fc Region have altered binding to FcγRIA (CD64), FcγRIIA (CD32A), FcγRIIB (CD32B), FcγRIIIA (CD16a) or FcγRIIIB (CD16b) (relative to the binding exhibited by a wild-type Fc Region), e.g., will have enhanced binding to an activating receptor and/or will have substantially reduced or no ability to bind to

inhibitory receptor(s). Thus, the Fc Region of the immunoconjugates of the present invention may include some or all of the CH2 Domain and/or some or all of the CH3 Domain of a complete Fc Region, or may comprise a variant CH2 and/or a variant CH3 sequence (that may include, for example, one or more insertions and/or one or more deletions with respect to the CH2 or CH3 domains of a complete Fc Region). Such Fc Regions may comprise non-Fc polypeptide portions, or may comprise portions of non-naturally complete Fc Regions, or may comprise non-naturally occurring orientations of CH2 and/or CH3 Domains (such as, for example, two CH2 domains or two CH3 domains, or in the N-terminal to C-terminal direction, a CH3 Domain linked to a CH2 Domain, *etc.*).

**[0082]** Fc Region modifications identified as altering effector function are known in the art, including modifications that increase binding to activating receptors (*e.g.*, FcγRIIA (CD16A) and reduce binding to inhibitory receptors (*e.g.*, FcγRIIB (CD32B) (see, *e.g.*, Stavenhagen, J.B. et al. (2007) "Fc Optimization Of Therapeutic Antibodies Enhances Their Ability To Kill Tumor Cells In Vitro And Controls Tumor Expansion In Vivo Via Low-Affinity Activating Fcγ Receptors," Cancer Res. 57(18):8882-8890). **Table 1** lists exemplary single, double, triple, quadruple and quintuple substitutions (numbering is that of the EU index as in Kabat, and substitutions are relative to the amino acid sequence of **SEQ ID NO:1**) of exemplary modification that increase binding to activating receptors and/or reduce binding to inhibitory receptors.

Table 1 Variations of Preferred Activating Fc Regions			
Single-Site Variations			
F243L	R292G	D270E	R292P
Y300L	P396L		
Double-Site Variations			
F243L and R292P	F243L and Y300L	F243L and P396L	R292P and Y300L
D270E and P396L	R292P and V305I	P396L and Q419H	P247L and N421K
R292P and P396L	Y300L and P396L	R255L and P396L	R292P and P305I
K392T and P396L			
Triple-Site Variations			
F243L, P247L and N421K		P247L, D270E and N421K	
F243L, R292P and Y300L		R255L, D270E and P396L	
F243L, R292P and V305I		D270E, G316D and R416G	
F243L, R292P and P396L		D270E, K392T and P396L	
F243L, Y300L and P396L		D270E, P396L and Q419H	
V284M, R292L and K370N		R292P, Y300L and P396L	
Quadruple-Site Variations			
L234F, F243L, R292P and Y300L		F243L, P247L, D270E and N421K	
L234F, F243L, R292P and Y300L		F243L, R255L, D270E and P396L	
L235I, F243L, R292P and Y300L		F243L, D270E, G316D and R416G	
L235Q, F243L, R292P and Y300L		F243L, D270E, K392T and P396L	

<b>Quadruple-Site Variations</b>	
P247L, D270E, Y300L and N421K	F243L, R292P, Y300L, and P396L
R255L, D270E, R292G and P396L	F243L, R292P, V305I and P396L
R255L, D270E, Y300L and P396L	F243L, D270E, P396L and Q419H
D270E, G316D, P396L and R416G	
<b>Quintuple-Site Variations</b>	
L235V, F243L, R292P, Y300L and P396L	F243L, R292P, V305I, Y300L and P396L
L235P, F243L, R292P, Y300L and P396L	

**[0083]** Exemplary variants of human IgG1 Fc Regions with reduced binding to CD32B and/or increased binding to CD16A contain F243L, R292P, Y300L, V305I or P396L substitutions, wherein the numbering is that of the EU index as in Kabat. These amino acid substitutions may be present in a human IgG1 Fc Region in any combination. In one embodiment, the variant human IgG1 Fc Region contains a F243L, R292P and Y300L substitution. In another embodiment, the variant human IgG1 Fc Region contains a F243L, R292P, Y300L, V305I and P396L substitution.

**[0084]** In certain embodiments, it is preferred for the Fc Regions of the immunoconjugates of the present invention to exhibit decreased (or substantially no) binding to FcγRIA (CD64), FcγRIIA (CD32A), FcγRIIB (CD32B), FcγRIIIA (CD16a) or FcγRIIIB (CD16b) (relative to the binding exhibited by the wild-type IgG1 Fc Region (**SEQ ID NO:1**)). In a specific embodiment, the immunoconjugates of the present invention comprise an IgG Fc Region that exhibits reduced ADCC effector function. In a preferred embodiment the CH2-CH3 Domains of immunoconjugates include any 1, 2, 3, or 4 of the substitutions: L234A, L235A, D265A, N297Q, and N297G, wherein the numbering is that of the EU index as in Kabat. In another embodiment, the CH2-CH3 Domains contain an N297Q substitution, an N297G substitution, L234A and L235A substitutions or a D265A substitution, as these mutations abolish FcR binding. Alternatively, a CH2-CH3 Domain of a naturally occurring Fc region that inherently exhibits decreased (or substantially no) binding to FcγRIIIA (CD16a) and/or reduced effector function (relative to the binding and effector function exhibited by the wild-type IgG1 Fc Region (**SEQ ID NO:1**)) is utilized. In a specific embodiment, the immunoconjugates of the present invention comprise an IgG2 Fc Region (**SEQ ID NO:2**) or an IgG4 Fc Region (**SEQ ID: NO:4**). When an IgG4 Fc Region is utilized, the instant invention also encompasses the introduction of a stabilizing mutation, such as the Hinge Region S228P substitution described above (see, e.g., **SEQ ID NO:77**). Since the N297G, N297Q, L234A, L235A and D265A substitutions abolish effector function, in circumstances in which effector function is desired, these substitutions would preferably not be employed.

**[0085]** A preferred IgG1 sequence for the CH2 and CH3 Domains of the Fc Region-containing immunoconjugates of the present invention having reduced or abolished effector function will comprise the substitutions L234A/L235A (shown underlined) (**SEQ ID NO:78**):

APEAAGGPSV FLFPKPKDT LMISRTPEVT CVVVDVSHED PEVKFNWYVD  
 GVEVHNAKTK PREEQYNSTY RVVSVLTVLH QDWLNGKEYK CKVSNKALPA  
 PIEKTISKAK GQPREPQVYT LPSSREEMTK NQVSLTCLVK GFYPSDIAVE  
 WESNGQPENN YKTTTPVLDS DGSFFLYSKL TVDKSRWQQG NVFSCSVMHE  
 ATLNHYTQKS TSTSPCY



ADMINHTQKS LCSPGX

wherein, X is a lysine (K) or is absent.

**[0086]** A second preferred IgG1 sequence for the CH2 and CH3 Domains of the Fc Region-containing immunoconjugates of the present invention comprises an S442C substitution (shown underlined), that permits two CH3 domains to be covalently bonded to one another via a disulfide bond or conjugation of a pharmaceutical agent. The amino acid sequence of such molecule is (SEQ ID NO:79):

APELLGGPSV FLFPPKPKDT LMISRTPEVT CVVVDVSHED PEVKFNWYVD  
GVEVHNAKTK PREEQYNSTY RVVSVLTVLH QDWLNGKEYK CKVSNKALPA  
PIEKTISKAK GQPREPQVYT LPPSREEMTK NQVSLTCLVK GFYPSDIAVE  
WESNGQPENN YKTTTPVLDS DGSFFLYSKL TVDKSRWQQG NVFSCSVME  
ALHNHYTQKS LCLSPGX

wherein, X is a lysine (K) or is absent.

**[0087]** A third preferred IgG1 sequence for the CH2 and CH3 Domains of the Fc Region-containing immunoconjugates of the present invention comprises the L234A/L235A substitutions (shown underlined) that reduce or abolish effector function and the S442C substitution (shown underlined) that permits two CH3 domains to be covalently bonded to one another via a disulfide bond or conjugation of a pharmaceutical agent. The amino acid sequence of such molecule is (SEQ ID NO:80):

APEAAGGPSV FLFPPKPKDT LMISRTPEVT CVVVDVSHED PEVKFNWYVD  
GVEVHNAKTK PREEQYNSTY RVVSVLTVLH QDWLNGKEYK CKVSNKALPA  
PIEKTISKAK GQPREPQVYT LPPSREEMTK NQVSLTCLVK GFYPSDIAVE  
WESNGQPENN YKTTTPVLDS DGSFFLYSKL TVDKSRWQQG NVFSCSVME  
ALHNHYTQKS LCLSPGX

wherein, X is a lysine (K) or is absent.

**[0088]** The serum half-life of proteins comprising Fc Regions may be increased by increasing the binding affinity of the Fc Region for FcRn. The term "half-life" as used herein means a pharmacokinetic property of a molecule that is a measure of the mean survival time of the molecules following their administration. Half-life can be expressed as the time required to eliminate fifty percent (50%) of a known quantity of the molecule from a subject's (e.g., a human patient or other mammal) body or a specific compartment thereof, for example, as measured in serum, i.e., circulating half-life, or in other tissues. In general, an increase in half-life results in an increase in mean residence time (MRT) in circulation for the administered molecule.

**[0089]** In some embodiments, the immunoconjugates of the present invention comprise a variant Fc Region that comprises at least one amino acid modification relative to a wild-type Fc Region, such that said molecule has an increased half-life (relative to a molecule comprising a wild-type Fc Region). In some embodiments, the immunoconjugates of the present invention comprise a variant IgG Fc Region, wherein said variant Fc Region comprises a half-life extending amino acid substitution at one or more positions selected from the group consisting of 238, 250, 252, 254, 256, 257, 258, 265, 272, 286, 288, 303, 305, 307, 308, 309, 311, 312, 317, 340, 356, 360, 362, 376, 378, 380, 382, 413, 424, 428, 433, 434, 435, and 436, wherein the numbering is that of the EU index as in Kabat. Numerous mutations capable of increasing the half-life of an Fc Region-containing molecule are known in the art and include, for example M252Y, S254T, T256E, and combinations thereof. For example, see the mutations described in U.S. Patent Nos. 6,277,375,

7,083,784; 7,217,797, 8,088,376; U.S. Publication Nos. 2002/0147311; 2007/0148164; and PCT Publication Nos. WO 98/23289; WO 2009/058492; and WO 2010/033279. Immunoconjugates with enhanced half-life also include those possessing variant Fc Regions comprising substitutions at two or more of Fc Region residues 250, 252, 254, 256, 257, 288, 307, 308, 309, 311, 378, 428, 433, 434, 435 and 436, wherein the numbering is that of the EU index as in Kabat. In particular, two or more substitutions selected from: T250Q, M252Y, S254T, T256E, K288D, T307Q, V308P, A378V, M428L, N434A, H435K, and Y436I, wherein the numbering is that of the EU index as in Kabat.

**[0090]** In a specific embodiment, an immunoconjugate of the present invention possesses a variant IgG Fc Region comprising the substitutions:

1. (A) M252Y, S254T and T256E;
2. (B) M252Y and S254T;
3. (C) M252Y and T256E;
4. (D) T250Q and M428L;
5. (E) T307Q and N434A;
6. (F) A378V and N434A;
7. (G) N434A and Y436I;
8. (H) V308P and N434A; or
9. (I) K288D and H435K.

**[0091]** In a preferred embodiment, the immunoconjugate of the present invention possesses a variant IgG Fc Region comprising any 1, 2, or 3 of the substitutions: M252Y, S254T and T256E. The invention further encompasses immunoconjugates possessing variant Fc Regions comprising:

1. (A) one or more mutations which alter effector function and/or FcγR; and
2. (B) one or more mutations which extend serum half-life.

**[0092]** A fourth preferred IgG1 sequence for the CH2 and CH3 Domains of the Fc Region-containing immunoconjugates of the present invention comprises the M252Y, S254T and T256E substitutions (shown underlined), so as to extend the serum half-life. The amino acid sequence of such molecule is (**SEQ ID NO:147**):

APELLGGPSV FLFPPKPKDT LYITREPEVT CTVVVDVSHED PEVKFNWYVD  
 GVEVHNAKTK PREEQYNSTY RVVSVLTVLH QDWLNGKEYK CKVSNKALPA  
 PIEKTISKAK GQPREPQVYT LPPSREEMTK NQVSLTCLVK GFYPSDIAVE  
 WESNGQPENN YKTTTPVLDS DGSFFLYSKL TVDKSRWQQG NVFSCSV MHE  
 ALHNHYTQKS LSLSPGX

wherein, **X** is a lysine (K) or is absent.

**[0093]** A fifth preferred IgG1 sequence for the CH2 and CH3 Domains of the Fc Region-containing immunoconjugates of the present invention comprises the M252Y, S254T and T256E

substitutions (shown underlined), so as to extend the serum half-life, and the S442C substitution (shown underlined), so as to permit two CH3 domains to be covalently bonded to one another via a disulfide bond or to permit conjugation of a drug moiety. The amino acid sequence of such molecule is (SEQ ID NO: 148):

APELLGGPSV FLFPPKPKDT LYITREPEVT CVVVDVSHED PEVKFNWYVD  
GVEVHNAKTK PREEQYNSTY RVVSVLTVLH QDWLNGKEYK CKVSNKALPA  
PIEKTISKAK GQPREPQVYT LPPSREEMTK NQVSLTCLVK GFYPSDIAVE  
WESNGQPENN YKTTTPVLDS DGSFFLYSKL TVDKSRWQQG NVFSCSVME  
ALHNHYTQKS LCLSPGX

wherein, **X** is a lysine (K) or is absent.

**[0094]** A sixth preferred IgG1 sequence for the CH2 and CH3 Domains of the Fc Region-containing immunoconjugates of the present invention comprises the L234A/L235A substitutions (shown underlined) that reduce or abolish effector function and the M252Y, S254T and T256E substitutions (shown underlined), so as to extend the serum half-life. The amino acid sequence of such molecule is (SEQ ID NO: 149):

APEAAGGPSV FLFPPKPKDT LYITREPEVT CVVVDVSHED PEVKFNWYVD  
GVEVHNAKTK PREEQYNSTY RVVSVLTVLH QDWLNGKEYK CKVSNKALPA  
PIEKTISKAK GQPREPQVYT LPPSREEMTK NQVSLTCLVK GFYPSDIAVE  
WESNGQPENN YKTTTPVLDS DGSFFLYSKL TVDKSRWQQG NVFSCSVME  
ALHNHYTQKS LSLSPGX

wherein, **X** is a lysine (K) or is absent.

**[0095]** A seventh preferred IgG1 sequence for the CH2 and CH3 Domains of the Fc Region-containing immunoconjugates of the present invention comprises the L234A/L235A substitutions (shown underlined) that reduce or abolish effector function and the M252Y, S254T and T256E substitutions (shown underlined), so as to extend the serum half-life and the S442C substitution (shown underlined), so as to permit two CH3 domains to be covalently bonded to one another via a disulfide bond or to permit conjugation of a drug moiety. The amino acid sequence of such molecule is (SEQ ID NO:150):

APEAAGGPSV FLFPPKPKDT LYITREPEVT CVVVDVSHED PEVKFNWYVD  
GVEVHNAKTK PREEQYNSTY RVVSVLTVLH QDWLNGKEYK CKVSNKALPA  
PIEKTISKAK GQPREPQVYT LPPSREEMTK NQVSLTCLVK GFYPSDIAVE  
WESNGQPENN YKTTTPVLDS DGSFFLYSKL TVDKSRWQQG NVFSCSVME  
ALHNHYTQKS LCLSPGX

wherein, **X** is a lysine (K) or is absent.

## II. Exemplary Anti-ADAM9 Antibodies

**[0096]** Particular antibodies and antigen-binding fragments thereof capable of specifically binding to ADAM9 are useful in the generation of the immunoconjugates of the invention.

**[0097]** A representative human ADAM9 polypeptide (NCBI Sequence NP\_003807, including a 28 amino acid residue signal sequence, shown underlined), shown for illustration purposes only and not according to the claimed invention, has the amino acid sequence (SEQ ID NO:5):

MGSGARFPSG TLRVRWLLLL GLVGPVLGAA RPFQQTSHL SSYEIITPWR  
LTRERREAPR PYSKQVSYVI QAEGKEHIIH LERNKDLLPE DFVVYTYNKE  
GPGTGGDNT QVNGHPPKGYL RYNNNGSTL QDGGGRLGLL HENRQVGEF

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GTLITDHPNI QNHCHYRGYV EGVHNSIAL SDCFGLRGLL HLENASYGIE
PLQNSSHFEH IIRMDDEVYK EPLKCGVSNK DIEKETAKDE EEEPPSMTQL
LRRRRRAVL PQ TRYVELFIVV DKERYDMMGR NQTAVREEMI LLANYLDSMY
IMLNIRIVLV GLEIWTNGNL INIVGGAGDV LGNFVQWREK FLITRRRHDS
AQLVLKKGFG GTAGMAFVGT VCSRSHAGGI NVFGQITVET FASIVAHELG
HNLGMNHDDG RDCSCGAKSC IMNSGASGSR NFSSCSAEDF EKLTNLKGGN
CLLNIPKPDE AYSAPSCGNK LVDAGEECDG GTPKECELDG CCEGSTCKLK
SFAECAYGDC CKDCRFLPGG TLCRGKTSEC DVPEYCNSS QFCQPDVFIQ
NGYPCQNNKA YCYNGMCQYY DAQCQVIFGS KAKAAPKDCF IEVNSKGDRF
GNCGFSGNEY KKCATGNALC GKLQCEVQEI IPVFGIVPAI IQTPSRGTKC
WGVDLQLGSD VPDGPMVNEG TKCGAGKICR NFQCVDAVL NYDCDVQKKC
HGHGVCNSNK NCHCENGWAP PNCETKGYGG SVDSGPTYNE MNTALRDGLL
VFFFLIVPLI VCAIFIFIKR DQLWRSYFRK KRSQTYESDG KNQANPSRQP
GSVPRHVSPV TPPREVPIYA NRFAVPTYAA KQPQQFPSRP PPPQPKVSSQ
GNLIPARPAP APPLYSSLT

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**[0098]** Of the 819 amino acid residues of ADAM9 (**SEQ ID NO:5**), residues 1-28 are a signal sequence, residues 29-697 are the Extracellular Domain, residues 698-718 are the Transmembrane Domain, and residues 719-819 are the Intracellular Domain. Three structural domains are located within the Extracellular Domain: a Reprolysin (M12B) Family Zinc Metalloprotease Domain (at approximately residues 212-406); a Disintegrin Domain (at approximately residues 423-497); and an EGF-like Domain (at approximately residues 644-697). A number of post-translational modifications and isoforms have been identified and the protein is proteolytically cleaved in the trans-Golgi network before it reaches the plasma membrane to generate a mature protein. The removal of the pro-domain occurs via cleavage at two different sites. Processed most likely by a pro-protein convertase such as furin, at the boundary between the pro-domain and the catalytic domain (Arg-205/Ala-206). An additional upstream cleavage pro-protein convertase site (Arg-56/Glu-57) has an important role in the activation of ADAM9.

**[0099]** A representative cynomolgus monkey ADAM9 polypeptide (NCBI Sequence XM\_005563126.2, including a possible 28 amino acid residue signal sequence, shown underlined), shown for illustration purposes only and not according to the claimed invention, has the amino acid sequence (**SEQ ID NO:6**):

```

MSGVGSPSG TLRVRWLLL CLVGPVLGAA RPGFQQTSHL SSYEIITPWR
LTRERREAPR PYSKQVSYLI QAEGKEHIIH LERNKDLLPE DFFVYTYNKE
GTVITDHPNI QNHCHFRGYV EGVYNSVAL SNCFGLRGLL HLENASYGIE
PLQNSSHFEH IIRMDDEVHK EPLKCGVSNK DIEKETTKDE EEEPPSMTQL
LRRRRRAVL PQ TRYVELFIVV DKERYDMMGR NQTAVREEMI LLANYLDSMY
IMLNIRIVLV GLEIWTNGNL INIAGGAGDV LGNFVQWREK FLITRRRHDS
AQLVLKKGFG GTAGMAFVGT VCSRSHAGGI NVFGHITVET FASIVAHELG
HNLGMNHDDG RDCSCGAKSC IMNSGASGSR NFSSCSAEDF EKLTNLKGGN
CLLNIPKPDE AYSAPSCGNK LVDAGEECDG GTPKECELDG CCEGSTCKLK
SFAECAYGDC CKDCRFLPGG TLCRGKTSEC DVPEYCNSS QFCQPDVFIQ
NGYPCQNNKA YCYNGMCQYY DAQCQVIFGS KAKAAPKDCF IEVNSKGDRF
GNCGFSGNEY KKCATGNALC GKLQCEVQEI IPVFGIVPAI IQTPSRGTKC
WGVDLQLGSD VPDGPMVNEG TKCGADKICR NFQCVDAVL NYDCDIQKKC
HGHGVCNSNK NCHCENGWAP PNCETKGYGG SVDSGPTYNE MNTALRDGLL
VFFFLIVPLI VCAIFIFIKR DQLWRRYFRK KRSQTYESDG KNQANPSRQP
VSVPRHVSPV TPPREVPIYA NRFPVPTYAA KQPQQFPSRP PPPQPKVSSQ
GNLTPARPAP APPLYSSTLT

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**[0100]** The Reprolysin (M12B) Family Zinc Metalloprotease Domain of the protein is at approximately residues 212-406; the Disintegrin Domain of the protein is at approximately residues 423-497.

**[0101]** In certain embodiments, the immunoconjugates comprising the anti-ADAM9 antibodies and ADAM9-binding fragments thereof of the invention are characterized by any one, two, three, four, five, six, seven, eight, or nine of the following criteria:

1. (1) the ability to immunospecifically bind human ADAM9 as endogenously expressed on the surface of a cancer cell;
2. (2) specifically binds human and non-human primate ADAM9 (e.g., ADAM9 of cynomolgus monkey) with a similar binding affinity;
3. (3) specifically binds human ADAM9 with an equilibrium binding constant ( $K_D$ ) of 4 nM or less;
4. (4) specifically binds non-human primate ADAM9 with an equilibrium binding constant ( $K_D$ ) of 4 nM or less
5. (5) specifically binds human ADAM9 with an on rate ( $k_a$ ) of  $5 \times 10^5 \text{ M}^{-1}\text{min}^{-1}$  or more;
6. (6) specifically binds non-human primate ADAM9 with an on rate ( $k_a$ ) of  $1 \times 10^6 \text{ M}^{-1}\text{min}^{-1}$  or more;
7. (7) specifically binds human ADAM9 with an off rate ( $k_d$ ) of  $1 \times 10^{-3} \text{ min}^{-1}$  or less;
8. (8) specifically binds non-human primate ADAM9 with an off rate ( $k_d$ ) of  $9 \times 10^{-4} \text{ min}^{-1}$  or less.
9. (9) optimized to have at least 100-fold enhancement (e.g., at least 100-fold, at least 150-fold, at least 200-fold, at least 250-fold, at least 300-fold, at least 350-fold, at least 400-fold, at least 450-fold, at least 500-fold, at least 550-fold, or at least 600-fold enhancement) in binding affinity (e.g., as measured by BIACORE<sup>®</sup> analysis) to cyno ADAM9 and retains high affinity binding to human ADAM9 (e.g., BIACORE<sup>®</sup> analysis) as compared to the chimeric or murine parental antibody.

**[0102]** As described herein, the binding constants of an anti-ADAM9 antibody or ADAM9-binding fragment thereof may be determined using surface plasmon resonance e.g., via a BIACORE<sup>®</sup> analysis. Surface plasmon resonance data may be fitted to a 1:1 Langmuir binding model (simultaneous  $k_a$   $k_d$ ) and an equilibrium binding constant  $K_D$  calculated from the ratio of rate constants  $k_d/k_a$ . Such binding constants may be determined for a monovalent anti-ADAM9 antibody or ADAM9-binding fragment thereof (*i.e.*, a molecule comprising a single ADAM9 epitope-binding site), a bivalent anti-ADAM9 antibody or ADAM9-binding fragment thereof (*i.e.*, a molecule comprising two ADAM9 epitope-binding sites), or anti-ADAM9 antibodies and ADAM9-binding fragments thereof having higher valency (e.g., a molecule comprising three, four, or more ADAM9 epitope-binding sites).

**[0103]** The present invention particularly encompasses immunoconjugates possessing an anti-ADAM9 antibody or an ADAM9-binding fragment thereof comprising an anti-ADAM9 Light Chain Variable (VL) Domain and an anti-ADAM9 Heavy Chain Variable (VH) Domain that immunospecifically bind to an epitope of a human ADAM9 polypeptide. Unless otherwise stated, all such anti-ADAM9 antibodies and ADAM9-binding fragment thereof are capable of immunospecifically binding to human ADAM9. As used herein such ADAM9 Variable Domains are referred to as "**anti-ADAM9-VL**" and "**anti-ADAM9-VH**," respectively.

#### **A. Murine Anti-Human ADAM9 Antibodies**

**[0104]** A murine anti-ADAM9 antibody that blocks the target protein processing activity of ADAM9, is internalized and having anti-tumor activity was identified (see, e.g., US Patent No. 8,361,475). This antibody, designated in US Patent Nos. 7,674,619 and 8,361,475 as an "anti-KID24" antibody produced by hybridoma clone ATCC PTA-5174, is designated herein as "**MAB-A**." MAB-A exhibits strong preferential binding to tumors over normal tissues (see, FIGs. 7A-7C). MAB-A exhibited little or no staining across a large panel of normal cell types (**Table 2**).

<b>Table 2</b>	
<b>Tissue</b>	<b>MAB-A (1.25 µg/mL)</b>
<b>Adrenal</b>	Negative
<b>Bladder</b>	Negative
<b>Bone Marrow</b>	Negative
<b>Breast</b>	Negative
<b>Cerebellum</b>	Negative
<b>Cerebrum</b>	ND
<b>Cervix</b>	Negative
<b>Colon</b>	Negative
<b>Esophagus</b>	Smooth Muscle +/- to 1+ (gr c) <5%
<b>Tissue</b>	<b>MAB-A (1.25 µg/mL)</b>
<b>Ovaduct</b>	Negative
<b>Heart</b>	Negative
<b>Kidney</b>	Negative
<b>Liver</b>	Negative
<b>Lung</b>	Negative
<b>Lymph Node</b>	Negative
<b>Ovary</b>	Negative
<b>Pancreas</b>	Very rare (possible acinar) 1+ (c)
<b>Parathyroid</b>	Epithelium parenchymal cells 1+ (gr c), 1% Cells (favor chief cells) 2+ (m,c)5% 1+ (m,c) 10% apical primarily
<b>Pituitary</b>	Posterior lobe cells (possibly neural cells and/or pituicytes 1+

<b>Table 2</b>	
	(c>m) <5%
<b>Placenta</b>	Vascular lining cells within chorionic plate 1+ (gr c>m) Mesenchymal cells of chorionic plate 1-2+ (gr c), 5%
<b>Prostate</b>	Glandular epithelium 2+ (gr c) 5% and 1+ (gr c) 5%
<b>Retina + Ciliary Body</b>	Favor negative (pigmented epi layer 3-4+ (gr c) due to pigment not stained)
<b>Submandibular Gland</b>	Ductal epi +/- (c) 10%
<b>Skeletal Muscle</b>	Negative
<b>Skin</b>	Negative
<b>Small Intestine</b>	Negative
<b>Spinal Cord</b>	Neuropil 1+ (gr c) <1%
<b>Spleen</b>	Negative
<b>Stomach</b>	Negative
<b>Testis</b>	Seminiferous tubule 1+ (gr c) <5% Interstitial cells (possibly Leydig cells) 2-3+ (gr c) <5% and 1+ (gr c) 10%
<b>Thyroid</b>	Negative
<b>Tonsil</b>	Endo cells 2-3+ (c,m) <5% and 1+ (m,c) 15%
<b>Ureter</b>	Transitional epithelium 1+ (m,c) <5% and 1+ (m,c) 5%; Endo cells 1+ (c) <5%
<b>Tissue</b>	MAB-A ( <b>1.25 µg/mL</b> )
<b>Uterus</b>	Negative
<b>A498 Cell Pellet</b>	2-3+ (m,c), 50%, 1+ (m,c) 45%

**[0105]** As shown in **FIG. 2**, MAB-A binds human ADAM9 with high affinity, but binds non-human primate (e.g., cynomolgus monkey) ADAM9 to a lesser extent.

**[0106]** The amino acid sequences of the VL and VH Domains of MAB-A are provided below for illustration purposes and are not according to the claimed invention. The VH and VL Domains of MAB-A were humanized and the CDRs optimized to improve affinity and/or to remove potential amino acid liabilities. The CDR<sub>H3</sub> was further optimized to enhance binding to non-human primate ADAM9 while maintaining its high affinity for human ADAM9.

**[0107]** The preferred immunoconjugates of the present invention comprising 1, 2 or all 3 of the CDR<sub>HS</sub> of a VH Domain and 1 or 2 of the CDR<sub>LS</sub> of the VL Domain of an optimized variant of MAB-A, and preferably further possess the humanized framework regions ("**FRs**") of the VH and/or VL Domains of humanized MAB-A. Other preferred immunoconjugates of the present invention possess the entire VH Domain of a humanized/optimized variant of MAB-A.

**[0108]** The invention particularly relates to immunoconjugates comprising:

1. (A)
  1. (1) the three CDR<sub>L</sub>s of the VL Domain of MAB-A; and
  2. (2) the four FRs of the VL Domain of a humanized variant of MAB-A; or
2. (B) the three CDR<sub>H</sub>s of the VH Domain of an optimized variant of MAB-A; and the three CDR<sub>L</sub>s of the VL Domain of MAB-A; or
3. (C)
  1. (1) the three CDR<sub>H</sub>s of the VH Domain of an optimized variant of MAB-A; and
  2. (2) the four FRs of the VH Domain of a humanized variant of MAB-A; or
4. (D)
  1. (1) the VH Domain of a humanized/optimized variant of MAB-A; and
  2. (2) the VL Domain of a humanized/optimized variant of MAB-A Murine Antibody "MAB-A"

**[0109]** The amino acid sequence of the VH Domain of the murine anti-ADAM9 antibody MAB-A is **SEQ ID NO:7**, shown for illustration purposes only and not according to the claimed invention, (the CDR<sub>H</sub> residues are shown underlined):

QVQLQQPGAE LVKPGASVKL SCKASGYTFT SYWMHWVKQR PGQGLEWIGE  
IIPINGHTNY NEKFKSKATL TLDKSSSTAY MQLSSLASED SAVYYCARGG  
YYYYGSRDYF DYWGQGTTLT VSS

**[0110]** The amino acid sequence of the CDR<sub>H1</sub> Domain of MAB-A is (**SEQ ID NO:8**): SYWMH.

**[0111]** The amino acid sequence of the CDR<sub>H2</sub> Domain of MAB-A is (**SEQ ID NO:9**): EIIPINGHTNYNEKFKS.

**[0112]** The amino acid sequence of the CDR<sub>H3</sub> Domain of MAB-A is (**SEQ ID NO:10**): GGYYYYGSRDYFDY.

**[0113]** The amino acid sequence of the VL Domain of the murine anti-ADAM9 antibody MAB-A is **SEQ ID NO:11**, shown for illustration purposes only and not according to the claimed invention, (the CDR<sub>L</sub> residues are shown underlined):

DIVLTQSPAS LAVSLGQRAT ISCKKASQSVD YDGDSYMNWY QQIPGQPPKL  
 LIYAASDLES GIPARFSGSG SGTDFTLNIH PVEEEDAATY YCQQSHEDPF  
TFGGGTKLEI K

**[0114]** The amino acid sequence of the CDR<sub>L1</sub> Domain of MAB-A is (**SEQ ID NO: 12**): KASQSVDYDGDSYMN.

**[0115]** The amino acid sequence of the CDR<sub>L2</sub> Domain of MAB-A is (**SEQ ID NO: 13**): AASDLES.



[0116] The amino acid sequence of the CDR<sub>L3</sub> Domain of MAB-A is (SEQ ID NO: 14): QQSHEDPFT.

## B. Exemplary Humanized/Optimized Anti-ADAM9-VH and VL Domains

### 1. Variant VH Domains of MAB-A

[0117] The amino acid sequences of certain preferred humanized/optimized anti-ADAM9-VH Domains of MAB-A are variants of the ADAM9-VH Domain of MAB-A (SEQ ID NO:7).

[0118] The amino acid sequences of certain preferred humanized/optimized anti-ADAM9-VH Domains of MAB-A:

hMAB-A VH(2D)	(SEQ ID NO:23)
hMAB-A VH(2E)	(SEQ ID NO:24)
hMAB-A VH(2F)	(SEQ ID NO:25)
hMAB-A VH(2A) (SEQ ID NO:20)	hMAB-A VH(2G) (SEQ ID NO:26)
hMAB-A VH(2B) (SEQ ID NO:21)	hMAB-A VH(2H) (SEQ ID NO:27)
hMAB-A VH(2C) (SEQ ID NO:22)	hMAB-A VH(2I) (SEQ ID NO:28)
and hMAB-A VH(2J) (SEQ ID NO:29)	

are presented below (CDR<sub>H</sub> residues are shown in single underline; differences relative to hMAB-A VH(1) (SEQ ID NO:7) are shown in double underline).

[0119] The amino acid sequences of humanized/optimized anti-ADAM9-VH Domains of MAB-A:

hMAB-A VH(1) (SEQ ID NO:16)

hMAB-A VH(2) (SEQ ID NO:17)

hMAB-A VH(3) (SEQ ID NO:18)

hMAB-A VH(4) (SEQ ID NO:19)

are also given below but the above sequences do not form part of the presently-claimed invention.

hMAB-A VH(1) (SEQ ID NO:16):

EVQLVESGGG LVKPGGSLRL SCAASGFTFS SYWMHWVRQA PGKGLEWVGE  
IIPINGHTNY NEKFKSRFTI SLDNSKNTLY LQMGSLRAED TAVYYCARGG  
YYYYGSRDYF DYWGQGTTVT VSS

hMAB-A VH(2) (SEQ ID NO:17):

EVQLVESGGG LVKPGGSLRL SCAASGFTFS SYWMHWVRQA PGKGLEWVGE  
IIPIFGHTNY NEKFKSRFTI SLDNSKNTLY LQMGSLRAED TAVYYCARGG  
YYYYGSRDYF DYWGQGTTVT VSS

IIPIFGHTNY NERFOGRFTI VSS

hMAB-A VH(3) (SEQ ID NO:18):

EVQLVESGGG LVKPGGSLRL SCAASGFTFS SYWMHWVRQA PGKGLEWVGE  
IIPIFGHTNY NERFOGRFTI SLDNSKNTLY LQMGSRAED TAVYYCARGG  
YYYYGSRDYF DYWGQGTTVT VSS

hMAB-A VH(4) (SEQ ID NO:19):

EVQLVESGGG LVKPGGSLRL SCAASGFTFS SYWIHWVRQA PGKGLEWVGE  
IIPIFGHTNY NERFOGRFTI SLDNSKNTLY LQMGSRAED TAVYYCARGG  
YYYYGSRDYF DYWGQGTTVT VSS

hMAB-A VH(2A) (SEQ ID NO:20):

EVQLVESGGG LVKPGGSLRL SCAASGFTFS SYWMHWVRQA PGKGLEWVGE  
IIPIFGHTNY NEKFKSRFTI SLDNSKNTLY LQMGSRAED TAVYYCARGG  
YYYYFNSGTL DYWGQGTTVT VSS

hMAB-A VH(2B) (SEQ ID NO:21):

EVQLVESGGG LVKPGGSLRL SCAASGFTFS SYWMHWVRQA PGKGLEWVGE  
IIPIFGHTNY NEKFKSRFTI SLDNSKNTLY LQMGSRAED TAVYYCARGG  
YYYYIGKGVL DYWGQGTTVT VSS

hMAB-A VH(2C) (SEQ ID NO:22):

EVQLVESGGG LVKPGGSLRL SCAASGFTFS SYWMHWVRQA PGKGLEWVGE  
IIPIFGHTNY NEKFKSRFTI SLDNSKNTLY LQMGSRAED TAVYYCARGG  
YYYYPRFGWL DYWGQGTTVT VSS

hMAB-A VH(2D) (SEQ ID NO:23):

EVQLVESGGG LVKPGGSLRL SCAASGFTFS SYWMHWVRQA PGKGLEWVGE  
IIPIFGHTNY NEKFKSRFTI SLDNSKNTLY LQMGSRAED TAVYYCARGG  
YYYYTGKGVL DYWGQGTTVT VSS

hMAB-A VH(2E) (SEQ ID NO:24):

EVQLVESGGG LVKPGGSLRL SCAASGFTFS SYWMHWVRQA PGKGLEWVGE  
IIPIFGHTNY NEKFKSRFTI SLDNSKNTLY LQMGSRAED TAVYYCARGG  
YYYYDSNAVL DYWGQGTTVT VSS

hMAB-A VH(2F) (SEQ ID NO:25):

EVQLVESGGG LVKPGGSLRL SCAASGFTFS SYWMHWVRQA PGKGLEWVGE  
IIPIFGHTNY NEKFKSRFTI SLDNSKNTLY LQMGSRAED TAVYYCARGG  
YYYYFHSGLL DYWGQGTTVT VSS

hMAB-A VH(2G) (SEQ ID NO:26):

EVQLVESGGG LVKPGGSLRL SCAASGFTFS SYWMHWVRQA PGKGLEWVGE  
IIPIFGHTNY NEKFKSRFTI SLDNSKNTLY LQMGSRAED TAVYYCARGG  
YYYYFNKAVL DYWGQGTTVT VSS

hMAB-A VH(2H) (SEQ ID NO:27):

EVQLVESGGG LVKPGGSLRL SCAASGFTFS SYWMHWVRQA PGKGLEWVGE  
IIPIFGHTNY NEKFKSRFTI SLDNSKNTLY LQMGSRAED TAVYYCARGG  
YYYYGSGVL DYWGQGTTVT VSS

hMAB-A VH(2I) (SEQ ID NO:28):

EVQLVESGGG LVKPGGSLRL SCAASGFTFS SYWMHWVRQA PGKGLEWVGE  
IIPIFGHTNY NEKFKSRFTI SLDNSKNTLY LQMGSRAED TAVYYCARGG  
YYYYPROGFL DYWGQGTTVT VSS

hMAB-A VH(2J) (SEQ ID NO:29):

EVQLVESGGG LVKPGGSLRL SCAASGFTFS SYWMHWVRQA PGKGLEWVGE  
EIIPFGHTNY NEKFKSRFTI SLDNSKNTLY LQMGSRAED TAVYYCARGG  
YYYYSNSGTL DYWGQTTVT VSS

[0120] Suitable amino acid sequences for the FRs of a humanized and/or optimized anti-ADAM9-VH Domain of MAB-A are:

FR<sub>H1</sub> Domain (SEQ ID NO:30): EVQLVESGGGLVKPGGSLRLSCAASGFTFS

FR<sub>H2</sub> Domain (SEQ ID NO:31): WVRQAPGKGLEWVG

FR<sub>H3</sub> Domain (SEQ ID NO:32): RFTISLDNSKNTLYLQMGSRAEDTAVYYCAR

FR<sub>H4</sub> Domain (SEQ ID NO:33): WGQGTDTVSS

[0121] The amino acid sequence for the CDR<sub>H1</sub> Domain of an anti-ADAM9-VH Domain is one of:

SEQ ID NO:8: SYWMH

SEQ ID NO:34: SYWIH

[0122] The amino acid sequence for the CDR<sub>H2</sub> Domain of an anti-ADAM9-VH Domain is one of:

SEQ ID NO:9: EIIPINGHTNYNEKFKS

SEQ ID NO:35: EIIPFGHTNYNEKFKS

SEQ ID NO:36: EIIPFGHTNYNERFQG

[0123] The amino acid sequence for the CDR<sub>H3</sub> Domain of an anti-ADAM9-VH Domain is one of:

SEQ ID NO:37: GGYYYFNSGTLDY

SEQ ID NO:38: GGYYYIGKGVLDY

SEQ ID NO:39: GGYYYPRFGWLDY

SEQ ID NO:40: GGYYYTGKGVLDY

SEQ ID NO:41: GGYYYDSNAVL DY

**SEQ ID NO:42:** GGYYYYFHSGTLDY

**SEQ ID NO:43:** GGYYYYFNKAVLDY

**SEQ ID NO:44:** GGYYYYGGSGVLDY

**SEQ ID NO:45:** GGYYYYPRQGFLDY

**SEQ ID NO:46:** GGYYYYNSGTLDY

**[0124]** A first exemplary humanized/optimized IgG1 Heavy Chain of a derivative/variant of MAB-A that falls outside of the scope of the presently-claimed invention contains the hMAB-A VH (2) Domain (**SEQ ID NO:17**), and has the amino acid sequence (**SEQ ID NO:50**):

```
EVQLVESGGG LVKPGGSLRL SCAASGFTFS SYWMHWVRQA PGKGLEWVGE
IIPIFGHTNY NEKFCSRFTI SLDNSKNTLY LQMGSLRAED TAVYYCARGG
YYYYGSRDYF DYWGQGTIVT VSSASTKGPS VFPLAPSSKS TSGGTAALGC
LVKDYFPEPV TVSWNSGALT SGVHTFPAVL QSSGLYSLSS VVTVPSSSLG
TQTYICNVNH KPSNTKVDKR VEPKSCDKTH TCPPCPAPEL LGGPSVFLFP
PKPKDTLMIS RTPEVTCVVV DVSIEDPEVK FNWYVDGVEV HNAKTKPREE
QYNSTYRVVS VLTVLHQDWL NGKEYKCKVS NKALPAPIEK TISKAKGQPR
EPQVYTLPPS REEMTKNQVS LTCLVKGFYP SDIAVEWESN GPENNYKTT
PPVLDSDGSF FLYSKLTVDK SRWQQGNVFS CSVMHEALHN HYTQKSLSL
PGX
```

wherein X is a lysine (K) or is absent.

**[0125]** A second exemplary humanized/optimized IgG1 Heavy Chain of a derivative/variant of MAB-A contains the hMAB-A VH (2C) Domain (**SEQ ID NO:22**), and has the amino acid sequence (**SEQ ID NO:51**):

```
EVQLVESGGG LVKPGGSLRL SCAASGFTFS SYWMHWVRQA PGKGLEWVGE
IIPIFGHTNY NEKFCSRFTI SLDNSKNTLY LQMGSLRAED TAVYYCARGG
YYYYPRFGWL DYWGQGTIVT VSSASTKGPS VFPLAPSSKS TSGGTAALGC
LVKDYFPEPV TVSWNSGALT SGVHTFPAVL QSSGLYSLSS VVTVPSSSLG
TQTYICNVNH KPSNTKVDKR VEPKSCDKTH TCPPCPAPEL LGGPSVFLFP
PKPKDTLMIS RTPEVTCVVV DVSIEDPEVK FNWYVDGVEV HNAKTKPREE
QYNSTYRVVS VLTVLHQDWL NGKEYKCKVS NKALPAPIEK TISKAKGQPR
EPQVYTLPPS REEMTKNQVS LTCLVKGFYP SDIAVEWESN GPENNYKTT
PPVLDSDGSF FLYSKLTVDK SRWQQGNVFS CSVMHEALHN HYTQKSLSL
PGX
```

wherein X is a lysine (K) or is absent.

**[0126]** A third exemplary humanized/optimized IgG1 Heavy Chain of a derivative/variant of MAB-A contains the hMAB-A VH (2I) Domain (**SEQ ID NO:28**), and has the amino acid sequence (**SEQ ID NO:52**):

```
EVQLVESGGG LVKPGGSLRL SCAASGFTFS SYWMHWVRQA PGKGLEWVGE
IIPIFGHTNY NEKFCSRFTI SLDNSKNTLY LQMGSLRAED TAVYYCARGG
YYYYPRQGFL DYWGQGTIVT VSSASTKGPS VFPLAPSSKS TSGGTAALGC
LVKDYFPEPV TVSWNSGALT SGVHTFPAVL QSSGLYSLSS VVTVPSSSLG
TQTYICNVNH KPSNTKVDKR VEPKSCDKTH TCPPCPAPEL LGGPSVFLFP
PKPKDTLMIS RTPEVTCVVV DVSIEDPEVK FNWYVDGVEV HNAKTKPREE
QYNSTYRVVS VLTVLHQDWL NGKEYKCKVS NKALPAPIEK TISKAKGQPR
EPQVYTLPPS REEMTKNQVS LTCLVKGFYP SDIAVEWESN GPENNYKTT
PPVLDSDGSF FLYSKLTVDK SRWQQGNVFS CSVMHEALHN HYTQKSLSL
PGX
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QYNSTYRVVS VLTVLHQDWL NGKEYKCKVS NKALPAPIEK TISKAKGQPR  
 EPQVYTLPPS REEMTKNQVS LTCLVKGFYP SDIAVEWESN GQPENNYKTT  
 PPVLDSGGSF FLYSKLTVDK SRWQQGNVFS CSVMHEALHN HYTQKSLSL  
 PGX

wherein X is a lysine (K) or is absent.

**[0127]** As provided above, the CH2-CH3 Domains of the Fc Region may be engineered for example, to reduce effector function and/or to introduce a conjugation site and/or to extend the serum half-life. In certain embodiments, the CH2-CH3 Domains of the exemplary humanized/optimized IgG1 Heavy Chains of the invention comprise one or more substitutions selected from: L234A, L235A, M252Y, S254T, T256E and S442C.

**[0128]** Thus, a fourth exemplary humanized/optimized IgG1 Heavy Chain of a derivative/variant of MAB-A contains the hMAB-A VH (21) Domain (SEQ ID NO:28), and further comprises the substitutions L234A, and L235A in the CH2-CH3 Domains of the Fc Region (SEQ ID NO:78) and has the amino acid sequence (SEQ ID NO:141)

EVQLVESGGG LVKPGGSLRL SCAASGFTFS SYWMHWVRQA PGKGLEWVGE  
 IIPIFGHTNY NEKFCSRFTI SLDNSKNTLY LQMGSRLAED TAVYYCARGG  
 YYYYPQQGFL DYWGQGTIVT VSSASTKGPS VFPLAPSSKS TSGGTAALGC  
 LVKDYFPEPV TVSWNSGALT SGVHTFPAVL QSSGLYSLSS VVTVPSSSLG  
 TQTYICNVNH KPSNTKVDKR VEPKSCDKTH TCPPCPAPEA A AGGPSVFLFP  
 PKPKDTLMIS RTPEVTCVVV DVSHEDPEVK FNWYVDGVEV HNAKTKPREE  
 QYNSTYRVVS VLTVLHQDWL NGKEYKCKVS NKALPAPIEK TISKAKGQPR  
 EPQVYTLPPS REEMTKNQVS LTCLVKGFYP SDIAVEWESN GQPENNYKTT  
 PPVLDSGGSF FLYSKLTVDK SRWQQGNVFS CSVMHEALHN HYTQKSLSL  
 PGX

wherein X is a lysine (K) or is absent.

**[0129]** A fifth exemplary humanized/optimized IgG1 Heavy Chain of a derivative/variant of MAB-A contains the hMAB-A VH (21) Domain (SEQ ID NO:28), and further comprises the S442C substitution in the CH2-CH3 Domains of the Fc Region (SEQ ID NO:79) and has the amino acid sequence (SEQ ID NO:142):

EVQLVESGGG LVKPGGSLRL SCAASGFTFS SYWMHWVRQA PGKGLEWVGE  
 IIPIFGHTNY NEKFCSRFTI SLDNSKNTLY LQMGSRLAED TAVYYCARGG  
 YYYYPQQGFL DYWGQGTIVT VSSASTKGPS VFPLAPSSKS TSGGTAALGC  
 LVKDYFPEPV TVSWNSGALT SGVHTFPAVL QSSGLYSLSS VVTVPSSSLG  
 TQTYICNVNH KPSNTKVDKR VEPKSCDKTH TCPPCPAPEL LGGPSVFLFP  
 PKPKDTLMIS RTPEVTCVVV DVSHEDPEVK FNWYVDGVEV HNAKTKPREE  
 QYNSTYRVVS VLTVLHQDWL NGKEYKCKVS NKALPAPIEK TISKAKGQPR  
 EPQVYTLPPS REEMTKNQVS LTCLVKGFYP SDIAVEWESN GQPENNYKTT  
 PPVLDSGGSF FLYSKLTVDK SRWQQGNVFS CSVMHEALHN HYTQKSLCLS  
 PGX

wherein X is a lysine (K) or is absent.

**[0130]** A sixth exemplary humanized/optimized IgG1 Heavy Chain of a derivative/variant of MAB-A contains the hMAB-A VH (21) Domain (SEQ ID NO:28), and further comprises the substitutions L234A, L235A and S442C in the CH2-CH3 Domains of the Fc Region (SEQ ID NO:80) and has the amino acid sequence (SEQ ID NO:143):

EVQLVESGGG LVKPGGSLRL SCAASGFTFS SYWMHWVRQA PGKGLEWVGE  
 IIPIFGHTNY NEKFCSRFTI SLDNSKNTLY LQMGSRLAED TAVYYCARGG  
 YYYYPQQGFL DYWGQGTIVT VSSASTKGPS VFPLAPSSKS TSGGTAALGC

YYYYPKQGFL DYWGQGTTVT VSSASTKGPS VFPLAPSSKS TSGGTAALGC  
 LVKDYFPEPV TVSWNSGALT SGVHTFPAVL QSSGLYSLSS VVTVPSSSLG  
 TQTYICNVNH KPSNTKVDKR VEPKSCDKTH TCPPCPAPEA AGGPSVFLFP  
 PKPKDTLMIS RTPEVTCVVV DVSHEDPEVK FNWYVDGVEV HNAKTKPREE  
 QYNSTYRVVS VLTVLHQDWL NGKEYKCKVS NKALPAPIEK TISKAKGQPR  
 EPQVYTLPPS REEMTKNQVS LTCLVKGFYP SDIAVEWESN GQPENNYKTT  
 PPVLDSGDSF FLYSKLTVDK SRWQQGNVFS CSVMHEALHN HYTQKSLCLS  
 PGX

wherein X is a lysine (K) or is absent.

**[0131]** A seventh exemplary humanized/optimized IgG1 Heavy Chain of a derivative/variant of MAB-A contains the hMAB-A VH (2I) Domain (SEQ ID NO:28), and further comprises the substitutions M252Y, S254T and T256E in the CH2-CH3 Domains of the Fc Region (SEQ ID NO:147) and has the amino acid sequence (SEQ ID NO:151):

EVQLVESGGG LVKPGGSLRL SCAASGFTFS SYWMHWVRQA PGKGLEWVGE  
 IIPFIGHTNY NEKFCSRFTI SLDNSKNTLY LQMGSRLAED TAVYYCARGG  
 YYYYPKQGFL DYWGQGTTVT VSSASTKGPS VFPLAPSSKS TSGGTAALGC  
 LVKDYFPEPV TVSWNSGALT SGVHTFPAVL QSSGLYSLSS VVTVPSSSLG  
 TQTYICNVNH KPSNTKVDKR VEPKSCDKTH TCPPCPAPEL LGGPSVFLFP  
 PKPKDTLYIT REPEVTCVVV DVSHEDPEVK FNWYVDGVEV HNAKTKPREE  
 QYNSTYRVVS VLTVLHQDWL NGKEYKCKVS NKALPAPIEK TISKAKGQPR  
 EPQVYTLPPS REEMTKNQVS LTCLVKGFYP SDIAVEWESN GQPENNYKTT  
 PPVLDSGDSF FLYSKLTVDK SRWQQGNVFS CSVMHEALHN HYTQKSLSLs  
 PGX

wherein X is a lysine (K) or is absent.

**[0132]** An eighth exemplary humanized/optimized IgG1 Heavy Chain of a derivative/variant of MAB-A contains the hMAB-A VH (2I) Domain (SEQ ID NO:28), and further comprises the substitutions M252Y, S254T, T256E, and S442C in the CH2-CH3 Domains of the Fc Region (SEQ ID NO:148) and has the amino acid sequence (SEQ ID NO:152):

EVQLVESGGG LVKPGGSLRL SCAASGFTFS SYWMHWVRQA PGKGLEWVGE  
 IIPFIGHTNY NEKFCSRFTI SLDNSKNTLY LQMGSRLAED TAVYYCARGG  
 YYYYPKQGFL DYWGQGTTVT VSSASTKGPS VFPLAPSSKS TSGGTAALGC  
 LVKDYFPEPV TVSWNSGALT SGVHTFPAVL QSSGLYSLSS VVTVPSSSLG  
 TQTYICNVNH KPSNTKVDKR VEPKSCDKTH TCPPCPAPEL LGGPSVFLFP  
 PKPKDTLYIT REPEVTCVVV DVSHEDPEVK FNWYVDGVEV HNAKTKPREE  
 QYNSTYRVVS VLTVLHQDWL NGKEYKCKVS NKALPAPIEK TISKAKGQPR  
 EPQVYTLPPS REEMTKNQVS LTCLVKGFYP SDIAVEWESN GQPENNYKTT  
 PPVLDSGDSF FLYSKLTVDK SRWQQGNVFS CSVMHEALHN HYTQKSLCLS  
 PGX

wherein X is a lysine (K) or is absent.

**[0133]** A ninth exemplary humanized/optimized IgG1 Heavy Chain of a derivative/variant of MAB-A contains the hMAB-A VH (2I) Domain (SEQ ID NO:28), and further comprises the substitutions L234A, L235A, M252Y, S254T and T256E in the CH2-CH3 Domains of the Fc Region (SEQ ID NO:149) and has the amino acid sequence (SEQ ID NO:153):

EVQLVESGGG LVKPGGSLRL SCAASGFTFS SYWMHWVRQA PGKGLEWVGE  
 IIPFIGHTNY NEKFCSRFTI SLDNSKNTLY LQMGSRLAED TAVYYCARGG  
 YYYYPKQGFL DYWGQGTTVT VSSASTKGPS VFPLAPSSKS TSGGTAALGC  
 LVKDYFPEPV TVSWNSGALT SGVHTFPAVL QSSGLYSLSS VVTVPSSSLG  
 TQTYICNVNH KPSNTKVDKR VEPKSCDKTH TCPPCPAPEA AGGPSVFLFP

PKPKDTLYIT REPEVTCVVV DVSHEDPEVK FNWYVDGVEV HNAKTKPREE  
 QYNSTYRVVS VLTVLHQDWL NGKEYKCKVS NKALPAPIEK TISKAKGQPR  
 EPQVYTLPPS REEMTKNQVS LTCLVKGFYP SDIAVEWESN GQPENNYKTT  
 PPVLDSGDSF FLYSKLTVDK SRWQQGNVFS CSVMHEALHN HYTQKSLSL  
 PGX

wherein **X** is a lysine (K) or is absent.

**[0134]** A tenth exemplary humanized/optimized IgG1 Heavy Chain of a derivative/variant of MAB-A contains the hMAB-A VH (2I) Domain (**SEQ ID NO:28**), and further comprises the substitutions L234A, L235A, M252Y, S254T, T256E, and S442C in the CH2-CH3 Domains of the Fc Region (**SEQ ID NO:150**) and has the amino acid sequence (**SEQ ID NO:154**):

EVQLVESGGG LVKPGGSLRL SCAASGFTFS SYWMHWVRQA PGKGLEWVGE  
 IIPIFGHTNY NEKFKSRFTI SLDNSKNTLY LQMGSLRAED TAVYYCARGG  
 YYYYPQQGFL DYWGQGTIVT VSSASTKGPS VFPLAPSSKS TSGGTAALGC  
 LVKDYFPEPV TVSWNSGALT SGVHTFPAVL QSSGLYSLSS VVTVPSSSLG  
 TQTYICNVNH KPSNTKVDKR VEPKSCDKTH TCPPCPAPEA AGGPSVFLFP  
 PKPKDTLYIT REPEVTCVVV DVSHEDPEVK FNWYVDGVEV HNAKTKPREE  
 QYNSTYRVVS VLTVLHQDWL NGKEYKCKVS NKALPAPIEK TISKAKGQPR  
 EPQVYTLPPS REEMTKNQVS LTCLVKGFYP SDIAVEWESN GQPENNYKTT  
 PPVLDSGDSF FLYSKLTVDK SRWQQGNVFS CSVMHEALHN HYTQKSLCLS  
 PGX

wherein **X** is a lysine (K) or is absent.

## 2. Variant VL Domains of MAB-A

**[0135]** The amino acid sequences of preferred humanized/optimized anti-ADAM9-VL Domains of MAB-A are variants of the ADAM9-VL Domain of MAB-A (**SEQ ID NO:11**).

**[0136]** The amino acid sequences of a preferred humanized anti-ADAM9-VL Domain of MAB-A: hMAB-A VL(1) (**SEQ ID NO:54**), and of certain preferred humanized/optimized anti-ADAM9-VL Domains of MAB-A: hMAB-A VL(2) (**SEQ ID NO:55**), hMAB-A VL(3) (**SEQ ID NO:56**), and hMAB-A VL(4) (**SEQ ID NO:57**), are presented below (CDRL residues are shown in single underline; differences relative to hMAB-A VL(1) (**SEQ ID NO:54**) are shown in double underline).

hMAB-A VL(1) (**SEQ ID NO:54**):

DIVMTQSPDS LAVSLGERAT ISCKKASQSVD YDGDSYMNWY QQKPGQPPKL  
 LIYAASDLES GIPARFSGSG SGTDFTLTIS SLEPEDFATY YCQQSHEDPF  
TFGQGTKLEI K

hMAB-A VL(2) (**SEQ ID NO:55**):

DIVMTQSPDS LAVSLGERAT ISCKKASQSVD YSGDYMNWY QQKPGQPPKL  
 LIYAASDLES GIPARFSGSG SGTDFTLTIS SLEPEDFATY YCQQSHEDPF  
TFGQGTKLEI K

hMAB-A VL(3) (**SEQ ID NO:56**):

DIVMTQSPDS LAVSLGERAT ISCRASQSVD YSGDYMNWY QQKPGQPPKL  
 LIYAASDLES GIPARFSGSG SGTDFTLTIS SLEPEDFATY YCQQSHEDPF  
TFGQGTKLEI K

hMAB-A VL(4) (**SEQ ID NO:57**):

DIVMTQSPDS LAVSLGERAT ISCRRASQSVD YSGDSYLNWY QQKPGQPPKL  
LIYAASDLES GIPARFSGSG SGTDFTLTIS SLEPEDFATY YCQQSYSTPF  
TFGQGTKLEI K

**[0137]** Accordingly, suitable amino acid sequences for the FRs of a humanized and/or optimized anti-ADAM9-VL Domain of MAB-A are:

FR<sub>L</sub>1 Domain (**SEQ ID NO:58**): DIVMTQSPDSLAVSLGERATISC

FR<sub>L</sub>2 Domain (**SEQ ID NO:59**): WYQQKPGQPPKLLIY

FR<sub>L</sub>3 Domain (**SEQ ID NO:60**): GIPARFSGSGSGTDFTLTISSLEPEDFATYYC

FR<sub>L</sub>4 Domain (**SEQ ID NO:61**): FGQGTKLEIK

**[0138]** The amino acid sequence for the CDR<sub>L</sub>1 Domain of an anti-ADAM9-VL Domain is one of:

**SEQ ID NO:12**: KASQSVDYDGDSYMN

**SEQ ID NO:62**: KASQSVDYSGDSYMN

**SEQ ID NO:63**: RASQSVDYSGDSYMN

**SEQ ID NO:64**: RASQSVDYSGDSYLN

**[0139]** The amino acid sequence for the CDR<sub>L</sub>3 Domain of an anti-ADAM9-VL Domain is one of:

**SEQ ID NO:14**: QQSHEDPFT

**SEQ ID NO:65**: QQSYSTPFT

**[0140]** An exemplary humanized/optimized IgG1 Light Chain of a derivative/variant of MAB-A contains the hMAB-A VL (2) Domain (**SEQ ID NO:55**), and has the amino acid sequence (**SEQ ID NO:68**):

DIVMTQSPDS LAVSLGERAT ISCKASQSVD YSGDSYMNWY QQKPGQPPKL  
LIYAASDLES GIPARFSGSG SGTDFTLTIS SLEPEDFATY YCQQSHEDPF  
TFGQGTKLEI KRTVAAPSVF IFPPSDEQLK SGTASVVCLL NNFYPREAKV  
QWKVDNALQS GNSQESVTEQ DSKDSTYSLT STLTLKADY EKHKVYACEV  
THQGLSSPVT KSFNRGEC

**[0141]** The invention further contemplates such immunoconjugates that further comprise any of



the above-provided humanized MAB-A FR<sub>H1</sub>, FR<sub>H2</sub>, FR<sub>H3</sub>, or FR<sub>H4</sub>, FR<sub>L1</sub>, FR<sub>L2</sub>, FR<sub>L3</sub>, or FR<sub>L4</sub>, and particularly contemplates such immunoconjugates that comprise FR<sub>H1</sub>, FR<sub>H2</sub>, FR<sub>H3</sub>, and FR<sub>H4</sub>, and/or that comprise FR<sub>L1</sub>, FR<sub>L2</sub>, FR<sub>L3</sub>, FR<sub>L4</sub> and FR<sub>H1</sub>.

**[0142]** In some embodiments, the humanized/optimized anti-ADAM9 antibody or ADAM9-binding fragment thereof includes a CDR<sub>H1</sub> domain, a CDR<sub>H2</sub> domain, and a CDR<sub>H3</sub> domain and a CDR<sub>L1</sub> domain, a CDR<sub>L2</sub> domain, and a CDR<sub>L3</sub> domain having the sequences selected from the group consisting of:

- (a) SEQ ID NOs: 8, 35, and 37 and SEQ ID NOs: 62, 13, 14, respectively;
- (b) SEQ ID NOs: 8, 35, and 38 and SEQ ID NOs: 62, 13, 14, respectively;
- (c) SEQ ID NOs: 8, 35, and 39 and SEQ ID NOs: 62, 13, 14, respectively;
- (d) SEQ ID NOs: 8, 35, and 40 and SEQ ID NOs: 62, 13, 14, respectively;
- (e) SEQ ID NOs: 8, 35, and 41 and SEQ ID NOs: 62, 13, 14, respectively;
- (f) SEQ ID NOs: 8, 35, and 42 and SEQ ID NOs: 62, 13, 14, respectively;
- (g) SEQ ID NOs: 8, 35, and 43 and SEQ ID NOs: 62, 13, 14, respectively;
- (h) SEQ ID NOs: 8, 35, and 44 and SEQ ID NOs: 62, 13, 14, respectively;
- (i) SEQ ID NOs: 8, 35, and 45 and SEQ ID NOs: 62, 13, 14, respectively; and
- (j) SEQ ID NOs: 8, 35, and 46 and SEQ ID NOs: 62, 13, 14, respectively.

**[0143]** In particular embodiments, the humanized/optimized anti-ADAM9 antibody or ADAM9-binding fragment thereof includes a CDR<sub>H1</sub> domain, a CDR<sub>H2</sub> domain, and a CDR<sub>H3</sub> domain and a CDR<sub>L1</sub> domain, a CDR<sub>L2</sub> domain, and a CDR<sub>L3</sub> domain having the sequences of SEQ ID NOs: 8, 35, and 45 and SEQ ID NOs: 62, 13, 14, respectively.

**[0144]** In some embodiments, the humanized/optimized anti-ADAM9 antibody or ADAM9-binding fragment thereof includes a heavy chain variable domain (VH) and a light chain variable domain (VL) having sequences that are at least 90%, at least 95%, at least 99%, or are 100% identical to the sequences as follows:

1. (a) SEQ ID NO:20 and SEQ ID NO:55, respectively;
2. (b) SEQ ID NO:21 and SEQ ID NO:55, respectively;
3. (c) SEQ ID NO:22 and SEQ ID NO:55, respectively;
4. (d) SEQ ID NO:23 and SEQ ID NO:55, respectively;
5. (e) SEQ ID NO:24 and SEQ ID NO:55, respectively;
6. (f) SEQ ID NO:25 and SEQ ID NO:55, respectively;
7. (g) SEQ ID NO:26 and SEQ ID NO:55, respectively;

8. (h) SEQ ID NO:27 and SEQ ID NO:55, respectively;
9. (i) SEQ ID NO:28 and SEQ ID NO:55, respectively; and
10. (j) SEQ ID NO:29 and SEQ ID NO:55, respectively

**[0145]** By "substantially identical" or "identical" is meant a polypeptide exhibiting at least 50% identity to a reference amino acid sequence (for example, any one of the amino acid sequences described herein). Preferably, such a sequence is at least 60%, more preferably at least 80% or at least 85%, and more preferably at least 90%, at least 95% at least 99%, or even 100% identical at the amino acid level or nucleic acid to the sequence used for comparison.

**[0146]** Sequence identity is typically measured using sequence analysis software (for example, Sequence Analysis Software Package of the Genetics Computer Group, University of Wisconsin Biotechnology Center, 1710 University Avenue, Madison, Wis. 53705, BLAST, BESTFIT, GAP, or PILEUP/PRETTYBOX programs). Such software matches identical or similar sequences by assigning degrees of homology to various substitutions, deletions, and/or other modifications. Conservative substitutions typically include substitutions within the following groups: glycine, alanine; valine, isoleucine, leucine; aspartic acid, glutamic acid, asparagine, glutamine; serine, threonine; lysine, arginine; and phenylalanine, tyrosine. In an exemplary approach to determining the degree of identity, a BLAST program may be used, with a probability score between  $e^{-3}$  and  $e^{-100}$  indicating a closely related sequence.

**[0147]** In particular embodiments, the humanized/optimized anti-ADAM9 antibody or ADAM9-binding fragment thereof includes a heavy chain variable domain (VH) and a light chain variable domain (VL) having sequences that are at least 90%, at least 95%, at least 99%, or are 100% identical to the sequences of SEQ ID NO:28 and SEQ ID NO:55, respectively.

**[0148]** In certain embodiments, the humanized/optimized anti-ADAM9 antibody comprises a heavy chain and a light chain sequence as follows:

1. (a) SEQ ID NO:51 and SEQ ID NO:68, respectively;
2. (b) SEQ ID NO:52 and SEQ ID NO:68, respectively;
3. (c) SEQ ID NO: 141 and SEQ ID NO:68, respectively;
4. (d) SEQ ID NO:142 and SEQ ID NO:68, respectively;
5. (e) SEQ ID NO: 143 and SEQ ID NO:68, respectively;
6. (f) SEQ ID NO: 151 and SEQ ID NO:68, respectively;
7. (g) SEQ ID NO: 152 and SEQ ID NO:68, respectively;
8. (h) SEQ ID NO:153 and SEQ ID NO:68, respectively; and
9. (i) SEQ ID NO: 154 and SEQ ID NO:68, respectively.

**[0149]** In particular embodiments, the humanized/optimized anti-ADAM9 antibody comprises a heavy chain having the sequence of SEQ ID NO:52 and a light chain having the sequence of SEQ ID NO:68. In other particular embodiments, the humanized/optimized anti-ADAM9 antibody

comprises a heavy chain having the sequence of SEQ ID NO:142 and a light chain having the sequence of SEQ ID NO:68. In other embodiments, the humanized/optimized anti-ADAM9 antibody is engineered for extended serum half life and comprises a heavy chain having the sequence of SEQ ID NO:151 and a light chain having the sequence of SEQ ID NO:68. In other particular embodiments, the humanized/optimized anti-ADAM9 antibody is engineered for extended serum half life and for site specific conjugation and comprises a heavy chain having the sequence of SEQ ID NO: 152 and a light chain having the sequence of SEQ ID NO:68.

**[0150]** The present invention also expressly contemplates immunoconjugates that immunospecifically bind to an epitope of a human ADAM9 polypeptide, and that comprise any of the above-provided humanized/optimized anti-ADAM9 MAB-A VL or VH Domains. The present invention particularly contemplates such anti-ADAM9 antibodies and ADAM9-binding fragments thereof that comprise any of the following combinations of humanized/optimized anti-ADAM9 VL or VH Domains:

hMAB-A VH / hMAB-A VL Combinations	
	hMAB-A VH(2D) / hMAB-A VL(1)
	hMAB-A VH(2D) / hMAB-A VL(2)
	hMAB-A VH(2D) / hMAB-A VL(3)
	hMAB-A VH(2D) / hMAB-A VL(4)
	hMAB-A VH(2E) / hMAB-A VL(1)
	hMAB-A VH(2E) / hMAB-A VL(2)
	hMAB-A VH(2E) / hMAB-A VL(3)
	hMAB-A VH(2E) / hMAB-A VL(4)
	hMAB-A VH(2F) / hMAB-A VL(1)
	hMAB-A VH(2F) / hMAB-A VL(2)
	hMAB-A VH(2F) / hMAB-A VL(3)
	hMAB-A VH(2F) / hMAB-A VL(4)
	hMAB-A VH(2G) / hMAB-A VL(1)
	hMAB-A VH(2G) / hMAB-A VL(2)
	hMAB-A VH(2G) / hMAB-A VL(3)
	hMAB-A VH(2G) / hMAB-A VL(4)
hMAB-A VH(2A) / hMAB-A VL(1)	hMAB-A VH(2H) / hMAB-A VL(1)
hMAB-A VH(2A) / hMAB-A VL(2)	hMAB-A VH(2H) / hMAB-A VL(2)
hMAB-A VH(2A) / hMAB-A VL(3)	hMAB-A VH(2H) / hMAB-A VL(3)
hMAB-A VH(2A) / hMAB-A VL(4)	hMAB-A VH(2H) / hMAB-A VL(4)
hMAB-A VH(2B) / hMAB-A VL(1)	hMAB-A VH(2I) / hMAB-A VL(1)
hMAB-A VH(2B) / hMAB-A VL(2)	hMAB-A VH(2I) / hMAB-A VL(2)
hMAB-A VH(2B) / hMAB-A VL(3)	hMAB-A VH(2I) / hMAB-A VL(3)
hMAB-A VH(2B) / hMAB-A VL(4)	hMAB-A VH(2I) / hMAB-A VL(4)

hMAB-A VH / hMAB-A VL Combinations	
hMAB-A VH(2C) / hMAB-A VL(1)	hMAB-A VH(2J) / hMAB-A VL(1)
hMAB-A VH(2C) / hMAB-A VL(2)	hMAB-A VH(2J) / hMAB-A VL(2)
hMAB-A VH(2C) / hMAB-A VL(3)	hMAB-A VH(2J) / hMAB-A VL(3)
hMAB-A VH(2C) / hMAB-A VL(4)	hMAB-A VH(2J) / hMAB-A VL(4)

**[0151]** The present invention specifically encompasses immunoconjugates comprising a humanized/optimized anti-ADAM9-VL and/or VH Domain as provided above. In particular embodiments, the immunoconjugates of the present invention comprise (i) a humanized/optimized anti-ADAM9-VL and/or VH Domain as provided above, and (ii) an Fc Region.

**[0152]** Although particular modifications to anti-ADAM9 VH and VL Domains are summarized above and compared in **FIGs. 3A-3B**, it is not necessary to modify all or most of these residues when engineering a humanized and/or optimized anti-ADAM9-VH or VL Domain of the invention. The present invention also encompasses minor variations of these VH and VL sequences including, for example, amino acid substitutions of the C-terminal and/or N-terminal amino acid residues which may be introduced to facilitate subcloning.

### III. Antibody Drug Conjugates

#### **Definitions**

**[0153]** The term "immunoconjugate," "conjugate," or "ADC" as used herein refers to a compound or a derivative thereof (a pharmacological agent) that is linked to or conjugated to an anti-ADAM9 antibody or ADAM9-binding fragment thereof as described herein.

**[0154]** A "linker" is any chemical moiety that is capable of linking a pharmacological agent described herein (e.g., maytansinoid or (indolinobenzodiazepine) compounds), to an anti-ADAM9 antibody or ADAM9-binding fragment thereof in a stable, covalent manner. Linkers can be susceptible to or be substantially resistant to acid-induced cleavage, light-induced cleavage, peptidase-induced cleavage, esterase-induced cleavage, and disulfide bond cleavage, at conditions under which the compound or the antibody remains active. Suitable linkers are well known in the art and include, for example, disulfide groups, thioether groups, acid labile groups, photolabile groups, peptidase labile groups and esterase labile groups. Linkers also include charged linkers, and hydrophilic forms thereof as described herein and known in the art.

**[0155]** "Alkyl" as used herein refers to a saturated linear or branched-chain monovalent hydrocarbon radical of one to twenty carbon atoms. Examples of alkyl include, but are not limited to, methyl, ethyl, 1-propyl, 2-propyl, 1-butyl, 2-methyl-1-propyl, -CH<sub>2</sub>CH(CH<sub>3</sub>)<sub>2</sub>, 2-butyl, 2-methyl-

2-propyl, 1-pentyl, 2-pentyl 3-pentyl, 2-methyl-2-butyl, 3-methyl-2-butyl, 3-methyl-1-butyl, 2-methyl-1-butyl, 1-hexyl, 2-hexyl, 3-hexyl, 2-methyl-2-pentyl, 3-methyl-2-pentyl, 4-methyl-2-pentyl, 3-methyl-3-pentyl, 2-methyl-3-pentyl, 2,3-dimethyl-2-butyl, 3,3-dimethyl-2-butyl, 1-heptyl, 1-octyl, and the like. Preferably, the alkyl has one to ten carbon atoms. More preferably, the alkyl has one to four carbon atoms.

**[0156]** The number of carbon atoms in a group can be specified herein by the prefix " $C_{x-xx}$ ", wherein x and xx are integers. For example, " $C_{1-4}$ alkyl" is an alkyl group having from 1 to 4 carbon atoms.

**[0157]** The term "**compound**" or "**cytotoxic compound**," or "**cytotoxic agent**" are used interchangeably. They are intended to include compounds for which a structure or formula or any derivative thereof has been disclosed in the present invention or a structure or formula or any derivative thereof that has been incorporated by reference. The term also includes, stereoisomers, geometric isomers, tautomers, solvates, metabolites, and salts (e.g., pharmaceutically acceptable salts) of a compound of all the formulae disclosed in the present invention. The term also includes any solvates, hydrates, and polymorphs of any of the foregoing. The specific recitation of "stereoisomers," "geometric isomers," "tautomers," "solvates," "metabolites," "salt", "conjugates," "conjugates salt," "solvate," "hydrate," or "polymorph" in certain aspects of the invention described in this application shall not be interpreted as an intended omission of these forms in other aspects of the invention where the term "compound" is used without recitation of these other forms.

**[0158]** The term "**chiral**" refers to molecules that have the property of non-superimposability of the mirror image partner, while the term "achiral" refers to molecules that are superimposable on their mirror image partner.

**[0159]** The term "**stereoisomer**" refers to compounds that have identical chemical constitution and connectivity, but different orientations of their atoms in space that cannot be interconverted by rotation about single bonds.

**[0160]** "**Diastereomer**" refers to a stereoisomer with two or more centers of chirality and whose molecules are not mirror images of one another. Diastereomers have different physical properties, e.g. melting points, boiling points, spectral properties, and reactivities. Mixtures of diastereomers can separate under high resolution analytical procedures such as crystallization, electrophoresis and chromatography.

**[0161]** "**Enantiomers**" refer to two stereoisomers of a compound that are non-superimposable mirror images of one another.

**[0162]** Stereochemical definitions and conventions used herein generally follow S. P. Parker, Ed., McGraw-Hill, Dictionary of Chemical Terms (1984) McGraw-Hill Book Company, New York; and Eliel, E. and Wilen, S., Stereochemistry of Organic Compounds, John Wiley & Sons, Inc., New York, 1994. The compounds of the invention can contain asymmetric or chiral centers, and therefore exist in different stereoisomeric forms. It is intended that all stereoisomeric forms of the

compounds of the invention, including diastereomers, enantiomers and atropisomers, as well as mixtures thereof such as racemic mixtures, form part of the present invention. Many organic compounds exist in optically active forms, *i.e.*, they have the ability to rotate the plane of plane-polarized light. In describing an optically active compound, the prefixes D and L, or R and S, are used to denote the absolute configuration of the molecule about its chiral center(s). The prefixes d and l or (+) and (-) are employed to designate the sign of rotation of plane-polarized light by the compound, with (-) or l meaning that the compound is levorotatory. A compound prefixed with (+) or d is dextrorotatory. For a given chemical structure, these stereoisomers are identical except that they are mirror images of one another. A specific stereoisomer can also be referred to as an enantiomer, and a mixture of such isomers is often called an enantiomeric mixture. A 50:50 mixture of enantiomers is referred to as a racemic mixture or a racemate, which can occur where there has been no stereoselection or stereospecificity in a chemical reaction or process. The terms "racemic mixture" and "racemate" refer to an equimolar mixture of two enantiomeric species, devoid of optical activity.

**[0163]** The term "**tautomer**" or "**tautomeric form**" refers to structural isomers of different energies that are interconvertible via a low energy barrier. For example, proton tautomers (also known as prototropic tautomers) include interconversions via migration of a proton, such as keto-enol and imine-enamine isomerizations. Valence tautomers include interconversions by reorganization of some of the bonding electrons.

**[0164]** The term "imine reactive reagent" refers to a reagent that is capable of reacting with an imine group. Examples of imine reactive reagent includes sulfites ( $\text{H}_2\text{SO}_3$ ,  $\text{H}_2\text{SO}_2$  or a salt of  $\text{HSO}_3^-$ ,  $\text{SO}_3^{2-}$  or  $\text{HSO}_2^-$  formed with a cation), metabisulfite ( $\text{H}_2\text{S}_2\text{O}_5$  or a salt of  $\text{S}_2\text{O}_5^{2-}$  formed with a cation), mono, di, tri, and tetra- thiophosphates ( $\text{PO}_3\text{SH}_3$ ,  $\text{PO}_2\text{S}_2\text{H}_3$ ,  $\text{POS}_3\text{H}_3$ ,  $\text{PS}_4\text{H}_3$  or a salt of  $\text{PO}_3\text{S}^{3-}$ ,  $\text{PO}_2\text{S}_2^{3-}$ ,  $\text{POS}_3^{3-}$  or  $\text{PS}_4^{3-}$  formed with a cation), thio phosphate esters ( $(\text{R}^i\text{O})_2\text{PS}(\text{OR}^i)$ ,  $\text{R}^i\text{SH}$ ,  $\text{R}^i\text{SOH}$ ,  $\text{R}^i\text{SO}_2\text{H}$ ,  $\text{R}^i\text{SO}_3\text{H}$ ), various amines (hydroxyl amine (*e.g.*,  $\text{NH}_2\text{OH}$ ), hydrazine (*e.g.*,  $\text{NH}_2\text{NH}_2$ ),  $\text{NH}_2\text{O}-\text{R}^i$ ,  $\text{R}^i\text{NH}-\text{R}^i$ ,  $\text{NH}_2-\text{R}^i$ ),  $\text{NH}_2-\text{CO}-\text{NH}_2$ ,  $\text{NH}_2-\text{C}(=\text{S})-\text{NH}_2$ , thiosulfate ( $\text{H}_2\text{S}_2\text{O}_3$  or a salt of  $\text{S}_2\text{O}_3^{2-}$  formed with a cation), dithionite ( $\text{H}_2\text{S}_2\text{O}_4$  or a salt of  $\text{S}_2\text{O}_4^{2-}$  formed with a cation), phosphorodithioate ( $\text{P}(=\text{S})(\text{OR}^k)(\text{SH})(\text{OH})$  or a salt thereof formed with a cation), hydroxamic acid ( $\text{R}^k\text{C}(=\text{O})\text{NHOH}$  or a salt formed with a cation), hydrazide ( $\text{R}^k\text{CONHNH}_2$ ), formaldehyde sulfoxylate ( $\text{HOCH}_2\text{SO}_2\text{H}$  or a salt of  $\text{HOCH}_2\text{SO}_2^-$  formed with a cation, such as  $\text{HOCH}_2\text{SO}_2^-\text{Na}^+$ ), glycosylated nucleotide (such as GDP-mannose), fludarabine or a mixture thereof, wherein  $\text{R}^i$  and  $\text{R}^{i'}$  are each independently a linear or branched alkyl having 1 to 10 carbon atoms and are substituted with at least one substituent selected from  $-\text{N}(\text{R}^j)_2$ ,  $-\text{CO}_2\text{H}$ ,  $-\text{SO}_3\text{H}$ , and  $-\text{PO}_3\text{H}$ ;  $\text{R}^i$  and  $\text{R}^{i'}$  can be further optionally substituted with a substituent for an alkyl described herein;  $\text{R}^j$  is a linear or branched alkyl having 1 to 6 carbon atoms; and  $\text{R}^k$  is a linear, branched or cyclic alkyl, alkenyl or alkynyl having 1 to 10 carbon atoms, aryl, heterocyclyl or heteroaryl (preferably,  $\text{R}^k$  is a linear or branched alkyl having 1 to 4 carbon atoms; more preferably,  $\text{R}^k$  is methyl, ethyl or propyl). Preferably, the cation is a monovalent cation, such as  $\text{Na}^+$  or  $\text{K}^+$ . Preferably, the imine

reactive reagent is selected from sulfites, hydroxyl amine, urea and hydrazine. More preferably, the imine reactive reagent is  $\text{NaHSO}_3$  or  $\text{KHSO}_3$ .

**[0165]** The term "cation" refers to an ion with positive charge. The cation can be monovalent (e.g.,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{NH}_4^+$  etc.), bi-valent (e.g.,  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ , etc.) or multi-valent (e.g.,  $\text{Al}^{3+}$  etc.). Preferably, the cation is monovalent

**[0166]** The phrase "**pharmaceutically acceptable salt**" as used herein, refers to pharmaceutically acceptable organic or inorganic salts of a compound of the invention. Exemplary salts include sulfate, citrate, acetate, oxalate, chloride, bromide, iodide, nitrate, bisulfate, phosphate, acid phosphate, isonicotinate, lactate, salicylate, acid citrate, tartrate, oleate, tannate, pantothenate, bitartrate, ascorbate, succinate, maleate, gentisinate, fumarate, gluconate, glucuronate, saccharate, formate, benzoate, glutamate, methanesulfonate "mesylate," ethanesulfonate, benzenesulfonate, p-toluenesulfonate, pamoate (*i.e.*, 1,1'-methylene-bis-(2-hydroxy-3-naphthoate)) salts, alkali metal (e.g., sodium and potassium) salts, alkaline earth metal (e.g., magnesium) salts, and ammonium salts. A pharmaceutically acceptable salt can involve the inclusion of another molecule such as an acetate ion, a succinate ion or other counter ion. The counter ion can be any organic or inorganic moiety that stabilizes the charge on the parent compound. Furthermore, a pharmaceutically acceptable salt can have more than one charged atom in its structure. Instances where multiple charged atoms are part of the pharmaceutically acceptable salt can have multiple counter ions. Hence, a pharmaceutically acceptable salt can have one or more charged atoms and/or one or more counter ion.

**[0167]** If the compound is a base, the desired pharmaceutically acceptable salt can be prepared by any suitable method available in the art, for example, treatment of the free base with an inorganic acid, such as hydrochloric acid, hydrobromic acid, sulfuric acid, nitric acid, methanesulfonic acid, phosphoric acid and the like, or with an organic acid, such as acetic acid, maleic acid, succinic acid, mandelic acid, fumaric acid, malonic acid, pyruvic acid, oxalic acid, glycolic acid, salicylic acid, a pyranosidyl acid, such as glucuronic acid or galacturonic acid, an alpha hydroxy acid, such as citric acid or tartaric acid, an amino acid, such as aspartic acid or glutamic acid, an aromatic acid, such as benzoic acid or cinnamic acid, a sulfonic acid, such as p-toluenesulfonic acid or ethanesulfonic acid, or the like.

**[0168]** If the compound is an acid, the desired pharmaceutically acceptable salt can be prepared by any suitable method, for example, treatment of the free acid with an inorganic or organic base, such as an amine (primary, secondary or tertiary), an alkali metal hydroxide or alkaline earth metal hydroxide, or the like. Illustrative examples of suitable salts include organic salts derived from amino acids, such as glycine and arginine, ammonia, primary, secondary, and tertiary amines, and cyclic amines, such as piperidine, morpholine and piperazine, and inorganic salts derived from sodium, calcium, potassium, magnesium, manganese, iron, copper, zinc, aluminum and lithium.

**[0169]** As used herein, the term "**solvate**" means a compound that further includes a stoichiometric or non-stoichiometric amount of solvent such as water, isopropanol, acetone, ethanol, methanol, DMSO, ethyl acetate, acetic acid, and ethanolamine dichloromethane, 2-

propanol, or the like, bound by non-covalent intermolecular forces. Solvates or hydrates of the compounds are readily prepared by addition of at least one molar equivalent of a hydroxylic solvent such as methanol, ethanol, 1-propanol, 2-propanol or water to the compound to result in solvation or hydration of the imine moiety.

**[0170]** A "**metabolite**" or "**catabolite**" is a product produced through metabolism or catabolism in the body of a specified compound, a derivative thereof, or a conjugate thereof, or salt thereof. Metabolites of a compound, a derivative thereof, or a conjugate thereof, can be identified using routine techniques known in the art and their activities determined using tests such as those described herein. Such products can result for example from the oxidation, hydroxylation, reduction, hydrolysis, amidation, deamidation, esterification, deesterification, enzymatic cleavage, and the like, of the administered compound.

**[0171]** The phrase "**pharmaceutically acceptable**" indicates that the substance or composition must be compatible chemically and/or toxicologically, with the other ingredients comprising a formulation, and/or the mammal being treated therewith.

**[0172]** The term "**protecting group**" or "**protecting moiety**" refers to a substituent that is commonly employed to block or protect a particular functionality while reacting other functional groups on the compound, a derivative thereof, or a conjugate thereof. For example, an "amine-protecting group" or an "amino-protecting moiety" is a substituent attached to an amino group that blocks or protects the amino functionality in the compound. Such groups are well known in the art (see for example P. Wuts and T. Greene, 2007, Protective Groups in Organic Synthesis, Chapter 7, J. Wiley & Sons, NJ) and exemplified by carbamates such as methyl and ethyl carbamate, Fmoc, substituted ethyl carbamates, carbamates cleaved by 1,6- $\beta$ -elimination (also termed "self immolative"), ureas, amides, peptides, alkyl and aryl derivatives. Suitable amino-protecting groups include acetyl, trifluoroacetyl, t-butoxycarbonyl (BOC), benzyloxycarbonyl (CBZ) and 9-fluorenylmethylenoxycarbonyl (Fmoc). For a general description of protecting groups and their use, see P. G.M. Wuts & T. W. Greene, Protective Groups in Organic Synthesis, John Wiley & Sons, New York, 2007.

**[0173]** The term "**amino acid**" refers to naturally occurring amino acids or non-naturally occurring amino acid. In one embodiment, the amino acid is represented by  $\text{NH}_2\text{-C}(\text{R}^{\text{aa}}\text{R}^{\text{aa}'})\text{-C(=O)OH}$ , wherein  $\text{R}^{\text{aa}}$  and  $\text{R}^{\text{aa}'}$  are each independently H, an optionally substituted linear, branched or cyclic alkyl, alkenyl or alkynyl having 1 to 10 carbon atoms, aryl, heteroaryl or heterocyclyl or  $\text{R}^{\text{aa}}$  and the N-terminal nitrogen atom can together form a heterocyclic ring (e.g., as in proline). The term "**amino acid residue**" refers to the corresponding residue when one hydrogen atom is removed from the amine and/or carboxy end of the amino acid, such as  $\text{-NH-C}(\text{R}^{\text{aa}'}\text{R}^{\text{aa}})\text{-C(=O)O-}$ .

**[0174]** The term "**peptide**" refers to short chains of amino acid monomers linked by peptide (amide) bonds. In some embodiments, the peptides contain 2 to 20 amino acid residues. In other embodiments, the peptides contain 2 to 10 amino acid residues. In yet other embodiments, the peptides contain 2 to 5 amino acid residues. As used herein, when a peptide is a portion of a cytotoxic agent or a linker described herein represented by a specific sequence of amino acids,



the peptide can be connected to the rest of the cytotoxic agent or the linker in both directions. For example, a dipeptide X1-X2 includes X1-X2 and X2-X1. Similarly, a tripeptide X1-X2-X3 includes X1-X2-X3 and X3-X2-X1 and a tetrapeptide X1-X2-X3-X4 includes X1-X2-X3-X4 and X4-X2-X3-X1. X1, X-2, X3 and X4 represents an amino acid residue.

**[0175]** The term "**reactive ester group**" refers to a group an ester group that can readily react with an amine group to form amide bond. Exemplary reactive ester groups include N-hydroxysuccinimide esters, N-hydroxyphthalimide esters, N-hydroxy sulfo-succinimide esters, para-nitrophenyl esters, dinitrophenyl esters, pentafluorophenyl esters and their derivatives, wherein said derivatives facilitate amide bond formation. In certain embodiments, the reactive ester group is a N-hydroxysuccinimide ester or a N-hydroxy sulfo-succinimide ester.

**[0176]** The term "**amine reactive group**" refers to a group that can react with an amine group to form a covalent bond. Exemplary amine reactive groups include reactive ester groups, acyl halides, sulfonyl halide, imidoester, or a reactive thioester groups. In certain embodiments, the amine reactive group is a reactive ester group. In one embodiment, the amine reactive group is a N-hydroxysuccinimide ester or a N-hydroxy sulfo-succinimide ester.

**[0177]** The term "**thiol-reactive group**" refers to a group that can react with a thiol (-SH) group to form a covalent bond. Exemplary thiol-reactive groups include maleimide, haloacetyl, aloacetamide, vinyl sulfone, vinyl sulfonamide or vinyl pyridine. In one embodiment, the thiol-reactive group is maleimide.

**[0178]** As used in the present disclosure and claims, the singular forms "**a**," "**an**," and "**the**" include plural forms unless the context clearly dictates otherwise.

**[0179]** It is understood that wherever embodiments are described herein with the language "**comprising**," otherwise analogous embodiments described in terms of "**consisting of**" and/or "**consisting essentially of**" are also provided.

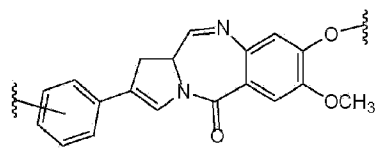
#### **A. Exemplary Immunoconjugates**

**[0180]** The present invention relates to immunoconjugates comprising an anti-ADAM9 antibody or an ADAM9-binding fragment thereof (as defined herein) conjugated to at least one pharmacological agent. Pharmacological agents include but are not limited to cytotoxins, (e.g., a cytostatic or cytotoxic agent), therapeutic agents, and radioactive metal ions, e.g., alpha-emitters. Cytotoxins or cytotoxic agents include any agent that is detrimental to cells such as, for example, Pseudomonas exotoxin, Diphtheria toxin, a botulinum toxin A through F, ricin abrin, saporin, and cytotoxic fragments of such agents. Therapeutic agents include any agent having a therapeutic effect to prophylactically or therapeutically treat a disorder. Such therapeutic agents may be may be chemical therapeutic agents, protein or polypeptide therapeutic agents, and include therapeutic agents that possess a desired biological activity and/or modify a given biological response. Examples of therapeutic agents include alkylating agents, angiogenesis inhibitors, anti-mitotic agents, hormone therapy agents, and antibodies useful for the treatment of cell

proliferative disorders. In certain embodiments, the therapeutic agents are maytansinoid compounds, such as those described in US Patent Nos. 5,208,020 and 7,276,497. In certain embodiments, the therapeutic agents are benzodiazepine compounds, such as pyrrolobenzodiazepine (PBD) (such as those described in WO2010/043880, WO2011/130616, WO2009/016516, WO 2013/177481 and WO 2012/112708) and indolinobenzodiazepine (IGN) compounds (such as those described in WO/2010/091150, and WO 2012/128868 and U.S. Application No. 15/195,269, filed on June 28, 2016, entitled "CONJUGATES OF CYSTEINE ENGINEERED ANTIBODIES").

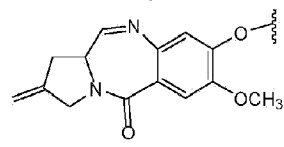
**[0181]** As used herein, a "pyrrolobenzodiazepine" (PBD) compound is a compound having a pyrrolobenzodiazepine core structure. The pyrrolobenzodiazepine can be substituted or unsubstituted. It also includes a compound having two pyrrolobenzodiazepine core linked by a linker. The imine functionality (-C=N-) as part of indolinobenzodiazepine core can be reduced.

**[0182]** In certain embodiments, the pyrrolobenzodiazepine compound comprises a core structure represented by



which can be optionally substituted.

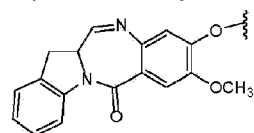
**[0183]** In certain embodiments, the pyrrolobenzodiazepine compounds comprises a core structure represented by



which can be optionally substituted.

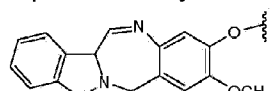
**[0184]** As used herein, a "indolinobenzodiazepine" (IGN) compound is a compound having an indolinobenzodiazepine core structure. The indolinobenzodiazepine can be substituted or unsubstituted. It also includes a compound having two indolinobenzodiazepine core linked by a linker. The imine functionality (-C=N-) as part of indolinobenzodiazepine core can be reduced.

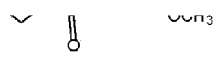
**[0185]** In certain embodiments, the indolinobenzodiazepine compound comprises a core structure represented by



which can be optionally substituted.

**[0186]** In some embodiments, the indolinobenzodiazepine compound comprises a core structure represented by



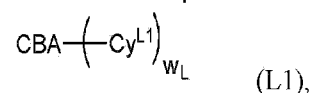


which can be further substituted.

**[0187]** The pharmacological agent may be coupled or conjugated either directly to the anti-ADAM9 antibody or ADAM9-binding fragment thereof or indirectly, through a linker using techniques known in the art to produce an "immunoconjugate," "conjugate," or "ADC."

**[0188]** In a first embodiment, the immunoconjugate of the present invention comprises an anti-ADAM9 antibody or an ADAM9-binding fragment thereof described herein covalently linked to a pharmacological agent described herein through the  $\epsilon$ -amino group of one or more lysine residues located on the anti-ADAM9 antibody or an ADAM9-binding fragment thereof.

**[0189]** In a 1<sup>st</sup> specific embodiment of the first embodiment, the immunoconjugate of the present invention is represented by the following formula:

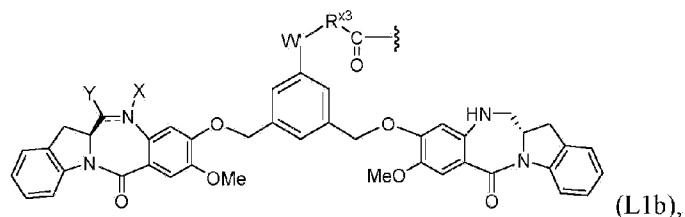
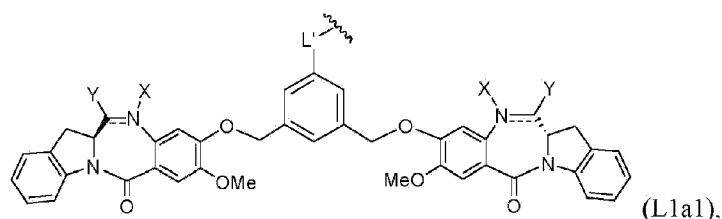
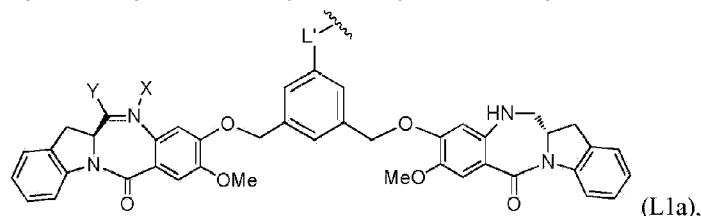


wherein:

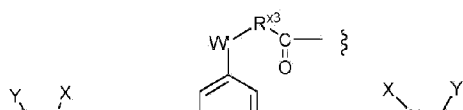
CBA is an anti-ADAM9 antibody or an ADAM9-binding fragment thereof described herein above, that is covalently linked to  $\text{Cy}^{\text{L1}}$  through a lysine residue;

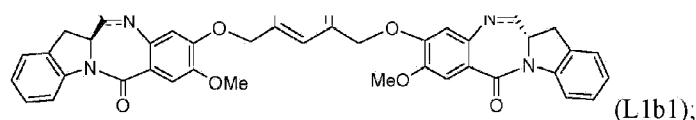
$\text{WL}$  is an integer from 1 to 20; and

$\text{Cy}^{\text{L1}}$  is a cytotoxic compound represented by the following formula:



or





or a pharmaceutically acceptable salt thereof, wherein:

the double line

==

between N and C represents a single bond or a double bond, provided that when it is a double bond, X is absent and Y is -H or a (C<sub>1</sub>-C<sub>4</sub>)alkyl; and when it is a single bond, X is -H or an amine protecting moiety, and Y is -OH or -SO<sub>3</sub>H or a pharmaceutically acceptable salt thereof;

W is -NR<sup>e1</sup>,

R<sup>e1</sup> is -(CH<sub>2</sub>-CH<sub>2</sub>-O)<sub>n</sub>-R<sup>k</sup>;

n is an integer from 2 to 6;

R<sup>k</sup> is -H or -Me;

R<sup>x3</sup> is a (C<sub>1</sub>-C<sub>6</sub>)alkyl;

L' is represented by the following formula:

- NR<sub>5</sub>-P-C(=O)-(CR<sub>a</sub>R<sub>b</sub>)<sub>m</sub>-C(=O)- (B1'); or
- NR<sub>5</sub>-P-C(=O)-(CR<sub>a</sub>R<sub>b</sub>)<sub>m</sub>-S-Z<sup>s1</sup>- (B2');

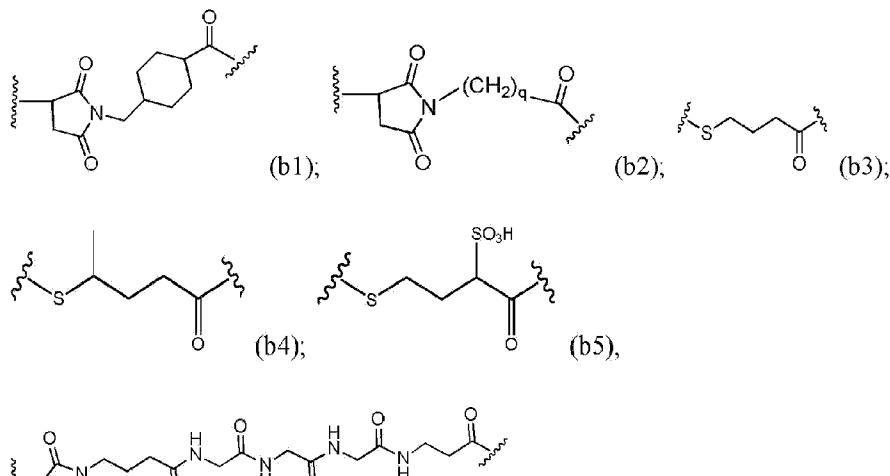
R<sub>5</sub> is -H or a (C<sub>1</sub>-C<sub>3</sub>)alkyl;

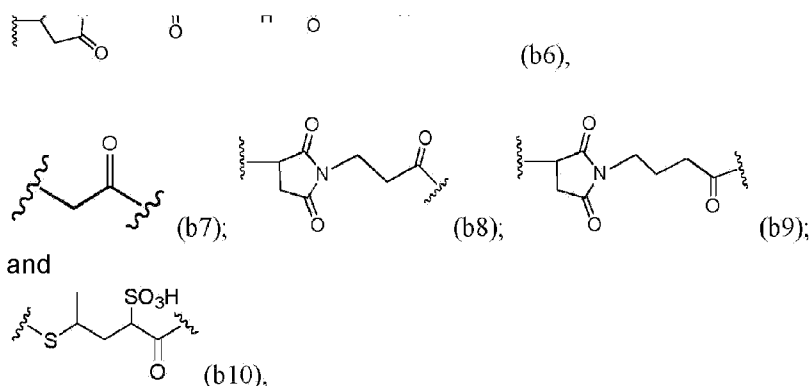
P is an amino acid residue or a peptide containing between 2 to 20 amino acid residues;

R<sub>a</sub> and R<sub>b</sub>, for each occurrence, are each independently -H, (C<sub>1</sub>-C<sub>3</sub>)alkyl, or a charged substituent or an ionizable group Q;

m is an integer from 1 to 6; and

Z<sup>s1</sup> is selected from any one of the following formulas:





wherein q is an integer from 1 to 5.

**[0190]** In a 2<sup>nd</sup> specific embodiment, for conjugates of formula (L1), Cy<sup>L1</sup> is represented by formula (L1a) or (L1a1); and the remaining variables are as described above in the 1<sup>st</sup> specific embodiment.

**[0191]** In a 3<sup>rd</sup> specific embodiment, for conjugates of formula (L1), Cy<sup>L1</sup> is represented by formula (L1b) or (L1b1); and the remaining variables are as described above in the 1<sup>st</sup> specific embodiment. More specifically, R<sup>x3</sup> is a (C<sub>2</sub>-C<sub>4</sub>)alkyl.

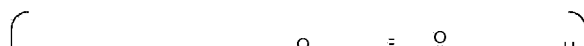
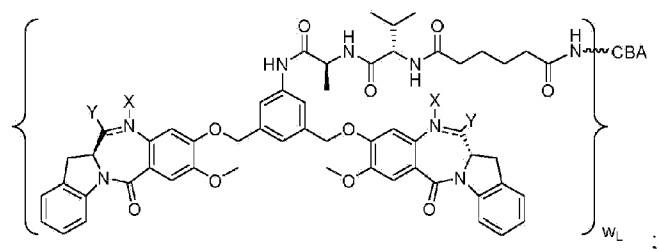
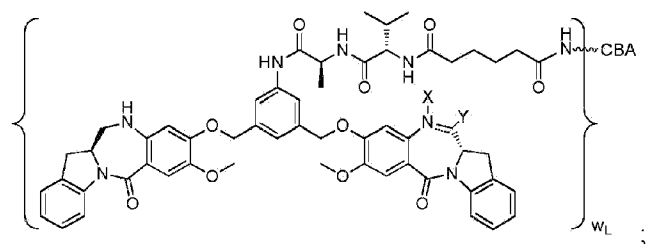
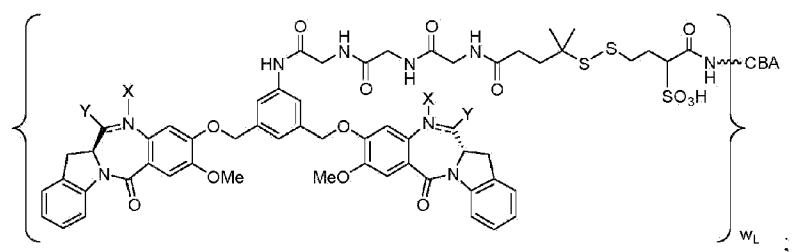
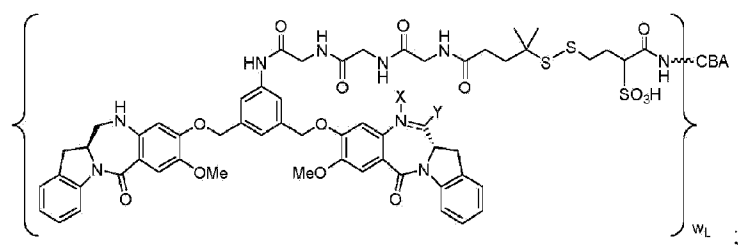
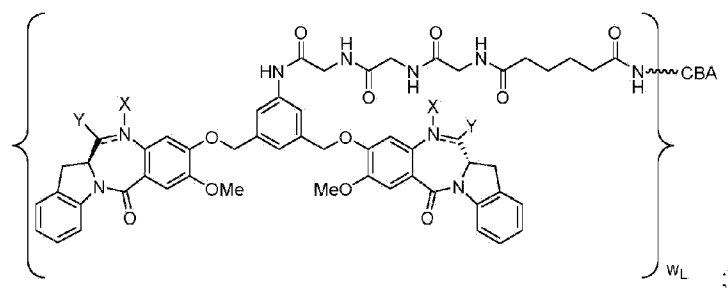
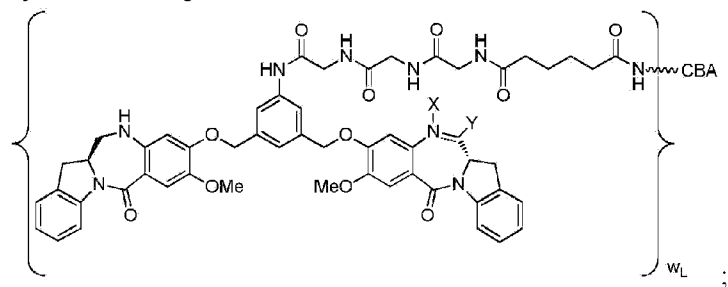
**[0192]** In a 4<sup>th</sup> specific embodiment, for conjugates of formula (L1), Cy<sup>L1</sup> is represented by formula (L1a); R<sub>a</sub> and R<sub>b</sub> are both H; R<sub>5</sub> is H or Me, and the remaining variables are as described above in the 1<sup>st</sup> specific embodiment.

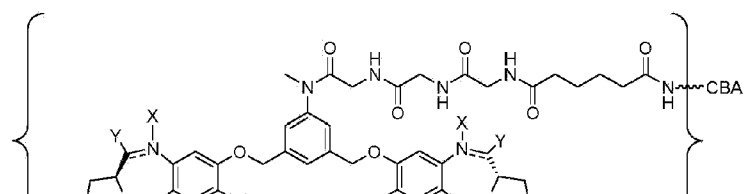
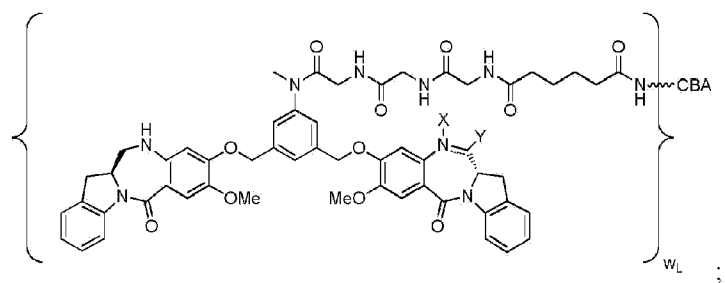
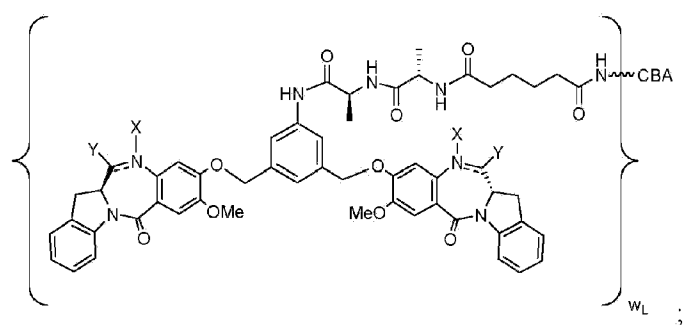
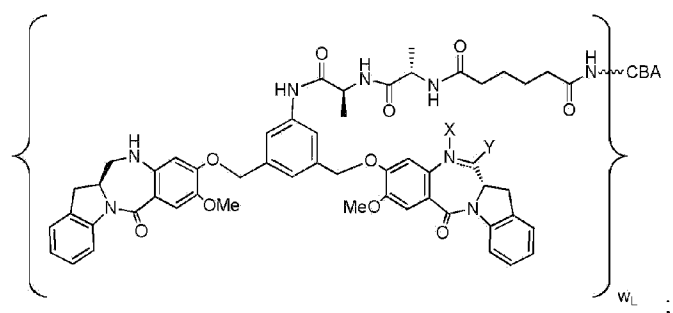
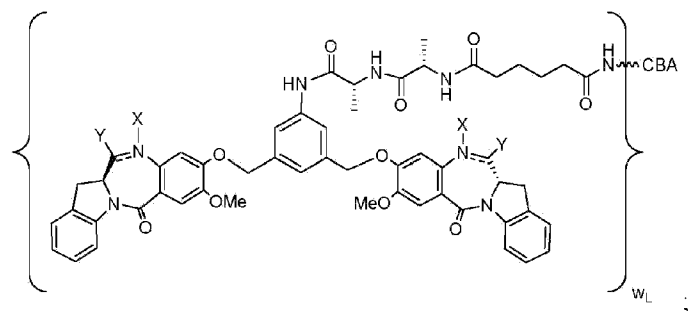
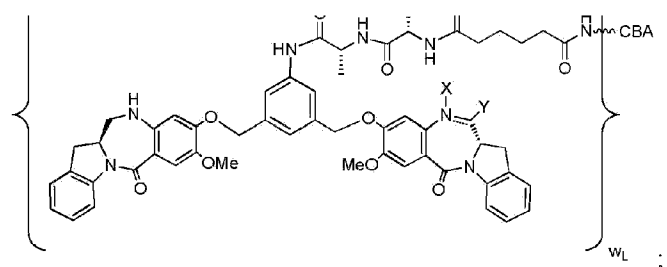
**[0193]** In a 5<sup>th</sup> specific embodiment, P is a peptide containing 2 to 5 amino acid residues; and the remaining variables are described above in the 1<sup>st</sup>, 2<sup>nd</sup> or 4<sup>th</sup> specific embodiment. In a more specific embodiment, P is selected from the group consisting of Gly-Gly-Gly, Ala-Val, Val-Ala, Val-Cit, Val-Lys, Phe-Lys, Lys-Lys, Ala-Lys, Phe-Cit, Leu-Cit, Ile-Cit, Trp, Cit, Phe-Ala, Phe-N<sup>9</sup>-tosyl-Arg, Phe-N<sup>9</sup>-nitro-Arg, Phe-Phe-Lys, D-Phe-Phe-Lys, Gly-Phe-Lys, Leu-Ala-Leu, Ile-Ala-Leu, Val-Ala-Val, Ala-Leu-Ala-Leu (SEQ ID NO:144, β-Ala-Leu-Ala-Leu (SEQ ID NO:145), Gly-Phe-Leu-Gly (SEQ ID NO:146), Val-Arg, Arg-Val, Arg-Arg, Val-D-Cit, Val-D-Lys, Val-D-Arg, D-Val-Cit, D-Val-Lys, D-Val-Arg, D-Val-D-Cit, D-Val-D-Lys, D-Val-D-Arg, D-Arg-D-Arg, Ala-Ala, Ala-D-Ala, D-Ala-Ala, D-Ala-D-Ala, Ala-Met, Met-Ala, Gln-Val, Asn-Ala, Gln-Phe and Gln-Ala. More specifically, P is Gly-Gly-Gly, Ala-Val, Ala-Ala, Ala-D-Ala, D-Ala-Ala, or D-Ala-D-Ala.

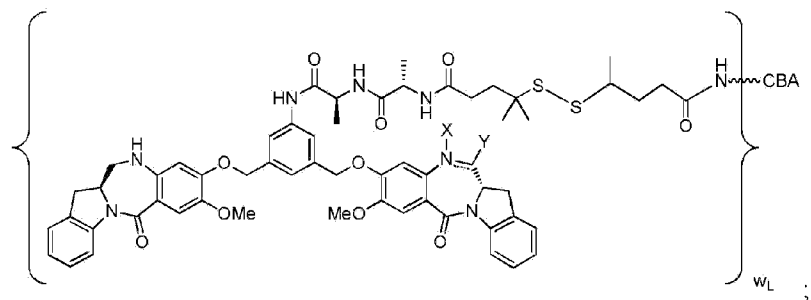
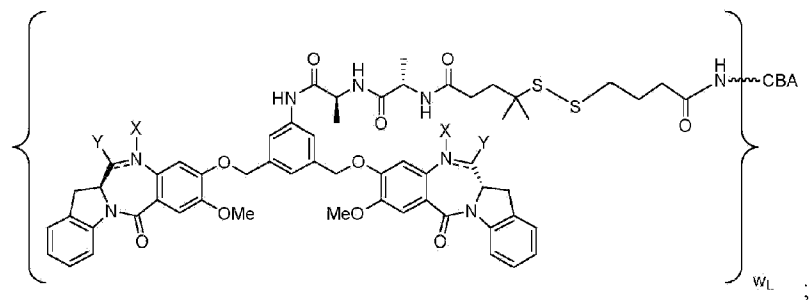
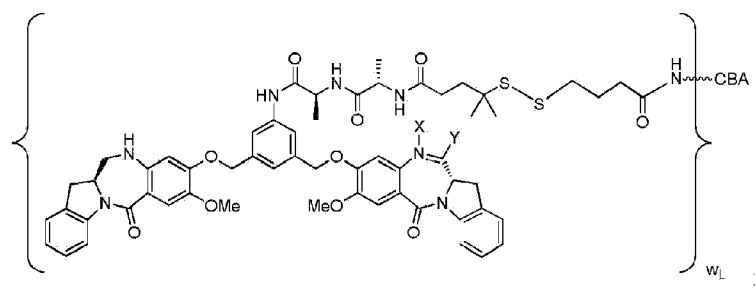
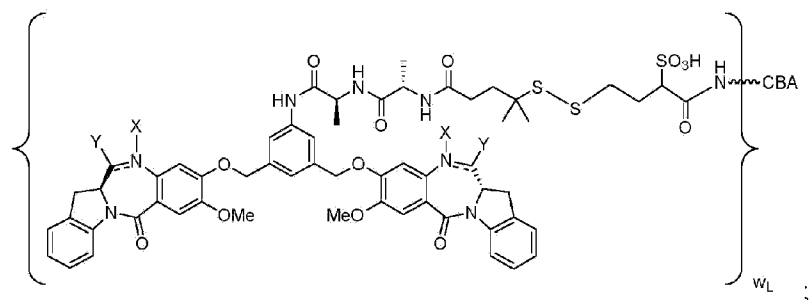
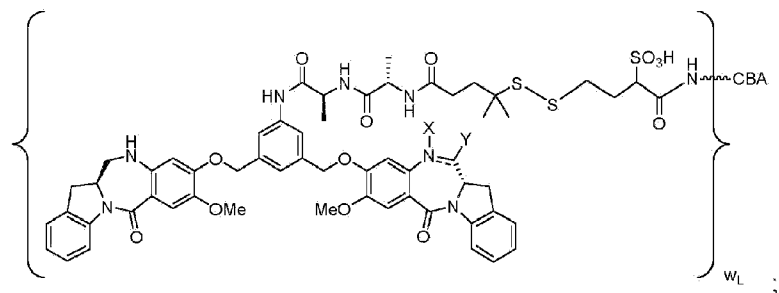
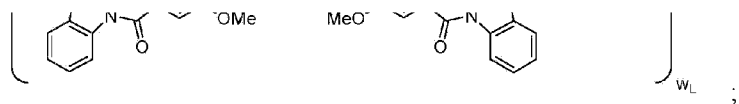
**[0194]** In a 6<sup>th</sup> specific embodiment, Q is -SO<sub>3</sub>H or a pharmaceutically acceptable salt thereof; and the remaining variables are as described above in the 1<sup>st</sup>, 2<sup>nd</sup>, 4<sup>th</sup> or 5<sup>th</sup> specific embodiment or any more specific embodiments described therein.

**[0195]** In a 7<sup>th</sup> specific embodiment, the immunoconjugate of the first embodiment is represented

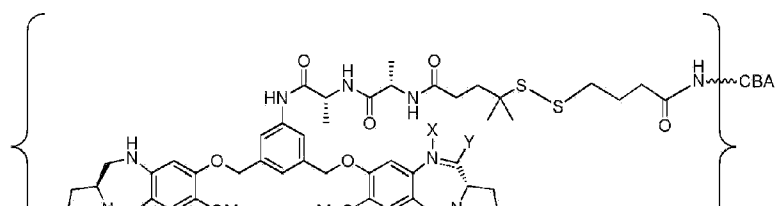
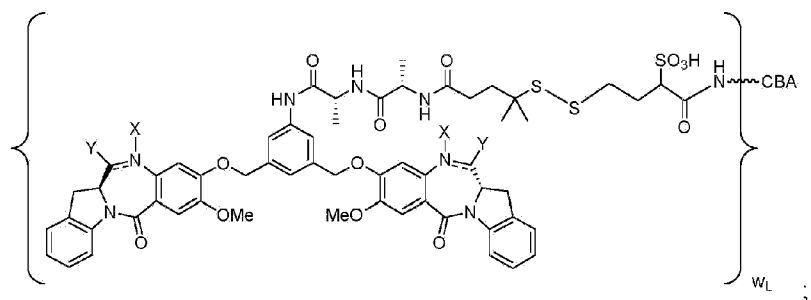
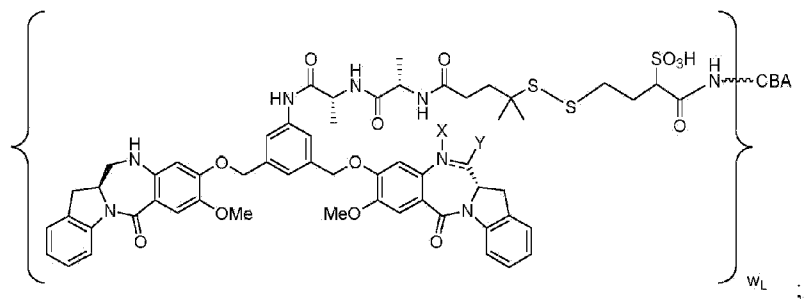
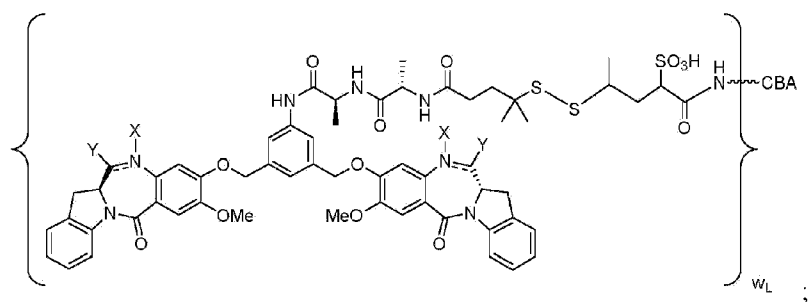
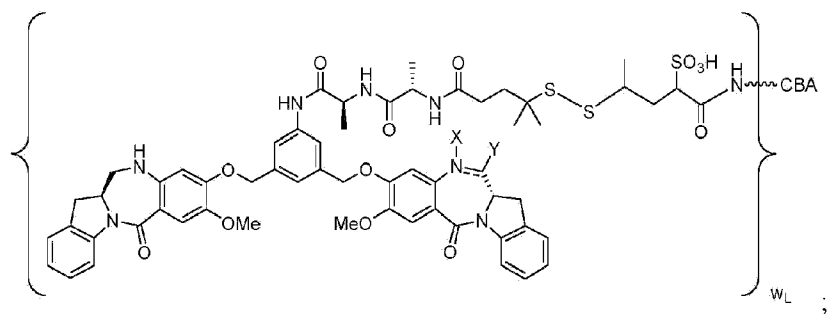
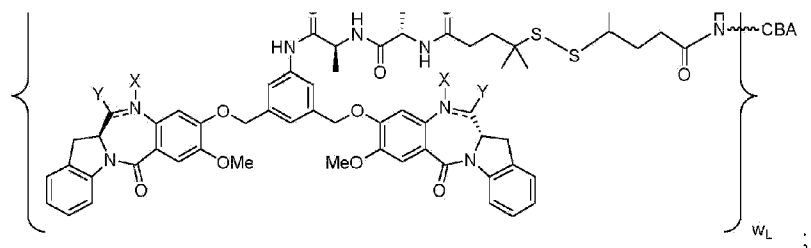
by the following formula:

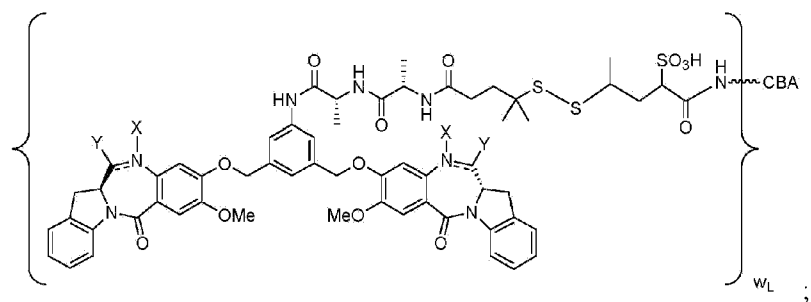
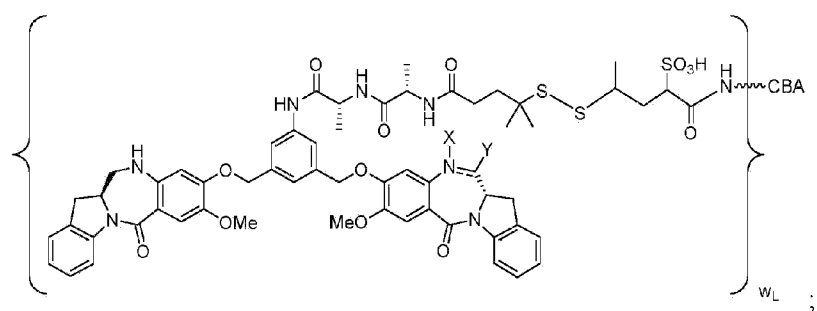
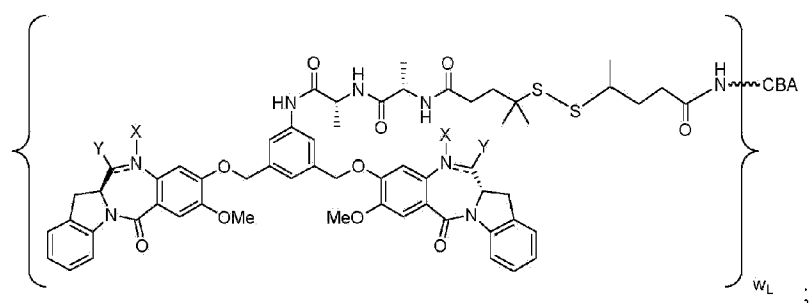
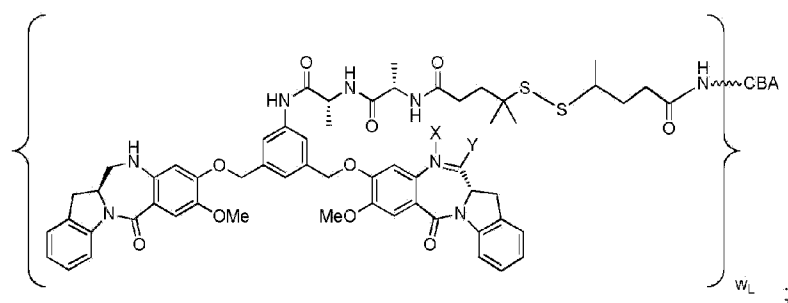
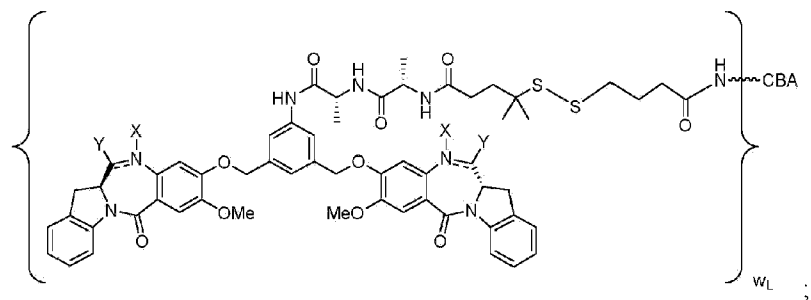
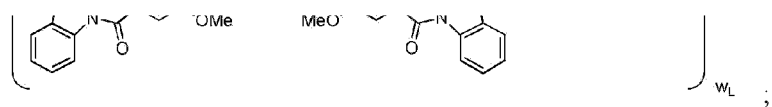


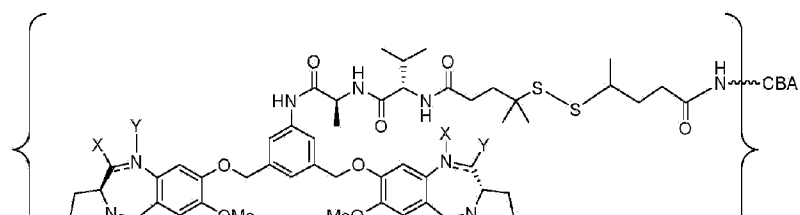
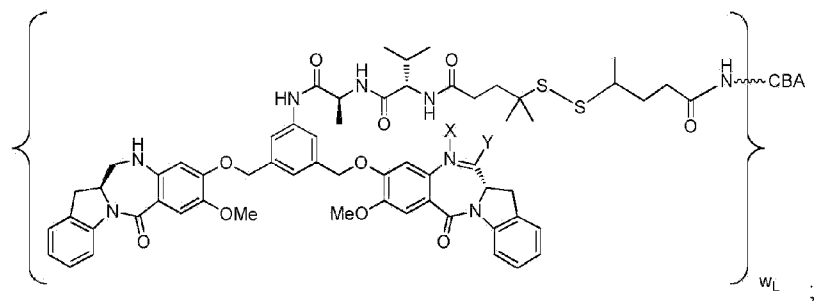
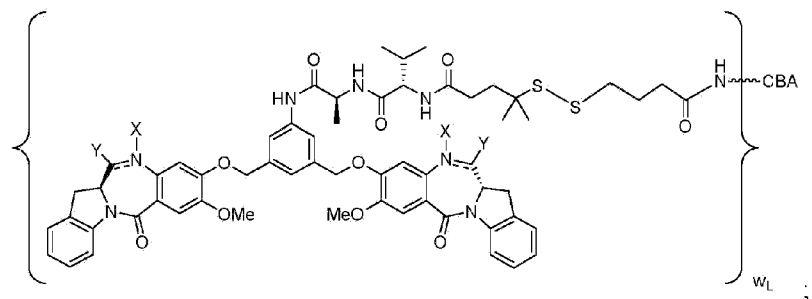
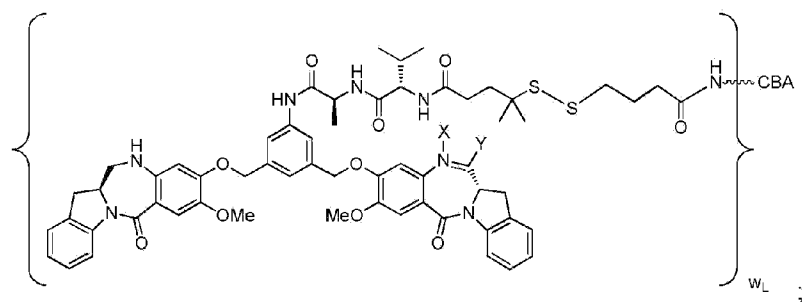
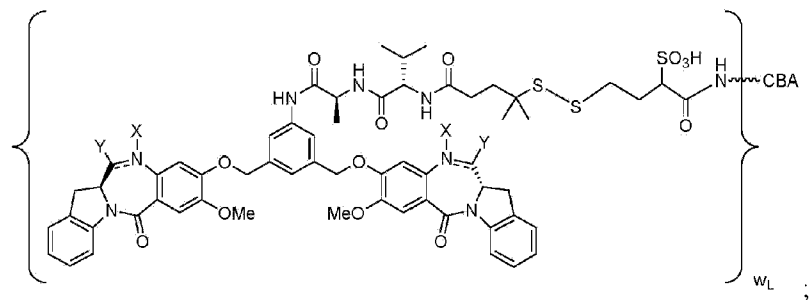
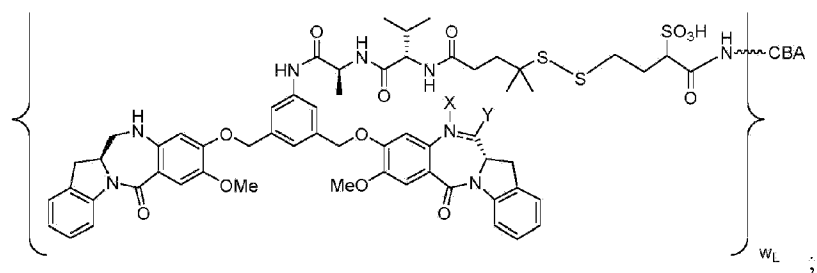


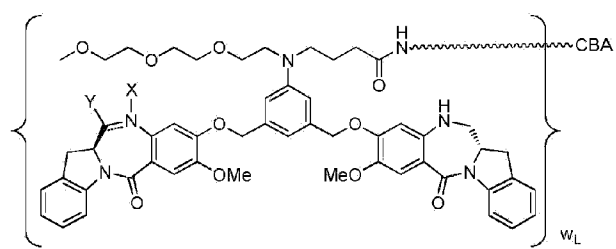
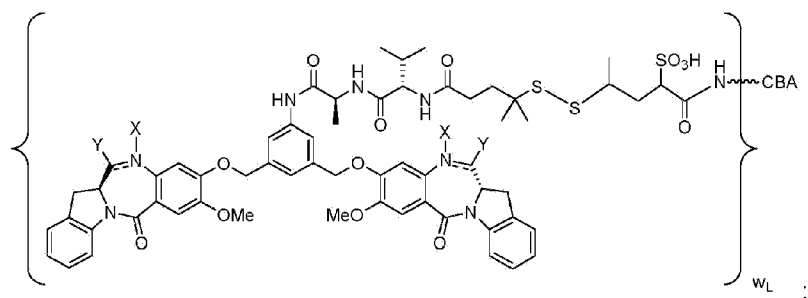
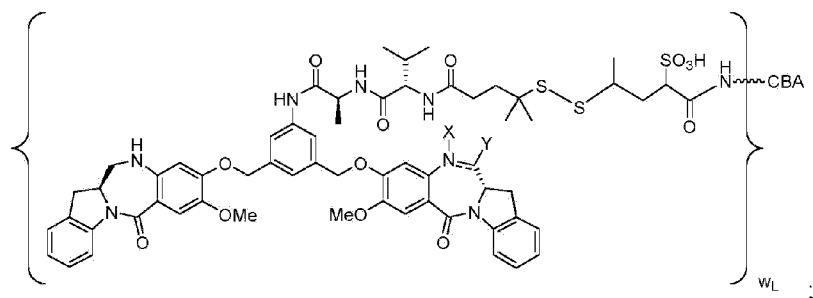










[illegible]

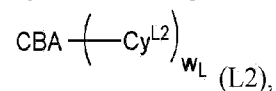
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between N and C represents a single bond, X is -H and Y is -SO<sub>3</sub>H or a pharmaceutically acceptable salt thereof.

**[0196]** In a 8<sup>th</sup> specific embodiment, the immunoconjugate of the first embodiment is represented by the following formula:

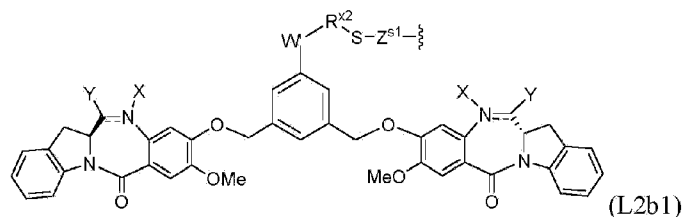
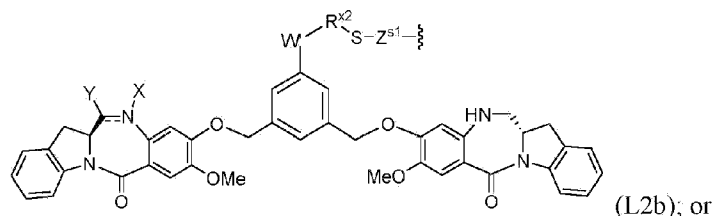
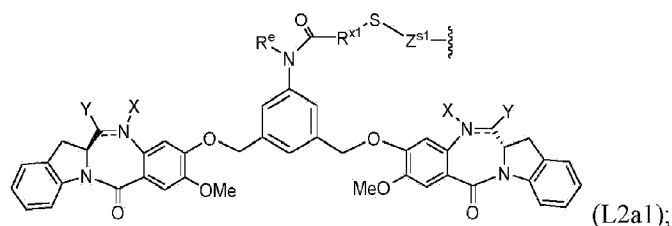
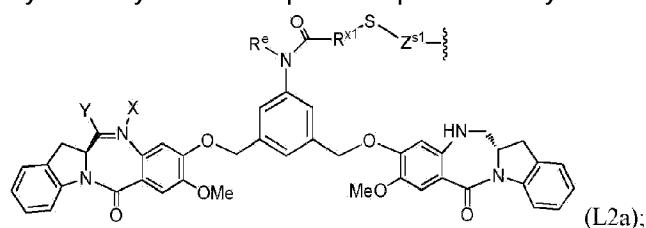


wherein:

CBA is an anti-ADAM9 antibody or an ADAM9-binding fragment thereof described herein above, that is covalently linked to  $\text{Cy}^{\text{L2}}$  through a lysine residue;

$\text{W}_\text{L}$  is an integer from 1 to 20; and

$\text{Cy}^{\text{L2}}$  is a cytotoxic compound represented by the following formula:



or a pharmaceutically acceptable salt thereof, wherein:

the double line



between N and C represents a single bond or a double bond, provided that when it is a double bond, X is absent and Y is -H or a (C<sub>1</sub>-C<sub>4</sub>)alkyl; and when it is a single bond, X is -H or an amine protecting moiety, and Y is -OH or -SO<sub>3</sub>H or a pharmaceutically acceptable salt thereof;

$R^{x1}$  and  $R^{x2}$  are independently  $(C_1-C_6)$ alkyl;

$R^e$  is -H or a  $(C_1-C_6)$ alkyl;

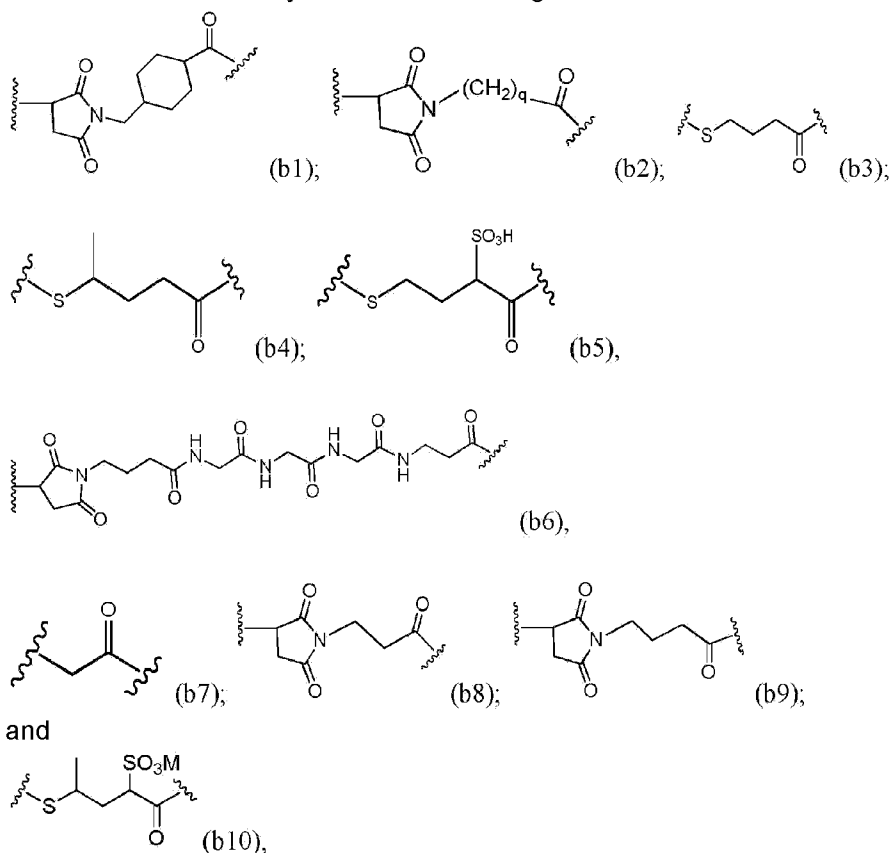
W is  $-NR^e$ ,

$R^{e'}$  is  $-(CH_2-CH_2-O)_n-R^k$ ;

n is an integer from 2 to 6;

$R^k$  is -H or -Me;

$Z^{s1}$  is selected from any one of the following formulas:



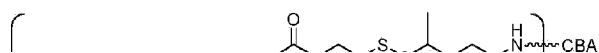
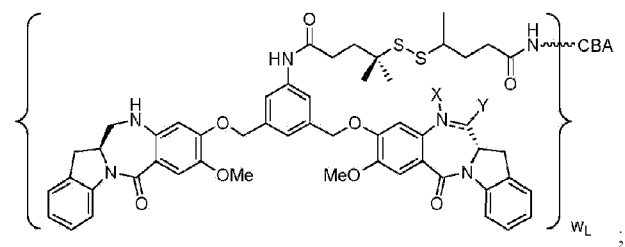
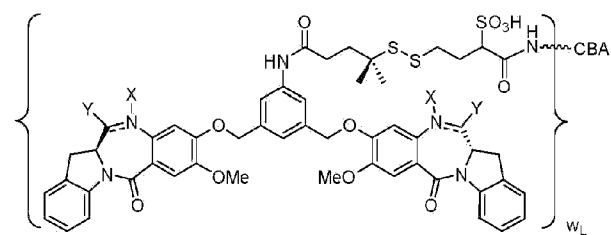
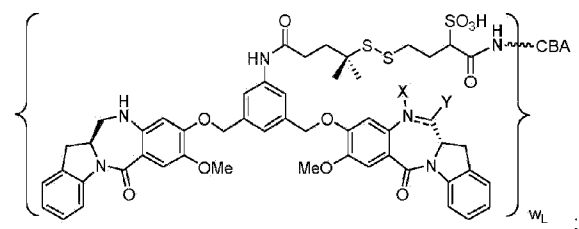
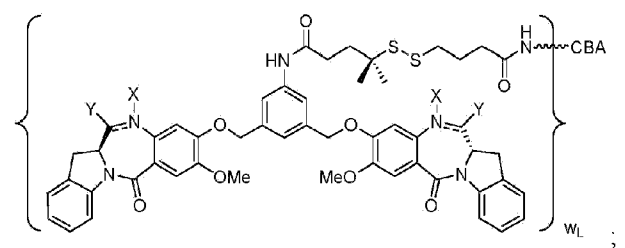
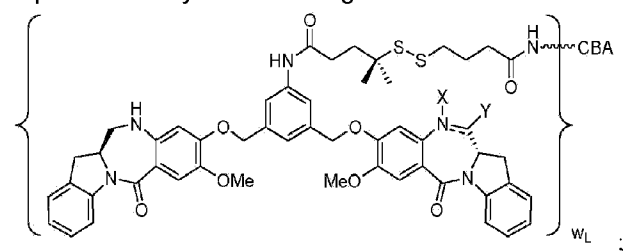
wherein q is an integer from 1 to 5.

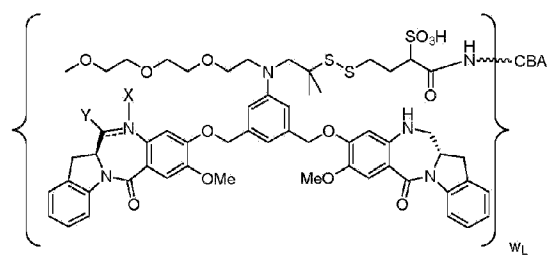
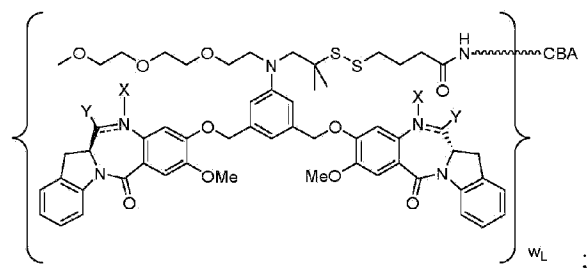
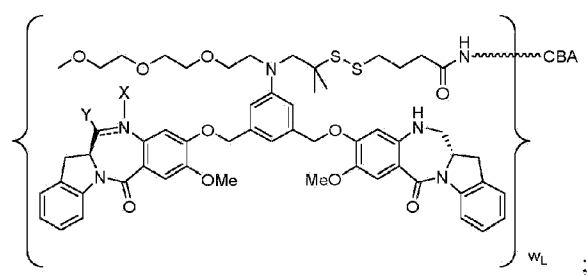
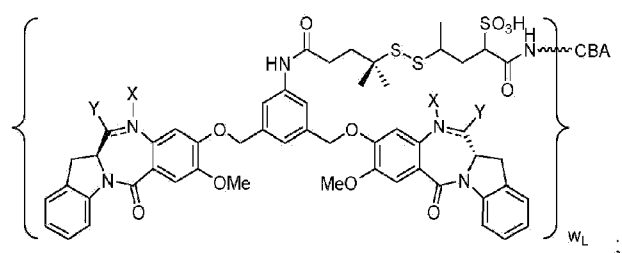
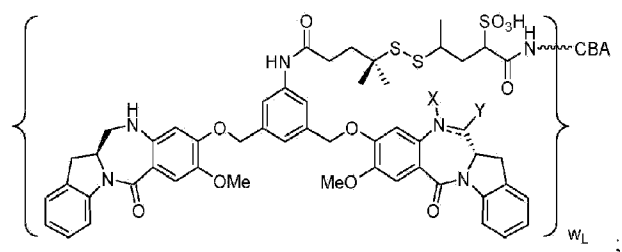
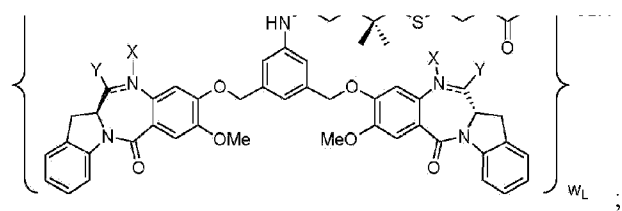
**[0197]** In a 9<sup>th</sup> specific embodiment, for immunoconjugates of formula (L2),  $Cy^{L2}$  is represented by formula (L2a) or (L2a1); and the remaining variables are as described above in the 8<sup>th</sup> specific embodiment.

**[0198]** In a 10<sup>th</sup> specific embodiment, for immunoconjugates of formula (L2),  $Cy^{L2}$  is represented by formula (L2b) or (L2b1); and the remaining variables are as described above in the 8<sup>th</sup> specific embodiment.

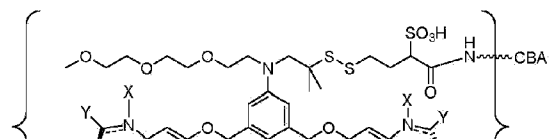
**[0199]** In a 11<sup>th</sup> specific embodiment, for immunoconjugates of formula (L2),  $R^e$  is H or Me;  $R^{X1}$  and  $R^{X2}$  are independently  $-(CH_2)_p-(CR^fR^g)-$ , wherein  $R^f$  and  $R^g$  are each independently -H or a  $(C_1-C_4)$ alkyl; and p is 0, 1, 2 or 3; and the remaining variables are as described above in the 8<sup>th</sup>, 9<sup>th</sup> or 10<sup>th</sup> specific embodiment. More specifically,  $R^f$  and  $R^g$  are the same or different, and are selected from -H and -Me.

**[0200]** In a 12<sup>th</sup> specific embodiment, the immunoconjugate of the first embodiment is represented by the following formula:

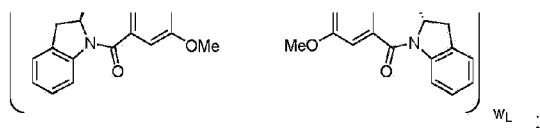




or







or a pharmaceutically acceptable salt thereof, wherein  $W_L$  is an integer from 1 to 10; the double line

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between N and C represents a single bond or a double bond, provided that when it is a double bond, X is absent and Y is -H; and when it is a single bond, X is -H and Y is -OH or -SO<sub>3</sub>H or a pharmaceutically acceptable salt thereof. In a more specific embodiment, the double line

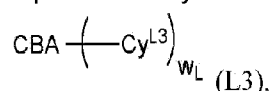
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between N and C represents a double bond. In another more specific embodiment, the double line

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between N and C represents a single bond, X is -H and Y is -SO<sub>3</sub>H or a pharmaceutically acceptable salt thereof.

**[0201]** In a 13<sup>th</sup> specific embodiment, the immunoconjugates of the first embodiment is represented by the following formula:

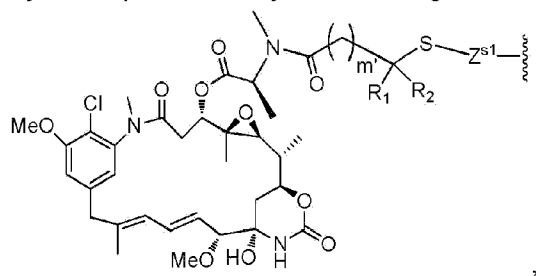


wherein:

CBA is an anti-ADAM9 antibody or an ADAM9-binding fragment thereof described herein above, which is covalently linked to  $\text{Cy}^{\text{L3}}$  through a Lys residue;

$W_L$  is an integer from 1 to 20;

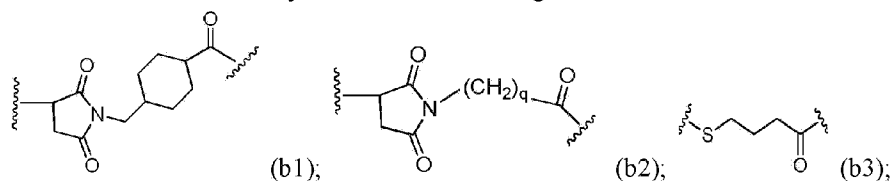
$\text{Cy}^{\text{L3}}$  is represented by the following formula:

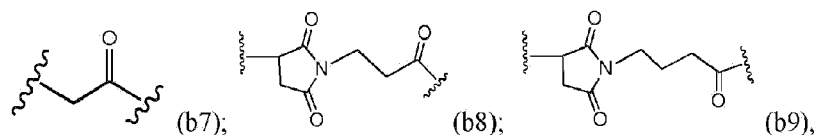
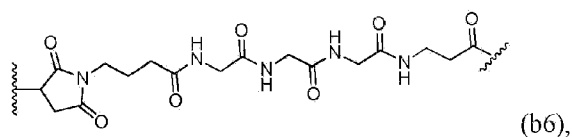
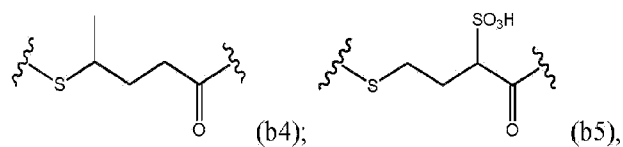


$m'$  is 1 or 2;

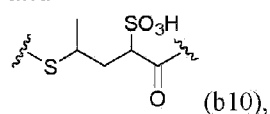
$R_1$  and  $R_2$ , are each independently H or a (C<sub>1</sub>-C<sub>3</sub>)alkyl; and

$Z^{\text{s1}}$  is selected from any one of the following formulas:





and

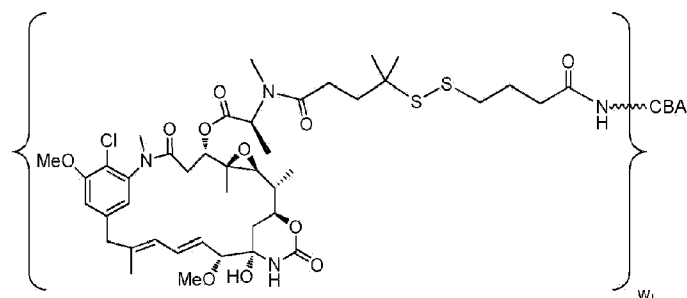
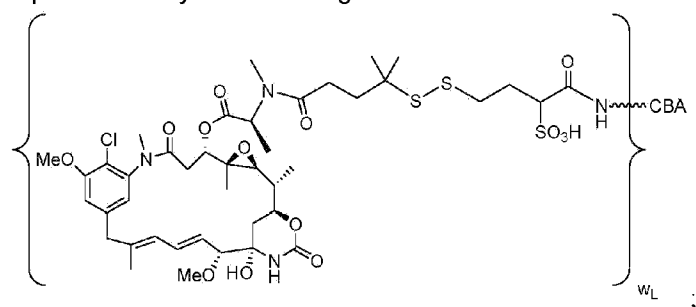


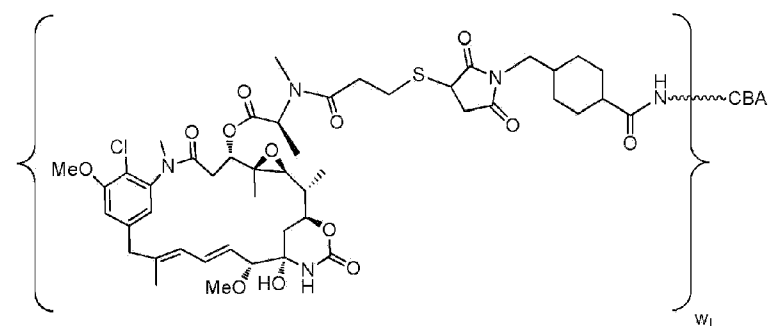
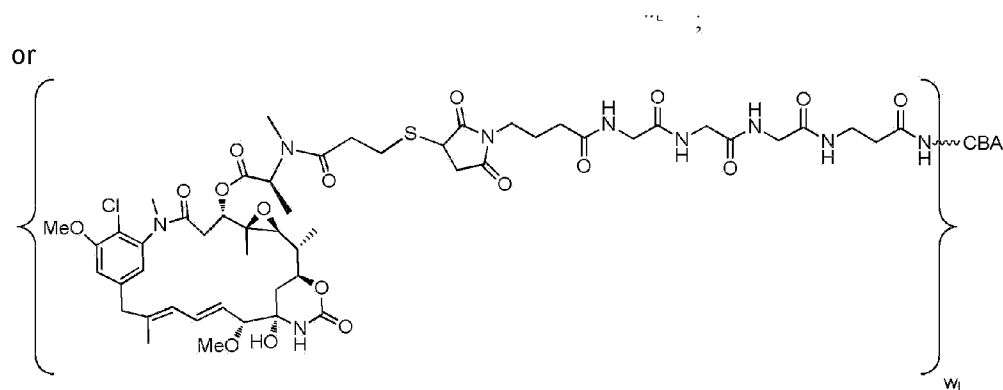
wherein  $q$  is an integer from 1 to 5

**[0202]** In a 14<sup>th</sup> specific embodiment, for immunoconjugates of formula (L3),  $m'$  is 1, and  $R_1$  and  $R_2$  are both H; and the remaining variables are as described above in the 13<sup>th</sup> specific embodiment.

**[0203]** In a 15<sup>th</sup> specific embodiment, for immunoconjugates of formula (L3),  $m'$  is 2, and  $R_1$  and  $R_2$  are both Me; and the remaining variables are as described above in the 13<sup>th</sup> specific embodiment.

**[0204]** In a 16<sup>th</sup> specific embodiment, the immunoconjugates of the first embodiment is represented by the following formula:





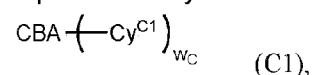
or a pharmaceutically acceptable salt thereof, wherein  $w_L$  is an integer from 1 to 10.

**[0205]** In a 17<sup>th</sup> specific embodiment, for immunoconjugates of the first embodiment, Y is  $-\text{SO}_3\text{H}$ ,  $-\text{SO}_3\text{Na}$  or  $-\text{SO}_3\text{K}$ ; and the remaining variables are as described above in any one of the 1<sup>st</sup> to 16<sup>th</sup> specific embodiment or any more specific embodiments described therein. In one embodiment, Y is  $-\text{SO}_3\text{Na}$ .

**[0206]** In certain embodiments, for compositions (e.g., pharmaceutical compositions) comprising immunoconjugates of the first embodiment, or the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup>, 6<sup>th</sup>, 7<sup>th</sup>, 8<sup>th</sup>, 9<sup>th</sup>, 10<sup>th</sup>, 11<sup>th</sup>, 12<sup>th</sup>, 13<sup>th</sup>, 14<sup>th</sup>, 15<sup>th</sup>, 16<sup>th</sup> or 17<sup>th</sup> specific embodiment, the average number of the cytotoxic agent per antibody molecule (*i.e.*, average value of  $w_L$ ), also known as Drug-Antibody Ratio (DAR) in the composition is in the range of 1.0 to 8.0. In some embodiments, DAR is in the range of 1.0 to 5.0, 1.0 to 4.0, 1.0 to 3.4, 1.0 to 3.0, 1.5 to 2.5, 2.0 to 2.5, or 1.8 to 2.2. In some embodiments, the DAR is less than 4.0, less than 3.8, less than 3.6, less than 3.5, less than 3.0 or less than 2.5.

**[0207]** In a second embodiment, the immunoconjugates of the present invention comprises an anti-ADAM9 antibody or an ADAM9-binding fragment thereof described herein above covalently linked to a cytotoxic agent described herein through the thiol group ( $-\text{SH}$ ) of one or more cysteine residues located on the anti-ADAM9 antibody or an ADAM9-binding fragment thereof.

**[0208]** In a 1<sup>st</sup> specific embodiment, the immunoconjugate of the second embodiment is represented by the following formula:

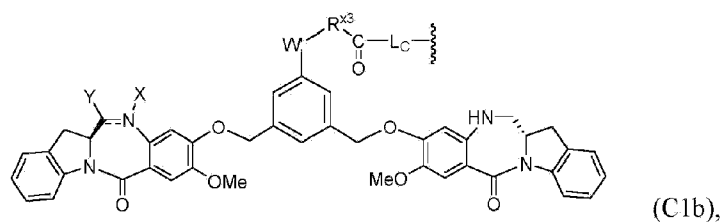
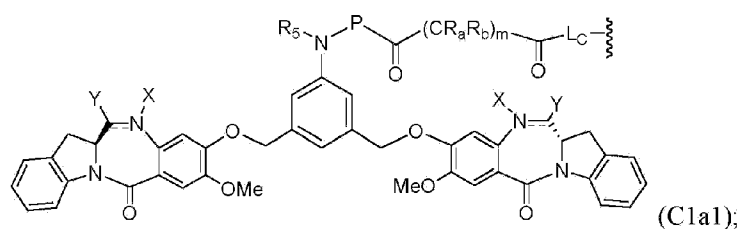
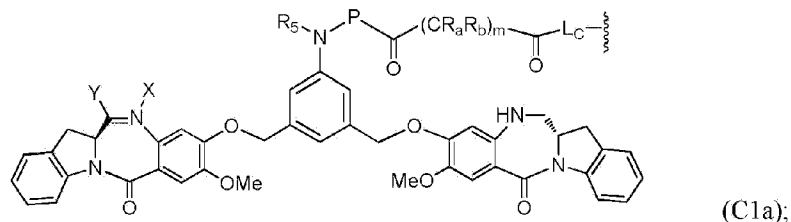


wherein:

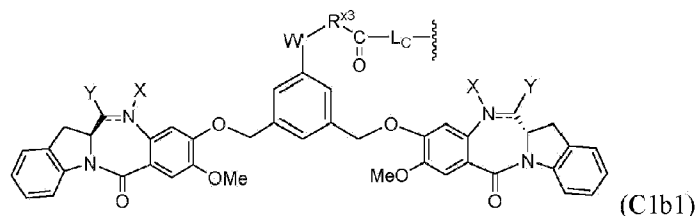
CBA is anti-ADAM9 antibody or an ADAM9-binding fragment thereof described herein covalently linked to Cy<sup>C1</sup> through a cysteine residue;

W<sub>C</sub> is 1 or 2;

Cy<sup>C1</sup> is represented by the following formula:



or



or a pharmaceutically acceptable salt thereof, wherein:

the double line

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between N and C represents a single bond or a double bond, provided that when it is a double bond, X is absent and Y is -H or a (C<sub>1</sub>-C<sub>4</sub>)alkyl; and when it is a single bond, X is -H or an amine protecting moiety, Y is -OH or -SO<sub>3</sub>H or a pharmaceutically acceptable salt thereof;

R<sub>5</sub> is -H or a (C<sub>1</sub>-C<sub>3</sub>)alkyl;

P is an amino acid residue or a peptide containing 2 to 20 amino acid residues;

R<sub>a</sub> and R<sub>b</sub>, for each occurrence, are independently -H, (C<sub>1</sub>-C<sub>3</sub>)alkyl, or a charged substituent or an ionizable group Q;

W is  $-NR^{e'}$ ,

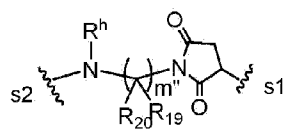
$R^{e'}$  is  $-(CH_2-CH_2-O)_n-R^k$ ;

n is an integer from 2 to 6;

$R^k$  is -H or -Me;

$R^{x3}$  is a  $(C_1-C_6)$ alkyl; and,

$L_C$  is represented by:



wherein  $s_1$  is the site covalently linked to CBA, and  $s_2$  is the site covalently linked to the  $-C(=O)-$  group on  $Cy^{C1}$ ; wherein:

$R_{19}$  and  $R_{20}$ , for each occurrence, are independently -H or a  $(C_1-C_3)$ alkyl;

$m''$  is an integer between 1 and 10; and

$R^h$  is -H or a  $(C_1-C_3)$ alkyl.

**[0209]** In a 2<sup>nd</sup> specific embodiment, for immunoconjugate of formula (C1),  $Cy^{C1}$  is represented by formula (C1a) or (C1a1); and the remaining variables are as described above in the 1<sup>st</sup> specific embodiment of the second embodiment.

**[0210]** In a 3<sup>rd</sup> specific embodiment, for immunoconjugate of formula (C1),  $Cy^{C1}$  is represented by formula (C1b) or (C1b1); and the remaining variables are as described above in the 1<sup>st</sup> specific embodiment of the second embodiment.

**[0211]** In a 4<sup>th</sup> specific embodiment, for immunoconjugate of formula (C1),  $Cy^{C1}$  is represented by formula (C1a) or (C1a1);  $R_a$  and  $R_b$  are both H; and  $R_5$  is H or Me; and the remaining variables are as described above in the 1<sup>st</sup> or 2<sup>nd</sup> specific embodiment of the second embodiment.

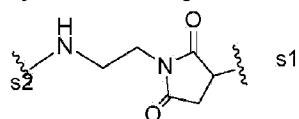
**[0212]** In a 5<sup>th</sup> specific embodiment, for immunoconjugate of formula (C1), P is a peptide containing 2 to 5 amino acid residues; and the remaining variables are as described above in the 1<sup>st</sup>, 2<sup>nd</sup> or 4<sup>th</sup> specific embodiment of the second embodiment. In a more specific embodiment, P is selected from Gly-Gly-Gly, Ala-Val, Val-Ala, Val-Cit, Val-Lys, Phe-Lys, Lys-Lys, Ala-Lys, Phe-Cit, Leu-Cit, Ile-Cit, Trp, Cit, Phe-Ala, Phe-N<sup>9</sup>-tosyl-Arg, Phe-N<sup>9</sup>-nitro-Arg, Phe-Phe-Lys, D-Phe-Phe-Lys, Gly-Phe-Lys, Leu-Ala-Leu, Ile-Ala-Leu, Val-Ala-Val, Ala-Leu-Ala-Leu (SEQ ID NO: 144),  $\beta$ -

Ala-Leu-Ala-Leu (SEQ ID NO: 145), Gly-Phe-Leu-Gly (SEQ ID NO:146), Val-Arg, Arg-Val, Arg-Arg, Val-D-Cit, Val-D-Lys, Val-D-Arg, D-Val-Cit, D-Val-Lys, D-Val-Arg, D-Val-D-Cit, D-Val-D-Lys, D-Val-D-Arg, D-Arg-D-Arg, Ala-Ala, Ala-D-Ala, D-Ala-Ala, D-Ala-D-Ala, Ala-Met, Met-Ala, Gln-Val, Asn-Ala, Gln-Phe and Gln-Ala. In another more specific embodiment, P is Gly-Gly-Gly, Ala-Val, Ala-Ala, Ala-D-Ala, D-Ala-Ala, or D-Ala-D-Ala.

**[0213]** In a 6<sup>th</sup> specific embodiment, for immunoconjugates of formula (C1), Q is -SO<sub>3</sub>H or a pharmaceutically acceptable salt thereof; and the remaining variables are as describe above in the 1<sup>st</sup>, 2<sup>nd</sup>, 4<sup>th</sup> or 5<sup>th</sup> specific embodiment of the second embodiment or any more specific embodiments described therein.

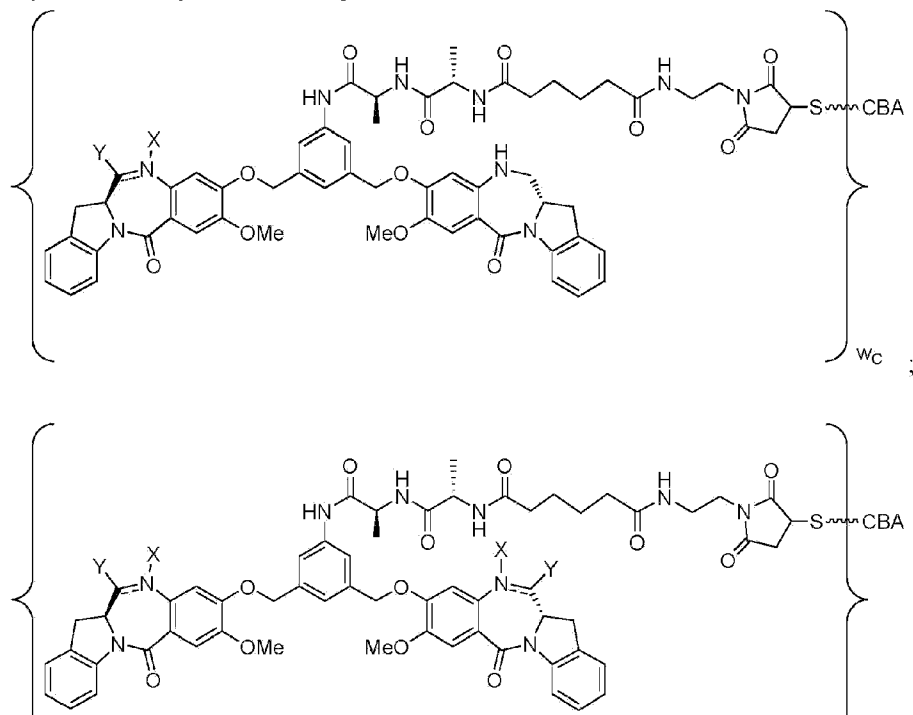
**[0214]** In a 7<sup>th</sup> specific embodiment, for immunoconjugates of formula (C1), R<sub>19</sub> and R<sub>20</sub> are both H; and m" is an integer from 1 to 6; and the remaining variables are as described above in the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup> or 6<sup>th</sup> specific embodiment of the second embodiment or any more specific embodiments described therein.

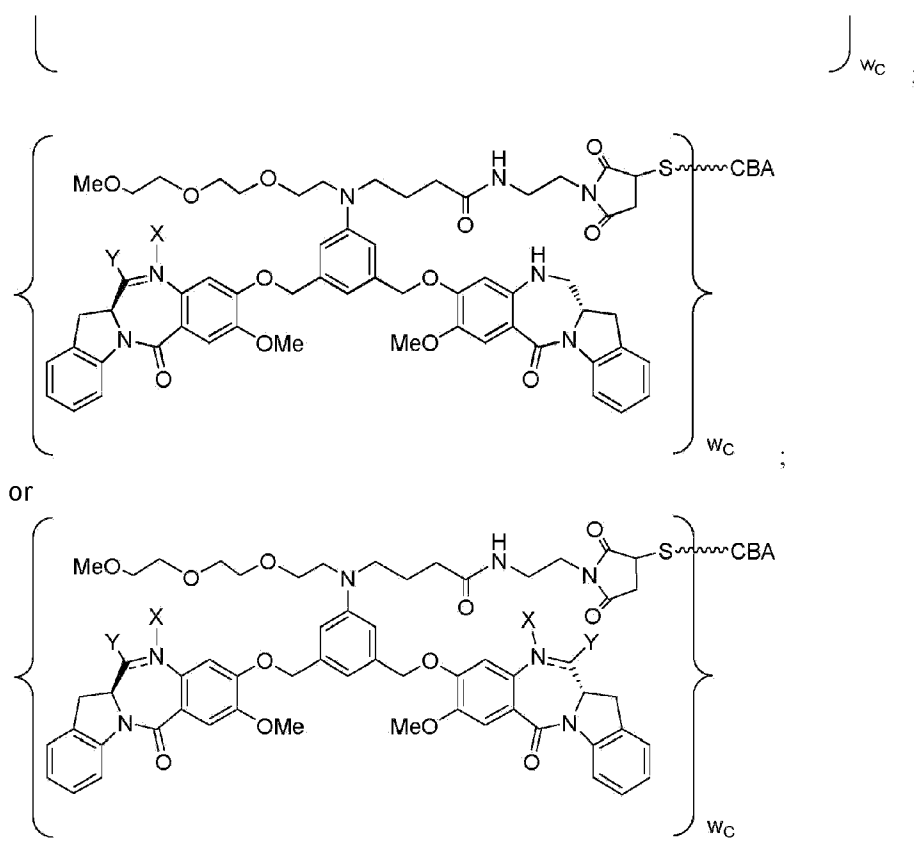
**[0215]** In a 8<sup>th</sup> specific embodiment, for immunoconjugates of formula (C1), -L-Lc- is represented by the following formula:



and the remaining variables are as described above in the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup>, 6<sup>th</sup> or 7<sup>th</sup> specific embodiment of the second embodiment or any more specific embodiments described therein.

**[0216]** In a 9<sup>th</sup> specific embodiment, the immunoconjugate of the second embodiment is represented by the following formula:





or a pharmaceutically acceptable salt thereof, wherein the double line

$$\frac{1}{2}$$

between N and C represents a single bond or a double bond, provided that when it is a double bond, X is absent and Y is -H, and when it is a single bond, X is -H, and Y is -OH or -SO<sub>3</sub>H or a pharmaceutically acceptable salt thereof. In a more specific embodiment, the double line

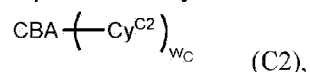
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between N and C represents a double bond, X is absent and Y is -H. In another more specific embodiment, the double line

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between N and C represents a single bond, X is -H and Y is -SO<sub>3</sub>H or a pharmaceutically acceptable salt thereof.

**[0217]** In a 10<sup>th</sup> specific embodiment, the immunoconjugate of the second embodiment is represented by the following formula:



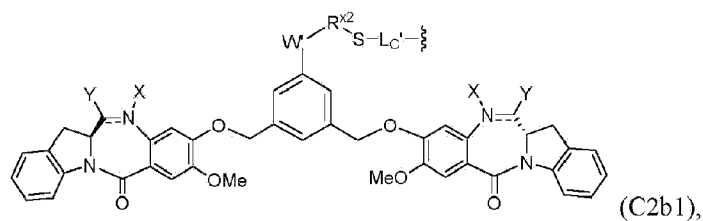
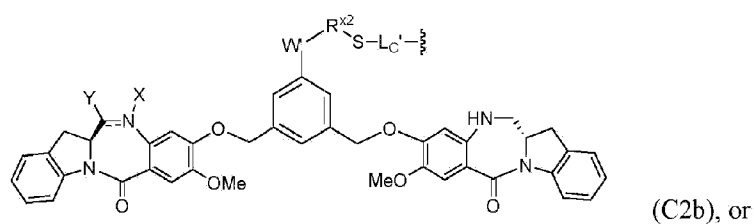
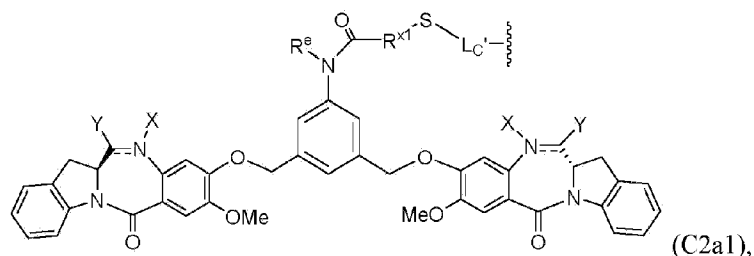
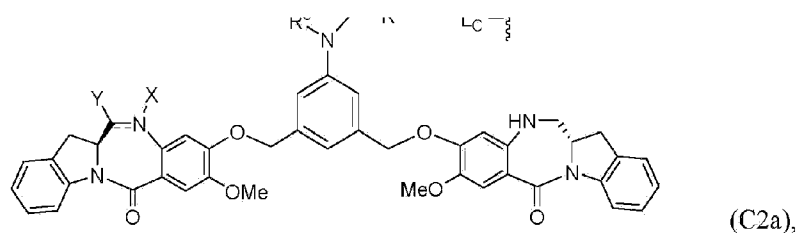
wherein:

CBA is a an anti-ADAM9 antibody or an ADAM9-binding fragment thereof described herein above covalently linked to Cy<sup>C2</sup> through a cysteine residue;

$W_C$  is 1 or 2;

Cy<sup>C2</sup> is represented by the following formula:





or a pharmaceutically acceptable salt thereof, wherein:

the double line

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between N and C represents a single bond or a double bond, provided that when it is a double bond, X is absent and Y is -H or a (C<sub>1</sub>-C<sub>4</sub>)alkyl; and when it is a single bond, X is -H or an amine protecting moiety, Y is -OH or -SO<sub>3</sub>H or a pharmaceutically acceptable salt thereof;

R<sup>x1</sup> is a (C<sub>1</sub>-C<sub>6</sub>)alkyl;

R<sup>e</sup> is -H or a (C<sub>1</sub>-C<sub>6</sub>)alkyl;

W is -NR<sup>e'</sup>;

R<sup>e'</sup> is -(CH<sub>2</sub>-CH<sub>2</sub>-O)<sub>n</sub>-R<sup>k</sup>;

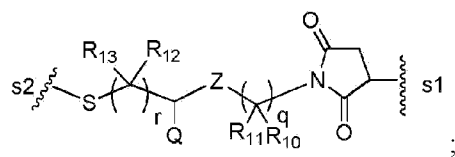
n is an integer from 2 to 6;

R<sup>k</sup> is -H or -Me;

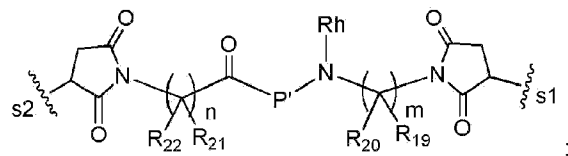
R<sup>x2</sup> is a (C<sub>1</sub>-C<sub>6</sub>)alkyl;



$L_C'$  is represented by the following formula:



or



wherein:

$s_1$  is the site covalently linked to the CBA and  $s_2$  is the site covalently linked to -S-group on  $Cy^{C2}$ ;

Z is  $-C(=O)-NR_9-$ , or  $-NR_9-C(=O)-$ ;

Q is -H, a charged substituent, or an ionizable group;

$R_9$ ,  $R_{10}$ ,  $R_{11}$ ,  $R_{12}$ ,  $R_{13}$ ,  $R_{19}$ ,  $R_{20}$ ,  $R_{21}$  and  $R_{22}$ , for each occurrence, are independently -H or a  $(C_1-C_3)$ alkyl;

q and r, for each occurrence, are independently an integer between 0 and 10;

m and n are each independently an integer between 0 and 10;

$R^h$  is -H or a  $(C_1-C_3)$ alkyl; and

P' is an amino acid residue or a peptide containing 2 to 20 amino acid residues.

**[0218]** In a more specific embodiment, q and r are each independently an integer between 1 to 6, more specifically, an integer between 1 to 3. Even more specifically,  $R_{10}$ ,  $R_{11}$ ,  $R_{12}$  and  $R_{13}$  are all H.

**[0219]** In another more specific embodiment, m and n are each independently an integer between 1 and 6, more specifically, an integer between 1 to 3. Even more specifically,  $R_{19}$ ,  $R_{20}$ ,  $R_{21}$  and  $R_{22}$  are all H.

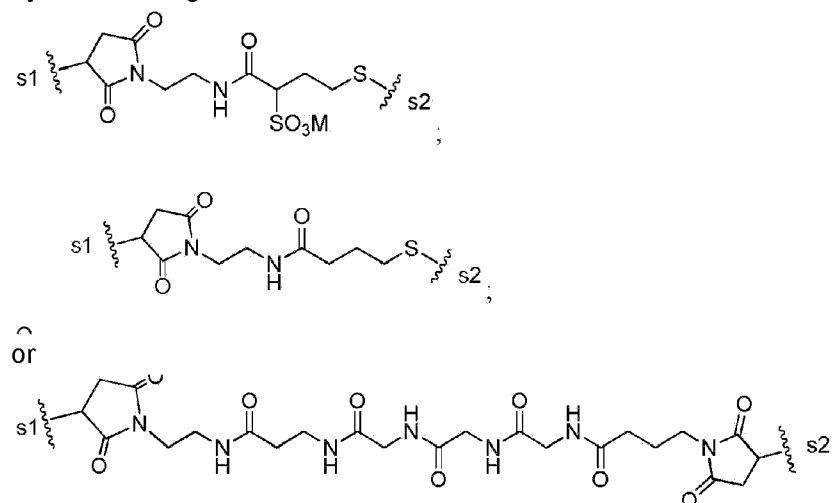
**[0220]** In a 11<sup>th</sup> specific embodiment, for immunoconjugates of formula (C2),  $Cy^{C2}$  is represented by formula (C2a) or (C2a1); and the remaining variables are as described above in the 10<sup>th</sup> specific embodiment of the second embodiment or any more specific embodiments described therein.

**[0221]** In a 12<sup>th</sup> specific embodiment, for immunoconjugates of formula (C2),  $Cy^{C2}$  is represented

by formula (C2b) or (C2b1); and the remaining variables are as described above in the 10<sup>th</sup> specific embodiment of the second embodiment.

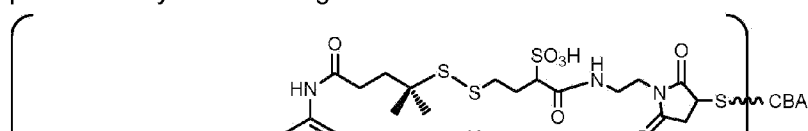
**[0222]** In a 13<sup>th</sup> specific embodiment, for immunoconjugates of formula (C2), P' is a peptide containing 2 to 5 amino acid residues; and the remaining variables are as described in the 10<sup>th</sup>, 11<sup>th</sup> or 12<sup>th</sup> specific embodiment of the second embodiment or any more specific embodiments described therein. In a more specific embodiment, P' is selected from Gly-Gly-Gly, Ala-Val, Val-Ala, Val-Cit, Val-Lys, Phe-Lys, Lys-Lys, Ala-Lys, Phe-Cit, Leu-Cit, Ile-Cit, Trp, Cit, Phe-Ala, Phe-N<sup>9</sup>-tosyl-Arg, Phe-N<sup>9</sup>-nitro-Arg, Phe-Phe-Lys, D-Phe-Phe-Lys, Gly-Phe-Lys, Leu-Ala-Leu, Ile-Ala-Leu, Val-Ala-Val, Ala-Leu-Ala-Leu (SEQ ID NO:144),  $\beta$ -Ala-Leu-Ala-Leu (SEQ ID NO: 145), Gly-Phe-Leu-Gly (SEQ ID NO: 146), Val-Arg, Arg-Val, Arg-Arg, Val-D-Cit, Val-D-Lys, Val-D-Arg, D-Val-Cit, D-Val-Lys, D-Val-Arg, D-Val-D-Cit, D-Val-D-Lys, D-Val-D-Arg, D-Arg-D-Arg, Ala-Ala, Ala-D-Ala, D-Ala-Ala, D-Ala-D-Ala, Ala-Met, Met-Ala, Gln-Val, Asn-Ala, Gln-Phe and Gln-Ala. In another more specific embodiment, P' is Gly-Gly-Gly, Ala-Val, Ala-Ala, Ala-D-Ala, D-Ala-Ala, or D-Ala-D-Ala.

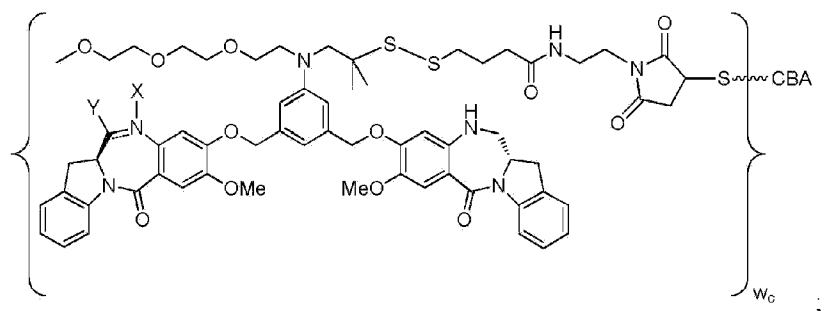
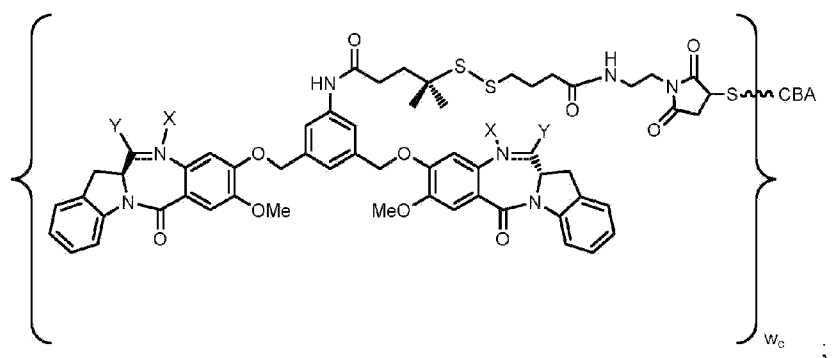
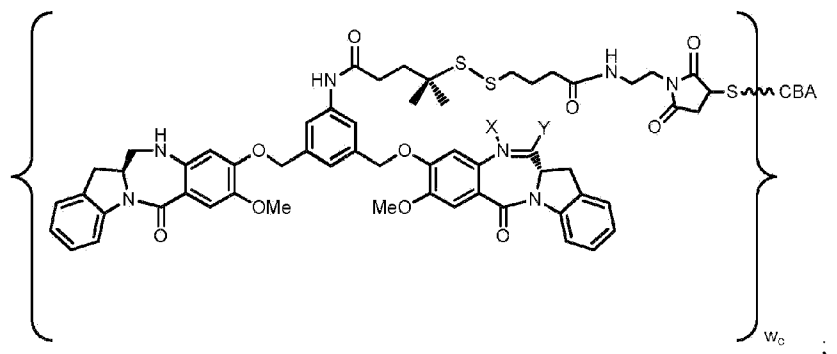
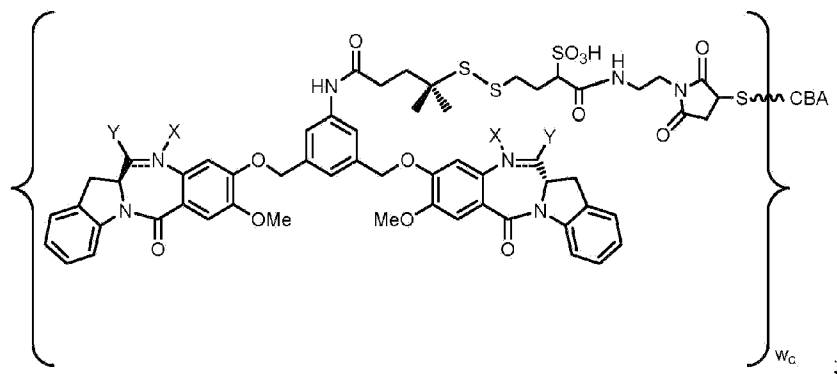
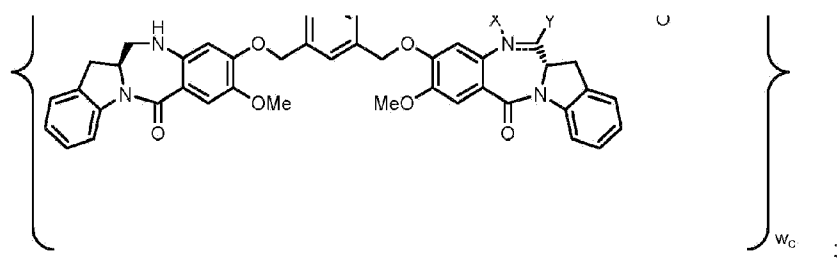
**[0223]** In a 14<sup>th</sup> specific embodiment, for immunoconjugates of formula (C2), -Lc'- is represented by the following formula:

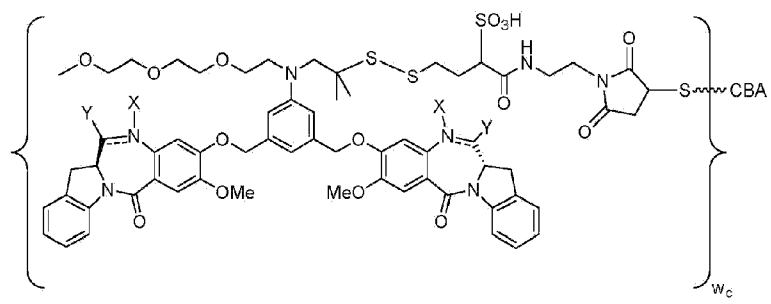
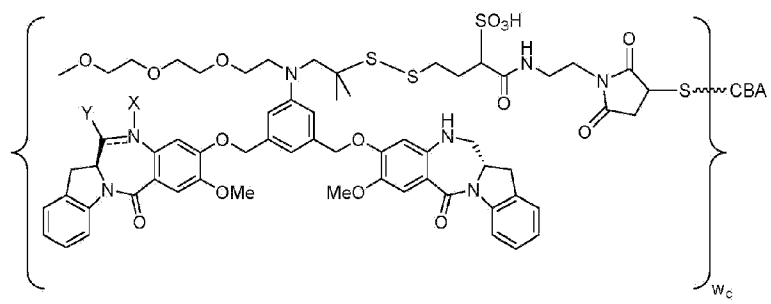
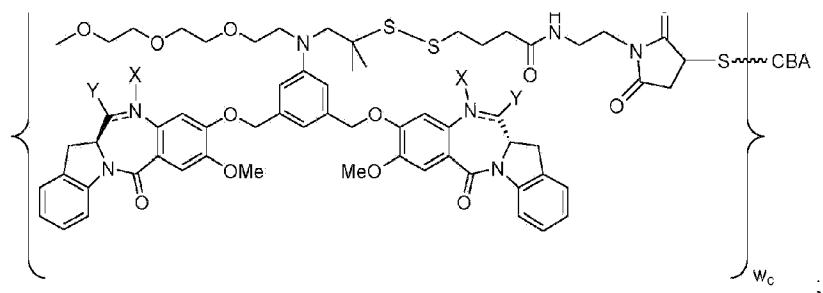


**[0224]** In a 15<sup>th</sup> specific embodiment, for immunoconjugates of (C2), R<sup>e</sup> is H or Me; R<sup>x1</sup> is -(CH2)<sub>p</sub>-(CR<sup>f</sup>R<sup>g</sup>)-, and R<sup>x2</sup> is -(CH2)<sub>p</sub>-(CR<sup>f</sup>R<sup>g</sup>)-, wherein R<sup>f</sup> and R<sup>g</sup> are each independently -H or a (C<sub>1</sub>-C<sub>4</sub>)alkyl; and p is 0, 1, 2 or 3; and the remaining variables are as described above in the 10<sup>th</sup>, 11<sup>th</sup>, 12<sup>th</sup>, 13<sup>th</sup>, or 14<sup>th</sup> specific embodiment of the second embodiment. More specifically, R<sup>f</sup> and R<sup>g</sup> are the same or different, and are selected from - H and -Me.

**[0225]** In a 16<sup>th</sup> specific embodiment, the immunoconjugate of the second embodiment is represented by the following formula:







or a pharmaceutically acceptable salt thereof, wherein the double line

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between N and C represents a single bond or a double bond, provided that when it is a double bond, X is absent and Y is -H, and when it is a single bond, X is -H, and Y is -OH or -SO<sub>3</sub>H or a pharmaceutically acceptable salt thereof. In a more specific embodiment, the double line

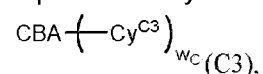
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between N and C represents a double bond, X is absent and Y is -H. In another specific embodiment, the double line

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between N and C represents a single bond, X is -H and Y is -SO<sub>3</sub>H or a pharmaceutically acceptable salt thereof.

**[0226]** In a 17<sup>th</sup> specific embodiment, the immunoconjugate of the second embodiment is represented by the following formula:

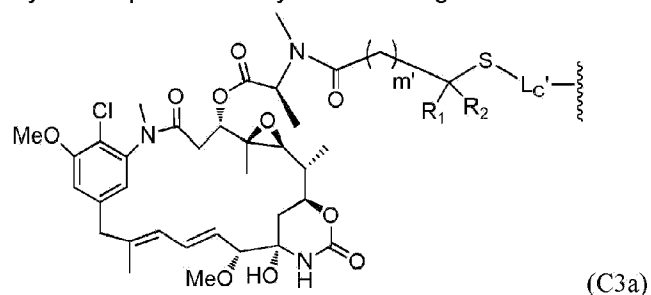


wherein:

CBA is an anti-ADAM9 antibody or an ADAM9-binding fragment thereof described herein above covalently linked to Cy<sup>C3</sup> through a cysteine residue;

W<sub>C</sub> is 1 or 2;

Cy<sup>C3</sup> is represented by the following formula:

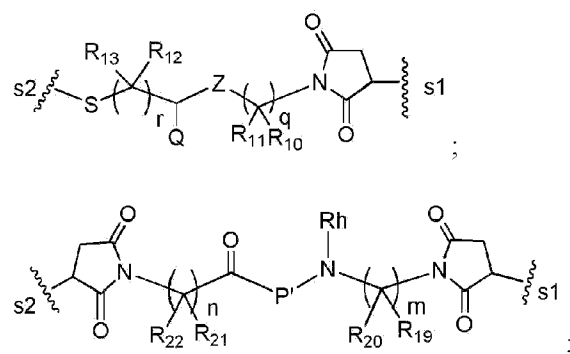


wherein:

m' is 1 or 2;

R<sub>1</sub> and R<sub>2</sub>, are each independently -H or a (C<sub>1</sub>-C<sub>3</sub>)alkyl;

L<sub>C'</sub> is represented by the following formula:



wherein:

s1 is the site covalently linked to the CBA and s2 is the site covalently linked to -S-group on Cy<sup>C3</sup>;

Z is -C(=O)-NR<sub>9</sub>-, or -NR<sub>9</sub>-C(=O)-;

Q is H, a charged substituent, or an ionizable group;

R<sub>9</sub>, R<sub>10</sub>, R<sub>11</sub>, R<sub>12</sub>, R<sub>13</sub>, R<sub>19</sub>, R<sub>20</sub>, R<sub>21</sub> and R<sub>22</sub>, for each occurrence, are independently -H or a (C<sub>1</sub>-C<sub>3</sub>)alkyl;

q and r, for each occurrence, are independently an integer between 0 and 10;

m and n are each independently an integer between 0 and 10;

R<sup>h</sup> is -H or a (C<sub>1</sub>-C<sub>3</sub>)alkyl; and

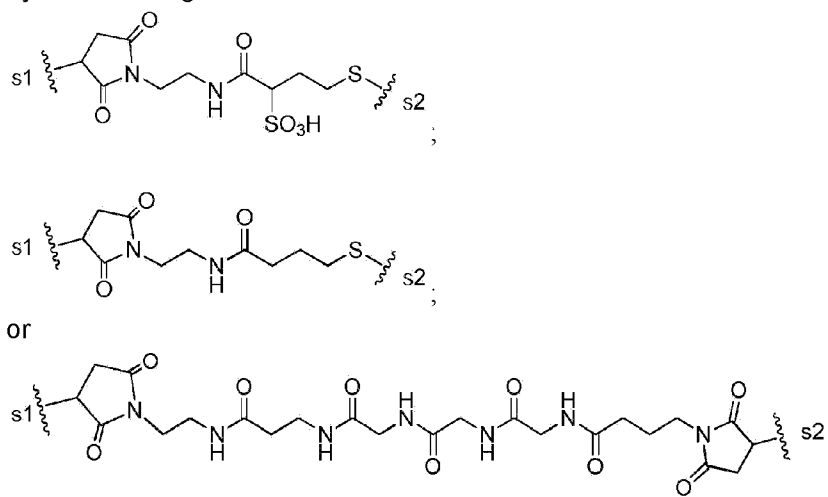
P' is an amino acid residue or a peptide containing 2 to 20 amino acid residues.

**[0227]** In a more specific embodiment, q and r are each independently an integer between 1 to 6, more specifically, an integer from 1 to 3. Even more specifically, R<sub>10</sub>, R<sub>11</sub>, R<sub>12</sub> and R<sub>13</sub> are all H.

**[0228]** In another more specific embodiment,  $m$  and  $n$  are each independently an integer between 1 and 6, more specifically, an integer from 1 to 3. Even more specifically,  $R_{19}$ ,  $R_{20}$ ,  $R_{21}$  and  $R_{22}$  are all H.

**[0229]** In a 18<sup>th</sup> specific embodiment, for immunoconjugates of formula (C3),  $P'$  is a peptide containing 2 to 5 amino acid residues; and the remaining variables are as described above in the 17<sup>th</sup> specific embodiment of the second embodiment or any more specific embodiments described therein. In a more specific embodiment,  $P'$  is selected from Gly-Gly-Gly, Ala-Val, Val-Ala, Val-Cit, Val-Lys, Phe-Lys, Lys-Lys, Ala-Lys, Phe-Cit, Leu-Cit, Ile-Cit, Trp, Cit, Phe-Ala, Phe-N<sup>9</sup>-tosyl-Arg, Phe-N<sup>9</sup>-nitro-Arg, Phe-Phe-Lys, D-Phe-Phe-Lys, Gly-Phe-Lys, Leu-Ala-Leu, Ile-Ala-Leu, Val-Ala-Val, Ala-Leu-Ala-Leu (SEQ ID NO:144),  $\beta$ -Ala-Leu-Ala-Leu (SEQ ID NO: 145), Gly-Phe-Leu-Gly (SEQ ID NO: 146), Val-Arg, Arg-Val, Arg-Arg, Val-D-Cit, Val-D-Lys, Val-D-Arg, D-Val-Cit, D-Val-Lys, D-Val-Arg, D-Val-D-Cit, D-Val-D-Lys, D-Val-D-Arg, D-Arg-D-Arg, Ala-Ala, Ala-D-Ala, D-Ala-Ala, D-Ala-D-Ala, Ala-Met, Met-Ala, Gln-Val, Asn-Ala, Gln-Phe and Gln-Ala. In another more specific embodiment,  $P'$  is Gly-Gly-Gly, Ala-Val, Ala-Ala, Ala-D-Ala, D-Ala-Ala, or D-Ala-D-Ala.

**[0230]** In a 19<sup>th</sup> specific embodiment, for immunoconjugates of formula (C3), -Lc'- is represented by the following formula:



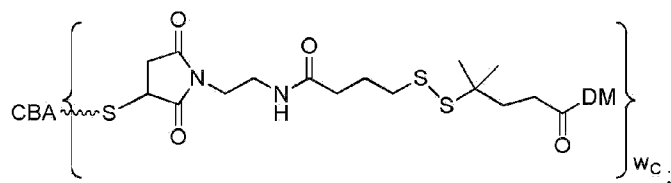
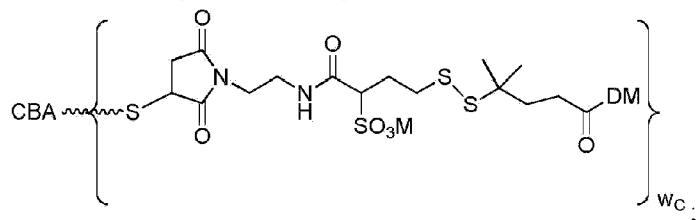
wherein  $M$  is  $H^+$  or a cation; and the remaining variables are as described above in the 17<sup>th</sup> or 18<sup>th</sup> specific embodiment of the second embodiment or any more specific embodiments described therein.

**[0231]** In a 20<sup>th</sup> specific embodiment, for immunoconjugates of formula (C3),  $m'$  is 1 and  $R_1$  and  $R_2$  are both H; and the remaining variables are as described above in the 17<sup>th</sup>, 18<sup>th</sup> or 19<sup>th</sup> specific embodiment of the second embodiment or any more specific embodiments described therein.

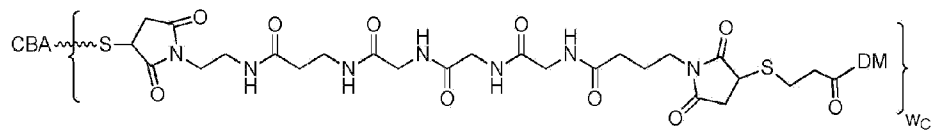
**[0232]** In a 21<sup>st</sup> specific embodiment, for immunoconjugates of formula (C3),  $m'$  is 2 and  $R_1$  and  $R_2$  are both Me; and the remaining variables are as described above in the 17<sup>th</sup>, 18<sup>th</sup> or 19<sup>th</sup>

specific embodiment of the second embodiment or any more specific embodiments described therein.

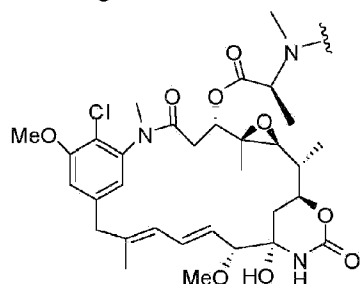
**[0233]** In a 22<sup>nd</sup> specific embodiment, the immunoconjugate of the second embodiment is represented by the following formula:



or



or a pharmaceutically acceptable salt thereof, wherein DM is a drug moiety represented by the following formula:



**[0234]** In a 23<sup>rd</sup> specific embodiment, for the immunoconjugates of the second embodiment, Y is -SO<sub>3</sub>H, -SO<sub>3</sub>Na or -SO<sub>3</sub>K; and the remaining variables are as described in any one of the 1<sup>st</sup> to 22<sup>nd</sup> specific embodiments of the second embodiment or any more specific embodiments described therein. In one embodiment, Y is -SO<sub>3</sub>Na.

### C. Exemplary Linker Molecules

**[0235]** Any suitable linkers known in the art can be used in preparing the immunoconjugates of the present invention. In certain embodiments, the linkers are bifunctional linkers. As used herein, the term "**bifunctional linker**" refers to modifying agents that possess two reactive groups; one of which is capable of reacting with a cell binding agent while the other one reacts with the cytotoxic compound to link the two moieties together. Such bifunctional crosslinkers are well

known in the art (see, for example, Isalm and Dent in Bioconjugation chapter 5, p218-363, Groves Dictionaries Inc. New York, 1999). For example, bifunctional crosslinking agents that enable linkage via a thioether bond include *N*-succinimidyl-4-(*N*-maleimidomethyl)-cyclohexane-1-carboxylate (SMCC) to introduce maleimido groups, or with *N*-succinimidyl-4-(iodoacetyl)-aminobenzoate (SIAB) to introduce iodoacetyl groups. Other bifunctional crosslinking agents that introduce maleimido groups or haloacetyl groups on to a cell binding agent are well known in the art (see US Patent Publication Nos. 2008/0050310, 20050169933, available from Pierce Biotechnology Inc. P.O. Box 117, Rockland, IL 61105, USA) and include bis-maleimidopolyethyleneglycol (BMPEO), BM(PEO)<sub>2</sub>, BM(PEO)<sub>3</sub>, N-(β-maleimidopropoxy)succinimide ester (BMPS), γ-maleimidobutyric acid *N*-succinimidyl ester (GMBS), ε-maleimidocaproic acid *N*-hydroxysuccinimide ester (EMCS), 5-maleimidovaleric acid NHS, HBVS, *N*-succinimidyl-4-(*N*-maleimidomethyl)-cyclohexane-1-carboxy-(6-amidocaproate), which is a "long chain" analog of SMCC (LC-SMCC), *m*-maleimidobenzoyl-*N*-hydroxysuccinimide ester (MBS), 4-(4-*N*-maleimidophenyl)-butyric acid hydrazide or HCl salt (MPBH), *N*-succinimidyl 3-(bromoacetamido)propionate (SBAP), *N*-succinimidyl iodoacetate (SIA), *k*-maleimidoundecanoic acid *N*-succinimidyl ester (KMUA), *N*-succinimidyl 4-(*p*-maleimidophenyl)-butyrate (SMPB), succinimidyl-6-(β-maleimidopropionamido)hexanoate (SMPH), succinimidyl-(4-vinylsulfonyl)benzoate (SVSB), dithiobis-maleimidoethane (DTME), 1,4-bis-maleimidobutane (BMB), 1,4-bismaleimidyl-2,3-dihydroxybutane (BMDB), bis-maleimidoethane (BMH), bis-maleimidoethane (BMOE), sulfosuccinimidyl 4-(*N*-maleimido-methyl)cyclohexane-1-carboxylate (sulfo-SMCC), sulfosuccinimidyl(4-iodo-acetyl)aminobenzoate (sulfo-SIAB), *m*-maleimidobenzoyl-*N*-hydroxysulfosuccinimide ester (sulfo-MBS), *N*-(γ-maleimidobutryloxy)sulfosuccinimide ester (sulfo-GMBS), *N*-(ε-maleimidocaproyloxy)sulfosuccinimide ester (sulfo-EMCS), *N*-(*k*-maleimidoundecanoyloxy)sulfosuccinimide ester (sulfo-KMUS), and sulfosuccinimidyl 4-(*p*-maleimidophenyl)butyrate (sulfo-SMPB).

**[0236]** Heterobifunctional crosslinking agents are bifunctional crosslinking agents having two different reactive groups. Heterobifunctional crosslinking agents containing both an amine-reactive *N*-hydroxysuccinimide group (NHS group) and a carbonyl-reactive hydrazine group can also be used to link the cytotoxic compounds described herein with a cell-binding agent (*e.g.*, antibody). Examples of such commercially available heterobifunctional crosslinking agents include succinimidyl 6-hydrazinonicotinamide acetone hydrazone (SANH), succinimidyl 4-hydrazidoterephthalate hydrochloride (SHTH) and succinimidyl hydrazinium nicotinate hydrochloride (SHNH). Conjugates bearing an acid-labile linkage can also be prepared using a hydrazine-bearing benzodiazepine derivative of the present invention. Examples of bifunctional crosslinking agents that can be used include succinimidyl-*p*-formyl benzoate (SFB) and succinimidyl-*p*-formylphenoxyacetate (SFPA).

**[0237]** Bifunctional crosslinking agents that enable the linkage of cell binding agent with cytotoxic compounds via disulfide bonds are known in the art and include *N*-succinimidyl-3-(2-pyridyldithio)propionate (SPDP), *N*-succinimidyl-4-(2-pyridyldithio)pentanoate (SPP), *N*-succinimidyl-4-(2-pyridyldithio)butanoate (SPDB), *N*-succinimidyl-4-(2-pyridyldithio)2-sulfo butanoate (sulfo-SPDB) to introduce dithiopyridyl groups. Other bifunctional crosslinking agents that can be used to introduce disulfide groups are known in the art and are disclosed in U.S. Patents 6,913,748, 6,716,821 and US Patent Publications 20090274713 and 20100129314.



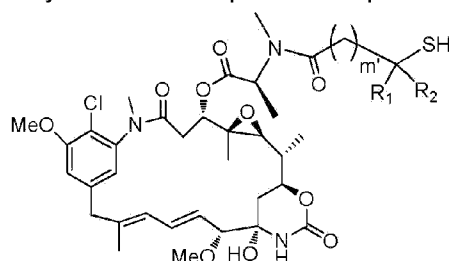
Alternatively, crosslinking agents such as 2-iminothiolane, homocysteine thiolactone or S-acetylsuccinic anhydride that introduce thiol groups can also be used.

**[0238]** In certain embodiments, the bifunctional linkers are represented by any one of the formula (a1L) - (a10L) described below.

## D. Exemplary Pharmacological Agents

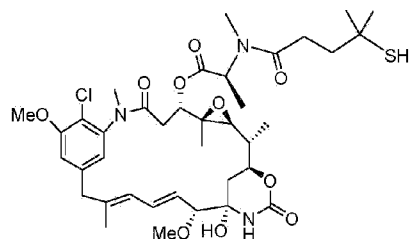
### 1. Maytansinoid

**[0239]** In certain embodiments, the pharmacological agent is a maytansinoid compound, such as those described in US Patent Nos. 5,208,020 and 7,276,497. In certain embodiments, the maytansinoid compound is represented by the following formula:

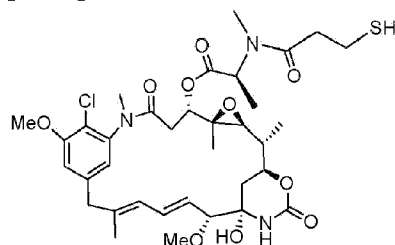


wherein the variables are as described above in any one of the 13<sup>th</sup> to 17<sup>th</sup> specific embodiments of the first embodiment above and any more specific embodiments described therein.

**[0240]** In a more specific embodiment, the maytansinoid compound is DM4:



**[0241]** In another embodiment, the maytansinoid compound is DM1:

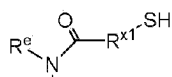
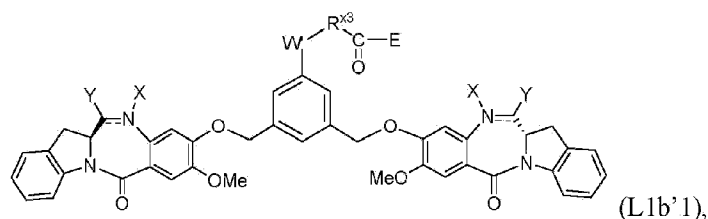
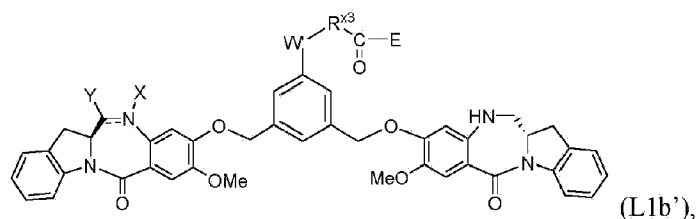
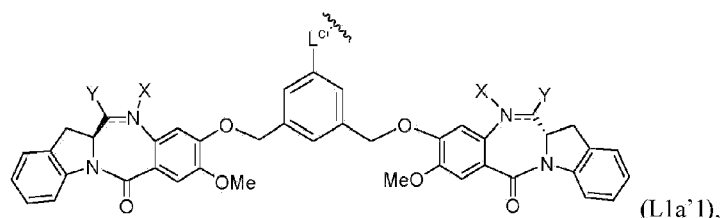
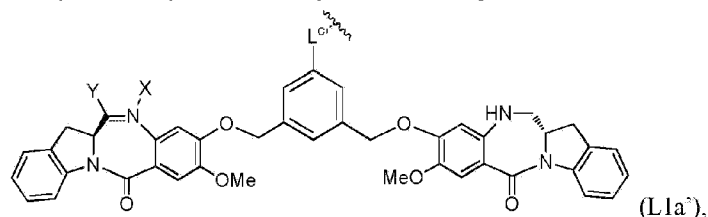


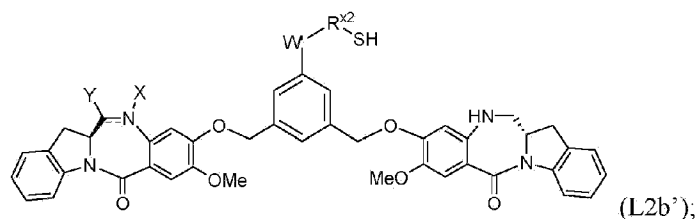
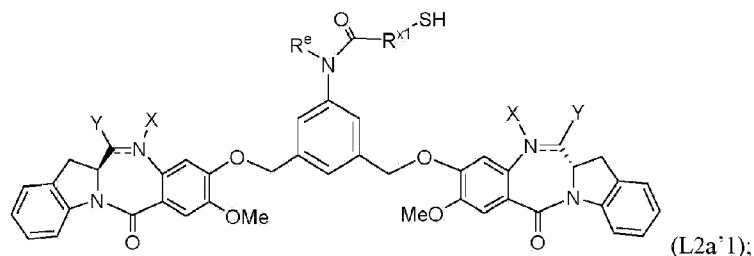
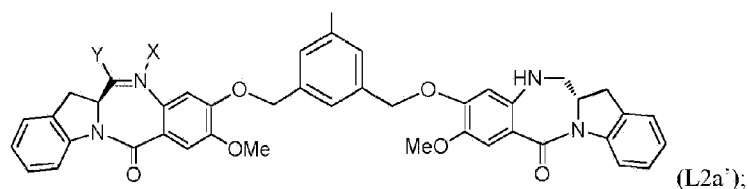
### 2. Benzodiazepine

**[0242]** In certain embodiments, the pharmacological agent is a benzodiazepine compound, such as pyrrolobenzodiazepine (PBD) (such as those described in WO2010/043880, WO2011/130616, WO2009/016516, WO 2013/177481 and WO 2012/112708) and indolinobenzodiazepine (IGN) compounds (such as those described in WO/2010/091150, and WO 2012/128868 and U.S. Application No. 15/195,269, filed on June 28, 2016, entitled "CONJUGATES OF CYSTEINE ENGINEERED ANTIBODIES". As used herein, a "benzodiazepine" compound is a compound having a benzodiazepine core structure. The benzodiazepine core can be substituted or unsubstituted, and/or fused with one or more ring structures. It also includes a compound having two benzodiazepine core linked by a linker. The imine functionality (-C=N-) as part of benzodiazepine core can be reduced.

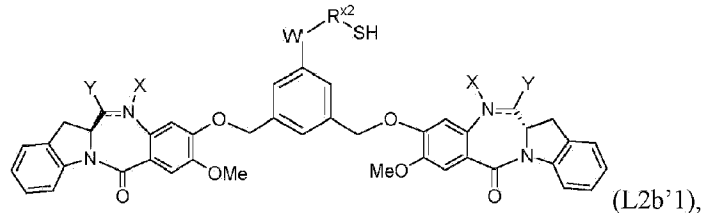
**[0243]** As used herein, a "pyrrolobenzodiazepine" (PBD) compound is a compound having a pyrrolobenzodiazepine core structure. The pyrrolobenzodiazepine can be substituted or unsubstituted. It also includes a compound having two pyrrolobenzodiazepine core linked by a linker. The imine functionality (-C=N-) as part of indolinobenzodiazepine core can be reduced.

**[0244]** In certain embodiments, the pharmacological agent is an indolinobenzodiazepine compound represented by the following formula:





or



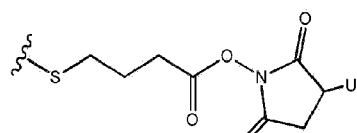
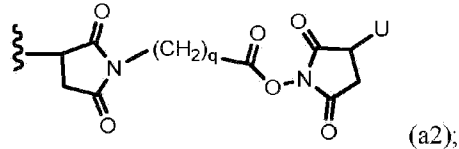
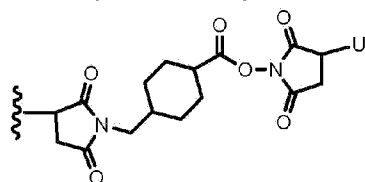
or a pharmaceutically acceptable salt thereof, wherein:

L<sup>c</sup> is represented by the following formula:

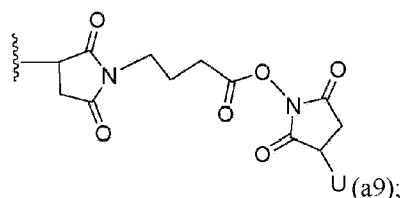
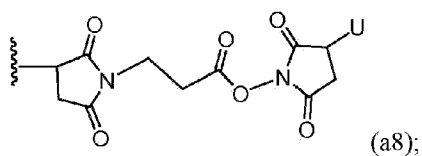
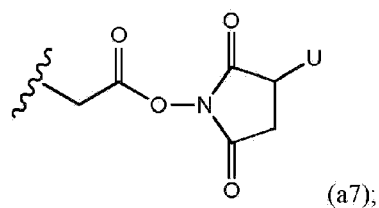
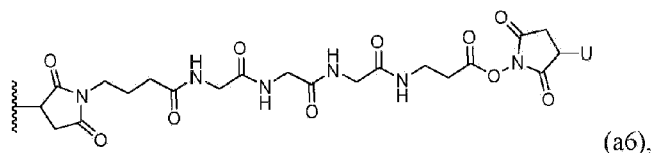
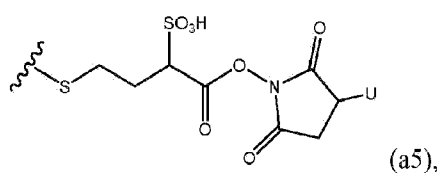
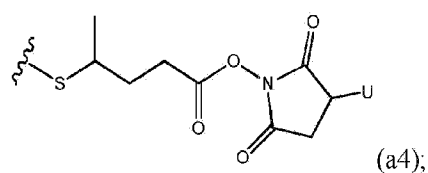
- NR<sub>5</sub>-P-C(=O)-(CR<sub>a</sub>R<sub>b</sub>)<sub>m</sub>-C(=O)E (B1); or
- NR<sub>5</sub>-P-C(=O)-(CR<sub>a</sub>R<sub>b</sub>)<sub>m</sub>-S-Z<sup>s</sup> (B2)

C(=O)E is a reactive ester group, such as N-hydroxysuccinimide ester, N-hydroxy sulfosuccinimide ester, nitrophenyl (e.g., 2 or 4-nitrophenyl) ester, dinitrophenyl (e.g., 2,4-dinitrophenyl) ester, sulfo-tetrafluorophenyl (e.g., 4-sulfo-2,3,5,6-tetrafluorophenyl) ester, or pentafluorophenyl ester, preferably N-hydroxysuccinimide ester;

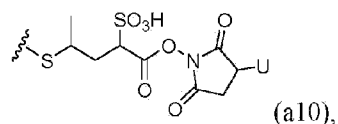
Z<sup>s</sup> is represented by the following formula:



 (a3);



and

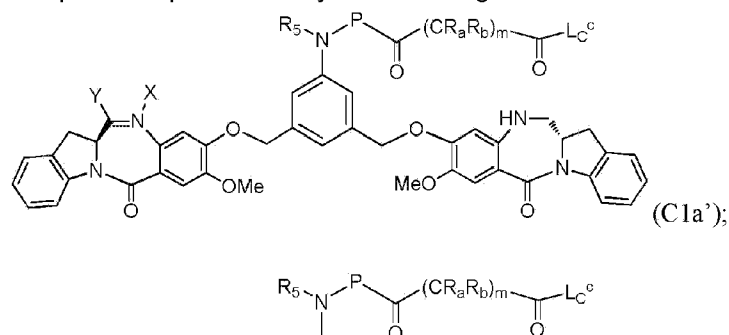


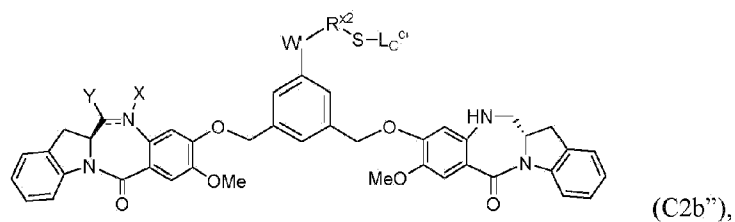
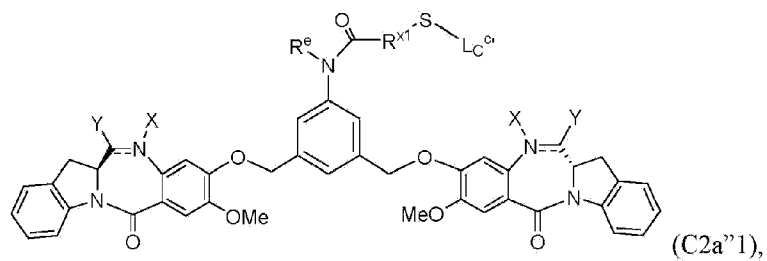
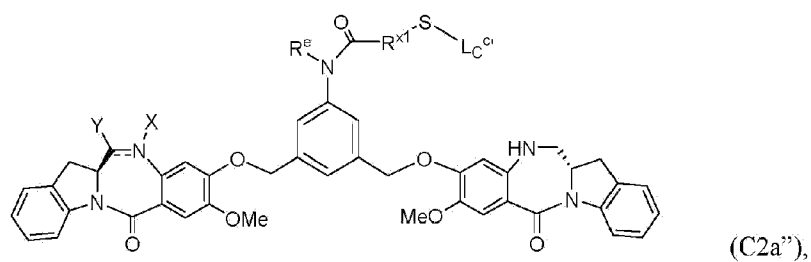
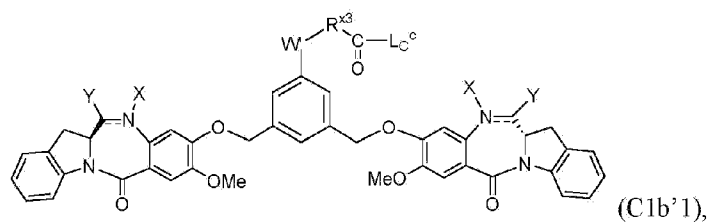
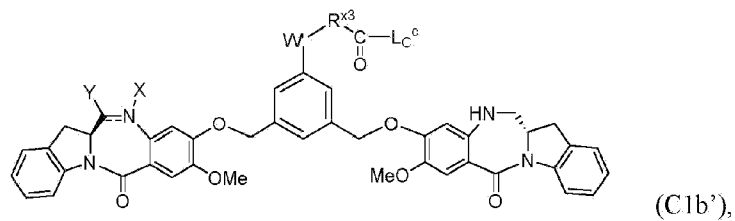
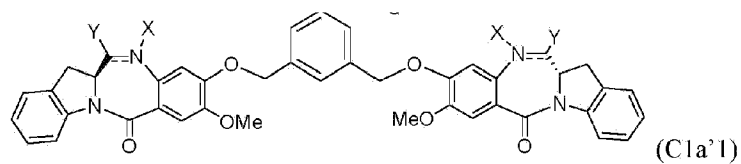
wherein:

q is an integer from 1 to 5; and

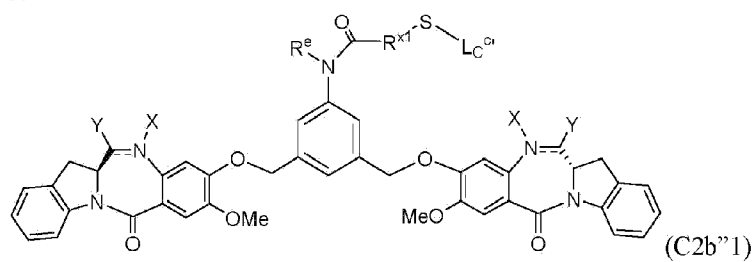
U is -H or SO<sub>3</sub>H or a pharmaceutically acceptable salt thereof; and the remaining variables are as described in any one of the 1<sup>st</sup> to 12<sup>th</sup> and 17<sup>th</sup> specific embodiments of the first embodiment described above or any more specific embodiments described therein.

**[0245]** In certain embodiments, the pharmacological agent is an indolinobenzodiazepine compound represented by the following formula:



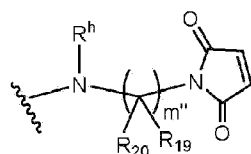


or



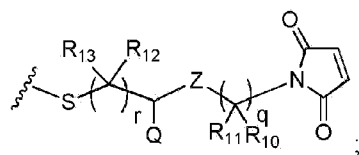
or a pharmaceutically acceptable salt thereof, wherein:

—L<sub>C</sub><sup>c</sup> for formulas (C1a'), (C1a'1), (C1b') and (C1b'1) is represented by the following formula:

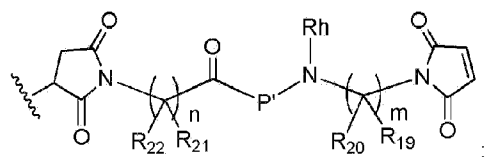


wherein the variables are as described above in any one of the 1<sup>st</sup> to 9<sup>th</sup> and 23<sup>rd</sup> specific embodiments of the second embodiment or any more specific embodiments described therein; and

L<sub>C</sub><sup>c'</sup> for formulas (C2a''), (C2a''1), (C2b'') and (C2b''1) is represented by the following formula:



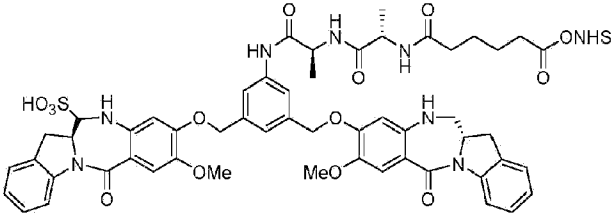
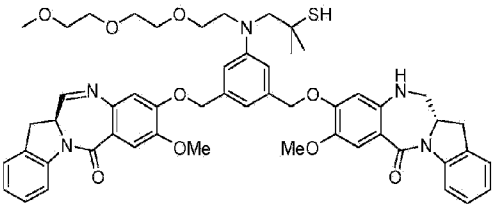
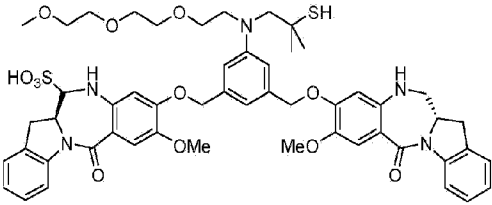
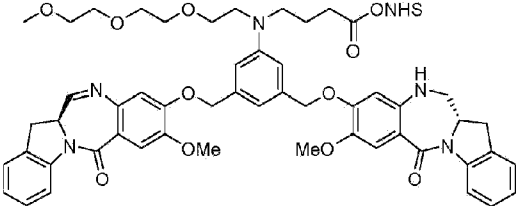
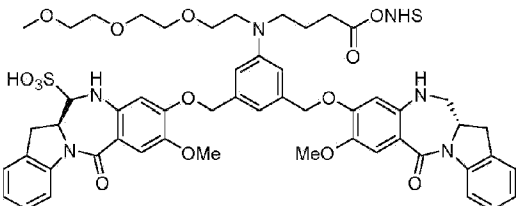
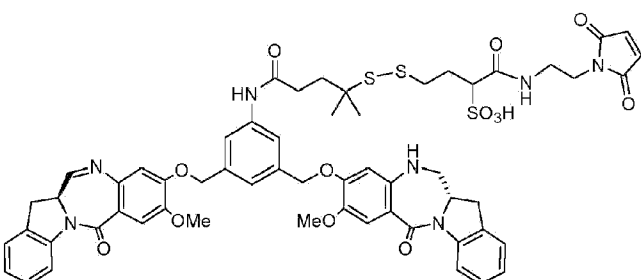
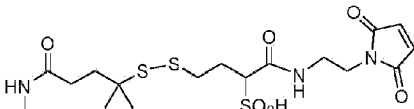
or

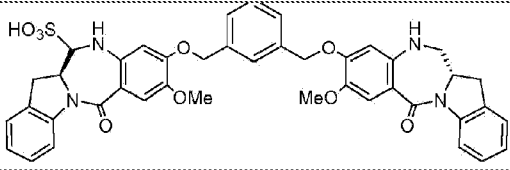
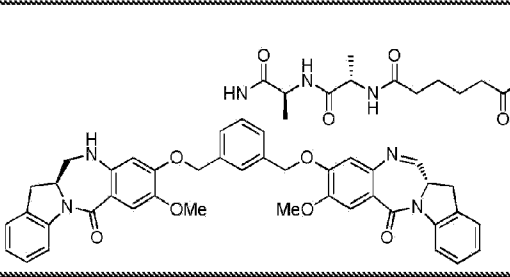
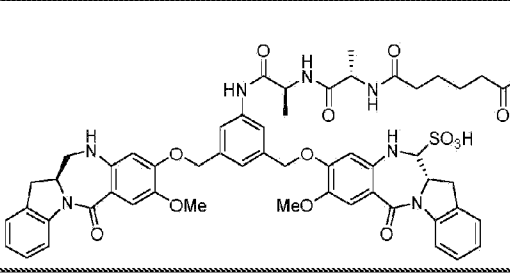
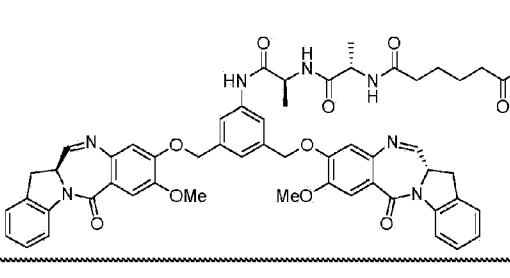
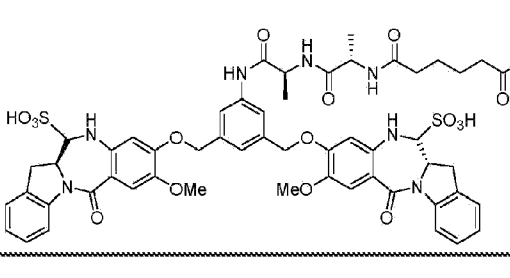
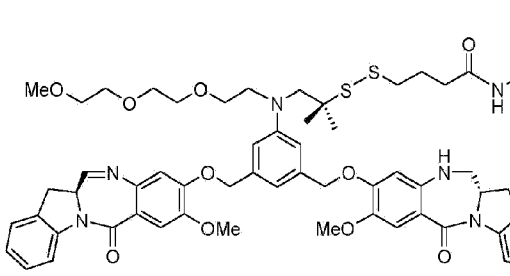
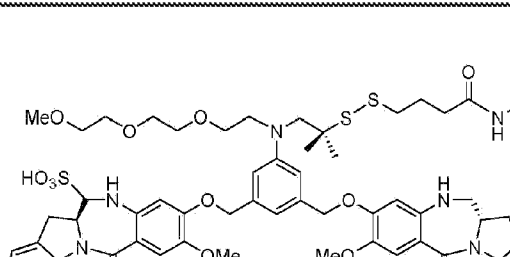


wherein the variables are as described above in any one of the 10<sup>th</sup> to 16<sup>th</sup> and 23<sup>rd</sup> specific embodiment of the second embodiment or any more specific embodiments described therein.

**[0246]** In certain embodiments, the pharmacological agent is an indolinobenzodiazepine compound of any one of the following or a pharmaceutically acceptable salt thereof:

Compound No.	Structure
D1	
sD1	
D2	

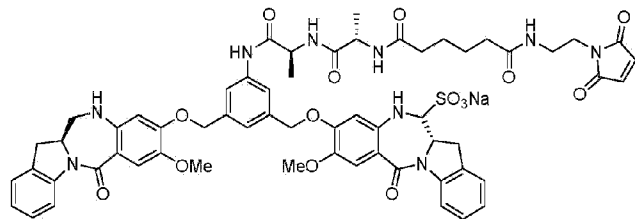
Compound No.	Structure
sD2	
DGN462	
sDGN462	
D3	
sD3	
D4	
sD4	

Compound No.	Structure
	
D5	
sD5	
D5'	
sD5'	
D6	
sD6	





formula:



#### IV. Methods of Production

**[0251]** The anti-ADAM9 antibodies and ADAM9-binding fragments thereof of the present invention are most preferably produced through the recombinant expression of nucleic acid molecules that encode such polypeptides, as is well-known in the art.

**[0252]** Polypeptides of the invention may be conveniently prepared using solid phase peptide synthesis (Merrifield, B. (1986) "Solid Phase Synthesis," Science 232(4748):341-347; Houghten, R.A. (1985) "General Method For The Rapid Solid-Phase Synthesis Of Large Numbers Of Peptides: Specificity Of Antigen-Antibody Interaction At The Level Of Individual Amino Acids," Proc. Natl. Acad. Sci. (U.S.A.) 82(15):5131-5135; Ganesan, A. (2006) "Solid-Phase Synthesis In The Twenty-First Century," Mini Rev. Med. Chem. 6(1):3-10).

**[0253]** In an alternative, antibodies may be made recombinantly and expressed using any method known in the art. Antibodies may be made recombinantly by first isolating the antibodies made from host animals, obtaining the gene sequence, and using the gene sequence to express the antibody recombinantly in host cells (e.g., CHO cells). Another method that may be employed is to express the antibody sequence in plants (e.g., tobacco) or transgenic milk. Suitable methods for expressing antibodies recombinantly in plants or milk have been disclosed (see, for example, Peeters et al. (2001) "Production Of Antibodies And Antibody Fragments In Plants," Vaccine 19:2756; Lonberg, N. et al. (1995) "Human Antibodies From Transgenic Mice," Int. Rev. Immunol 13:65-93; and Pollock et al. (1999) "Transgenic Milk As A Method For The Production Of Recombinant Antibodies," J. Immunol Methods 231:147-157). Suitable methods for making derivatives of antibodies, e.g., humanized, single-chain, etc. are known in the art, and have been described above. In another alternative, antibodies may be made recombinantly by phage display technology (see, for example, U.S. Patent Nos. 5,565,332; 5,580,717; 5,733,743; 6,265,150; and Winter, G. et al. (1994) "Making Antibodies By Phage Display Technology," Annu. Rev. Immunol. 12:433-455).

**[0254]** Vectors containing polynucleotides of interest (e.g., polynucleotides encoding the polypeptide chains of the anti-ADAM9 antibodies and ADAM9-binding fragments thereof of the present invention) can be introduced into the host cell by any of a number of appropriate means, including electroporation, transfection employing calcium chloride, rubidium chloride, calcium phosphate, DEAE- dextran, or other substances; microprojectile bombardment; lipofection; and infection (e.g., where the vector is an infectious agent such as vaccinia virus). The choice of introducing vectors or polynucleotides will often depend on features of the host cell.

**[0255]** Any host cell capable of overexpressing heterologous DNAs can be used for the purpose of expressing a polypeptide or protein of interest. Non-limiting examples of suitable mammalian host cells include but are not limited to COS, HeLa, and CHO cells.

**[0256]** The invention includes immunoconjugates comprising an amino acid sequence of an anti-ADAM9 antibody or ADAM9-binding fragment thereof of this invention. The polypeptides of this invention can be made by procedures known in the art. The polypeptides can be produced by proteolytic or other degradation of the antibodies, by recombinant methods (*i.e.*, single or fusion polypeptides) as described above or by chemical synthesis. Polypeptides of the antibodies, especially shorter polypeptides up to about 50 amino acids, are conveniently made by chemical synthesis. Methods of chemical synthesis are known in the art and are commercially available.

**[0257]** Modification of polypeptides is routine practice in the art and need not be described in detail herein. Examples of modified polypeptides include polypeptides with conservative substitutions of amino acid residues, one or more deletions or additions of amino acids which do not significantly deleteriously change the functional activity, or use of chemical analogs. Amino acid residues that can be conservatively substituted for one another include: glycine/alanine; serine/threonine; valine/isoleucine/leucine; asparagine/glutamine; aspartic acid/glutamic acid; lysine/arginine; and phenylalanine/tyrosine. These polypeptides also include glycosylated and non-glycosylated polypeptides, as well as polypeptides with other post-translational modifications, such as, for example, glycosylation with different sugars, acetylation, and phosphorylation. Preferably, the amino acid substitutions would be conservative, *i.e.*, the substituted amino acid would possess similar chemical properties as that of the original amino acid. Such conservative substitutions are known in the art, and examples have been provided above. Amino acid modifications can range from changing or modifying one or more amino acids to complete redesign of a region, such as the Variable Domain. Changes in the Variable Domain can alter binding affinity and/or specificity. Other methods of modification include using coupling techniques known in the art, including enzymatic means, oxidative substitution and chelation. Modifications can be used, for example, for attachment of labels for immunoassay, such as the attachment of radioactive moieties for radioimmunoassay. Modified polypeptides are made using established procedures in the art and can be screened using standard assays known in the art.

**[0258]** The invention encompasses immunoconjugates comprising fusion proteins possessing one or more of the anti-ADAM9-VL and/or VH of this invention. In one embodiment, a fusion polypeptide is provided that comprises a light chain, a heavy chain or both a light and heavy chain. In another embodiment, the fusion polypeptide contains a heterologous immunoglobulin constant region. In another embodiment, the fusion polypeptide contains a Light Chain Variable Domain and a Heavy Chain Variable Domain of an antibody produced from a publicly-deposited hybridoma. For purposes of this invention, an antibody fusion protein contains one or more polypeptide domains that specifically bind to ADAM9 and another amino acid sequence to which it is not attached in the native molecule, for example, a heterologous sequence or a homologous sequence from another region.

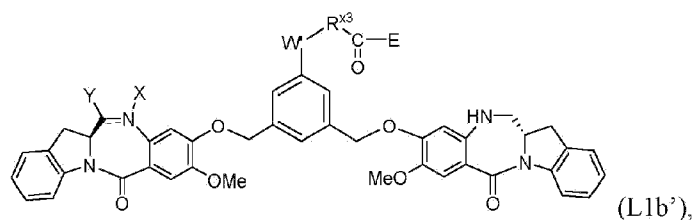
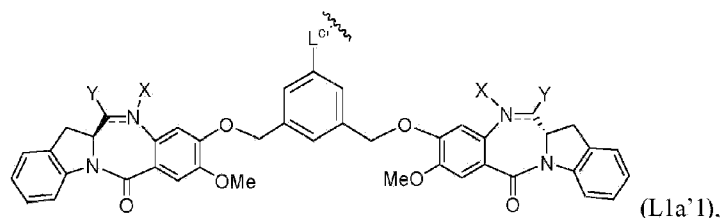
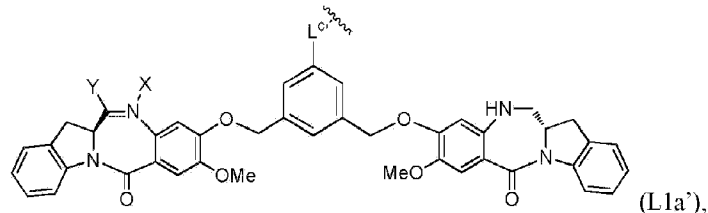
## **V. Drug Conjugation**

**[0259]** The immunoconjugates comprising an anti-ADAM9 antibody or an ADAM9-binding fragment thereof covalently linked to a pharmacological agent through the  $\epsilon$ -amino group of one or more lysine residues located on the anti-ADAM9 antibody or an ADAM9-binding fragment thereof as described the first embodiment above or any specific embodiments described therein can be prepared according to any methods known in the art, see, for example, WO 2012/128868 and WO2012/112687.

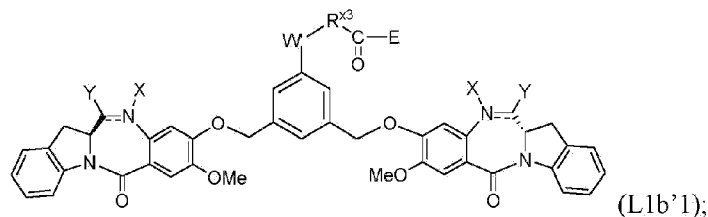
**[0260]** In certain embodiments, the immunoconjugates of the first embodiment can be prepared by a first method comprising the steps of reacting the CBA with the cytotoxic agent having an amine reactive group.

**[0261]** In one embodiment, for the first method described above, the reaction is carried out in the presence of an imine reactive reagent, such as  $\text{NaHSO}_3$ .

**[0262]** In one embodiment, for the first method described above the cytotoxic agent having an imine reactive group is represented by the following formula:



, or



or a pharmaceutically acceptable salt thereof, wherein the definitions for the variables are described above for formulas (L1a'), (L1a'1), (L1b') and (L1b'1).

**[0263]** In certain embodiments, the immunoconjugates of the first embodiment can be prepared by a second method comprising the steps of:

1. (a) reacting the cytotoxic agent with a linker compound having an amine reactive group and a thiol reactive group to form a cytotoxic agent-linker compound having the amine reactive group bound thereto; and
2. (b) reacting the CBA with the cytotoxic agent-linker compound.

**[0264]** In one embodiment, for the second method described above, the reaction in step (a) is carried out in the presence of an imine reactive reagent (e.g.,  $\text{NaHSO}_3$ ).

**[0265]** In one embodiment, for the second method described above, the cytotoxic agent-linker compound is reacted with the CBA without purification. Alternatively, the cytotoxic agent-linker compound is first purified before reacting with the CBA.

**[0266]** In certain embodiments, the immunoconjugates of the first embodiment can be prepared by a third method comprising the steps of:

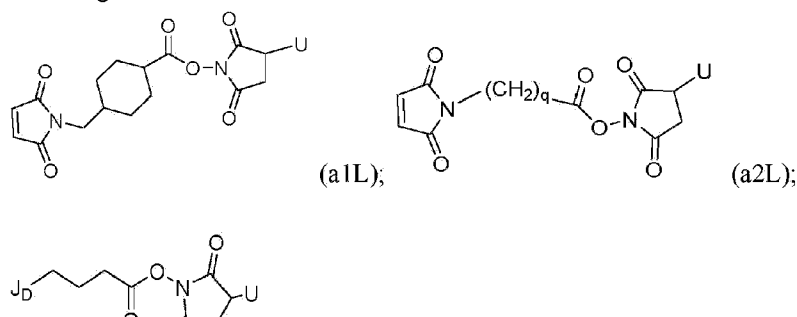
1. (a) reacting the CBA with a linker compound having an amine reactive group and a thiol reactive group to form a modified CBA having a thiol reactive group bound thereto; and
2. (b) reacting the modified CBA with the cytotoxic agent.

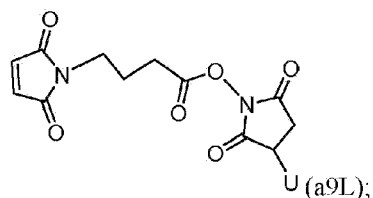
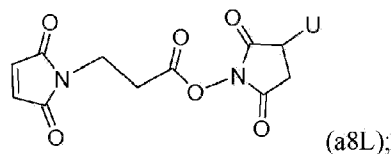
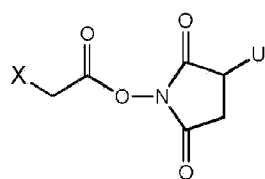
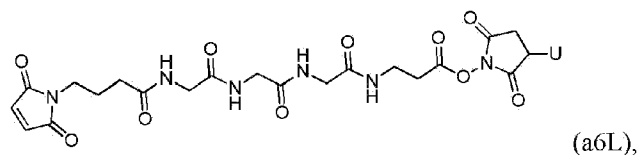
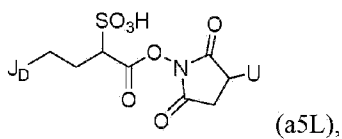
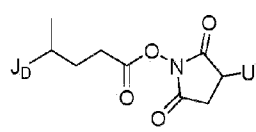
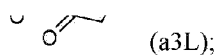
**[0267]** In one embodiment, for the third method described above, the reaction in step (b) is carried out in the presence of an imine reactive reagent (e.g.,  $\text{NaHSO}_3$ ).

**[0268]** In certain embodiments, the immunoconjugates of the first embodiment can be prepared by a fourth method comprising the steps of reacting the CBA, a cytotoxic compound and a linker compound having an amine reactive group and a thiol reactive group.

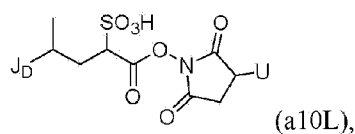
**[0269]** In one embodiment, for the fourth method, the reaction is carried out in the presence of an imine reactive agent (e.g.,  $\text{NaHSO}_3$ ).

**[0270]** In certain embodiments, for the second, third or fourth method, described above, the linker compound having an amine reactive group and a thiol reactive group is represented by the following formula:

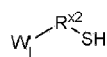
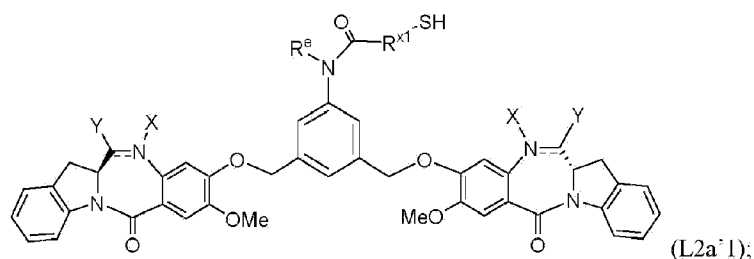
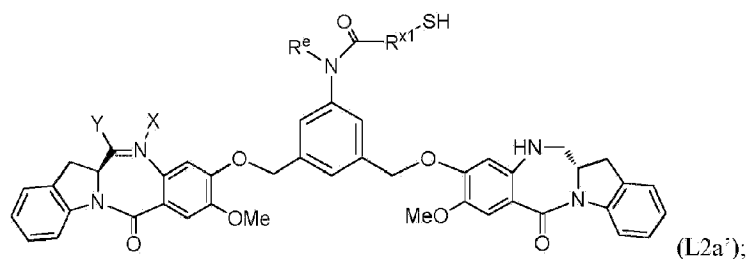


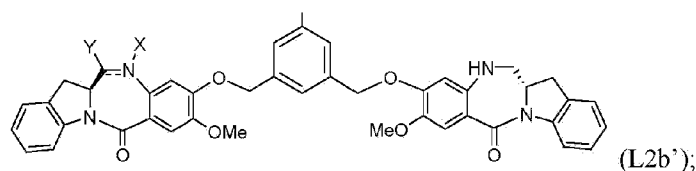


and

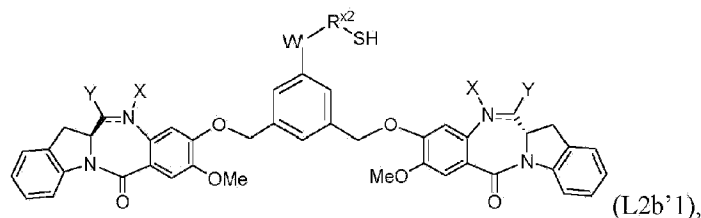


wherein X is halogen; J<sub>D</sub> -SH, -SSR<sup>d</sup>, or -SC(=O)R<sup>g</sup>; R<sup>d</sup> is phenyl, nitrophenyl, dinitrophenyl, carboxynitrophenyl, pyridyl or nitropyridyl; R<sup>g</sup> is an alkyl; and the remaining variables are as described above for formula (a1) - (a10); and the cytotoxic agent is represented by the following formula:



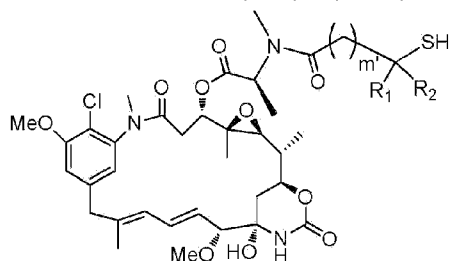


or



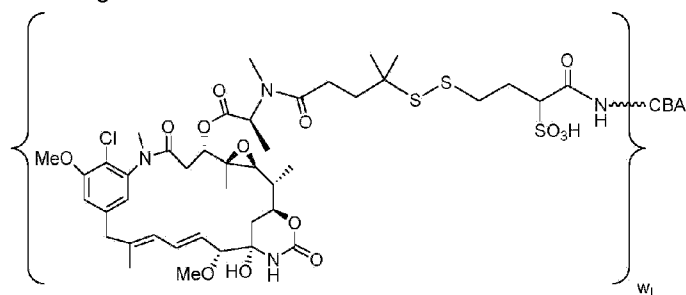
or a pharmaceutically acceptable salt thereof, wherein the variables are as described above for formulas (L1a'), (L1a'1), (L1b'), (L1b'1), (L2a'), (L2a'1), (L2b') and (L2b'1).

**[0271]** In certain embodiments, for the second, third or fourth methods described above, the linker compound having an amine reactive group and a thiol reactive group is represented by any one of the formula (a1L) - (a10L) and the cytotoxic agent is represented by the following formula:



wherein the variables are as described above in any one of the 13<sup>th</sup> to 17<sup>th</sup> specific embodiments of the first embodiment described above and any more specific embodiments described therein.

**[0272]** In a specific embodiment, for the second, third or fourth methods described above, the linker is sulfo-SPDB, the cytotoxic agent is DM4 and the immunoconjugate is represented by the following formula:

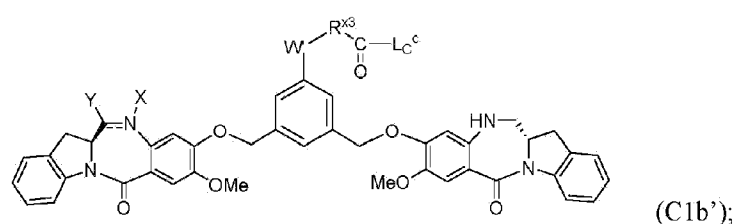
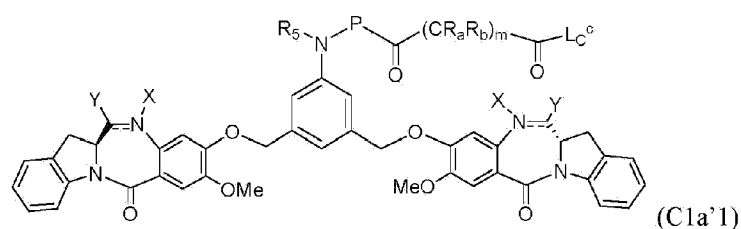
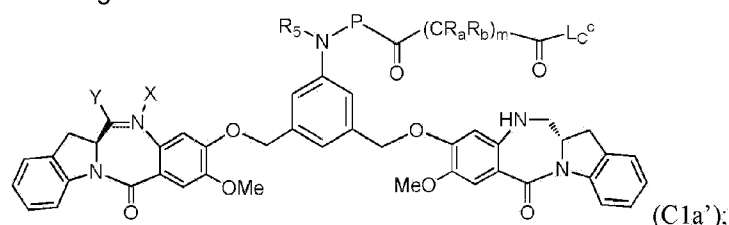


or a pharmaceutically acceptable salt thereof, wherein  $W_L$  is an integer from 1 to 10.

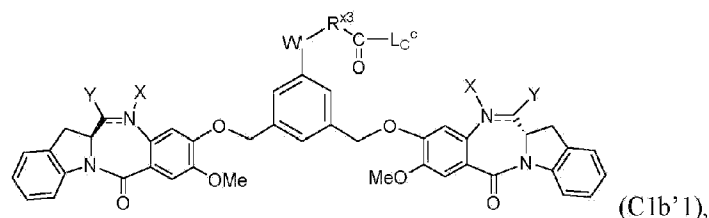
**[0273]** The immunoconjugates comprising an anti-ADAM9 antibody or an ADAM9-binding fragment thereof covalently linked to a cytotoxic agent through the thiol group (-SH) of one or more cysteine residues located on the anti-ADAM9 antibody or an ADAM9-binding fragment thereof as described in the second embodiment above (e.g., immunoconjugates of any one of the 1<sup>st</sup> to 23<sup>rd</sup> specific embodiments or any more specific embodiments described therein) can be prepared by reacting the CBA having one or more free cysteine with a cytotoxic agent having a thiol-reactive group described herein.

**[0274]** In a preferred embodiment, the immunoconjugates of the present invention possesses a variant IgG Fc Region comprising an additional cysteine residue, so as to permit the conjugation of a pharmacological agent to such molecule (e.g., **SEQ ID NOs: 79 and 80**).

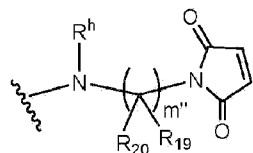
**[0275]** In one embodiment, the cytotoxic agent having a thiol-reactive group is represented by the following formula:



or

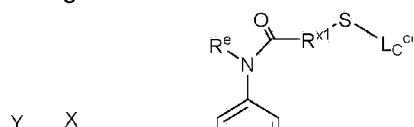


or a pharmaceutically acceptable salt thereof, wherein  $-L_C^c$  is represented by the following formula:

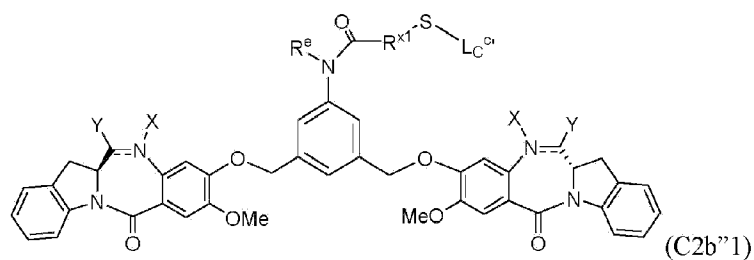
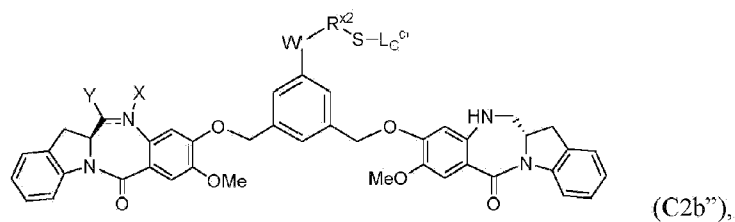
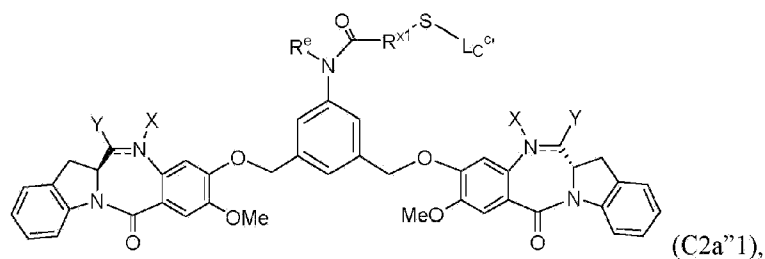
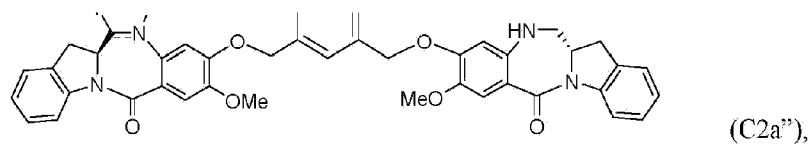


wherein the variables are as described above in any one of the 1<sup>st</sup> to 9<sup>th</sup> and 23<sup>rd</sup> specific embodiments of the second embodiment or any more specific embodiments described therein.

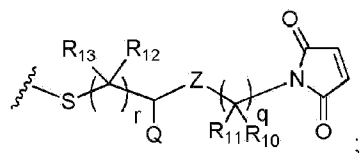
**[0276]** In another embodiment, the cytotoxic agent having a thiol-reactive group is represented by the following formula:



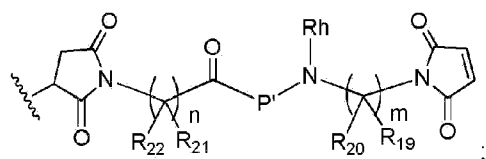




or a pharmaceutically acceptable salt thereof, wherein  $L_C^{C1}$  is represented by the following formula:

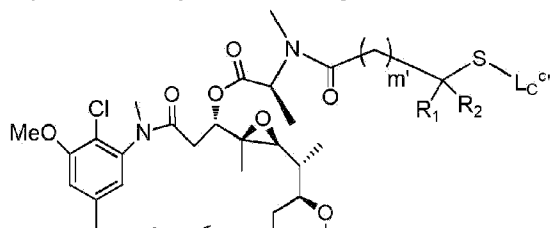


or



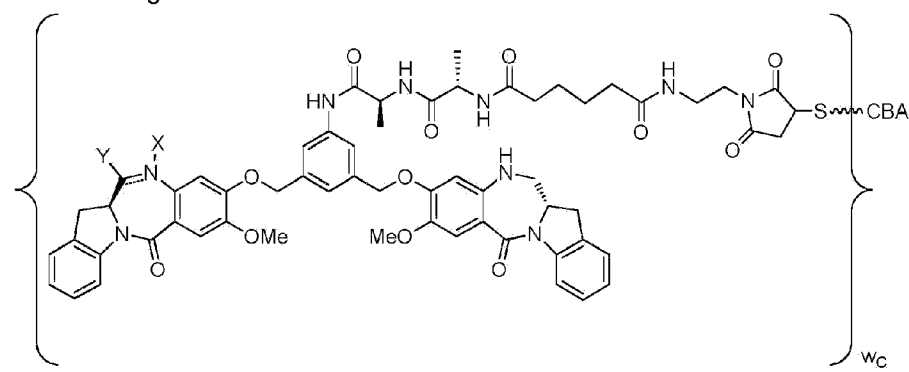
wherein the variables are as described above in any one of the 10<sup>th</sup> to 16<sup>th</sup> and 23<sup>rd</sup> specific embodiment of the second embodiment or any more specific embodiments described therein.

**[0277]** In yet another embodiment, the cytotoxic agent having a thiol-reactive group is represented by the following formula:





antibody or an ADAM9-binding fragment thereof) to form the immunoconjugate represented by the following formula:



or a pharmaceutically acceptable salt thereof, wherein:

the double line



between N and C represents a single bond or a double bond, provided that when it is a double bond, X is absent and Y is -H, and when it is a single bond, X is -H, and Y is -SO<sub>3</sub>H or a pharmaceutically acceptable salt thereof; and W<sub>C</sub> is 1 or 2. In a more specific embodiment, the double line



between N and C represents a double bond, X is absent and Y is -H. In another more specific embodiment, the double line

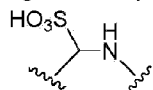


between N and C represents a single bond, X is -H and Y is -SO<sub>3</sub>H or a pharmaceutically acceptable salt thereof. Even more specifically, the pharmaceutically acceptable salt is a sodium or a potassium salt.

**[0282]** In certain embodiments, when Y is —SO<sub>3</sub>H or a pharmaceutically acceptable salt thereof, the immunoconjugates can be prepared by (a) reacting the imine-moiety in the imine-containing cytotoxic agent having a thiol-reactive group described above (*i.e.*, formula (C1a'), (C1a'1), (C1b'), (C1b'1), (C2a''), (C2a''1), (C2b'') or (C2b''1), wherein the double line



between N and C represents a double bond, X is absent and Y is -H) with a sulfur dioxide, bisulfite salt or a metabisulfite salt in an aqueous solution at a pH of 1.9 to 5.0 to form a modified cytotoxic agent comprising a modified imine moiety represented by the following formula:



or a pharmaceutically acceptable salt thereof; and (b) reacting the modified cytotoxic agent with the anti-ADAM9 antibody or an ADAM9-binding fragment thereof described herein to form the immunoconjugate.

**[0283]** In a 1<sup>st</sup> aspect, for the method described above, the reaction of step (a) is carried out at a pH of 1.9 to 5.0. More specifically, the pH is 2.5 to 4.9, 1.9 to 4.8, 2.0 to 4.8, 2.5 to 4.5, 2.9 to 4.5, 2.9 to 4.0, 2.9 to 3.7, 3.1 to 3.5, or 3.2 to 3.4. In another specific embodiment, the reaction of step (a) is carried out at a pH of 1.9, 2.0, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 3.0, 3.1, 3.2, 3.3, 3.4,

3.5, 3.6, 3.7, 3.8, 3.9, 4.0, 4.1, 4.2, 4.3, 4.5, 4.6, 4.7, 4.8, 4.9 or 5.0. In yet another specific embodiment, the reaction of step (a) is carried out at a pH of 3.3.

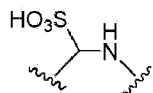
**[0284]** As used herein, a specific pH value means the specific value  $\pm 0.05$ .

**[0285]** In some embodiments, the reaction of step (a) is carried out in the presence of a buffer solution. Any suitable buffer solution known in the art can be used in the methods of the present invention. Suitable buffer solutions include, for example, a citrate buffer, an acetate buffer, a succinate buffer, a phosphate buffer, a glycine-containing buffer (e.g., glycine-HCl buffer), a phthalate buffer (e.g., a buffer solution comprising sodium or potassium hydrogen phthalate), and a combination thereof. In some embodiments, the buffer solution is a succinate buffer. In some embodiments, the buffer solution is a phosphate buffer. In some embodiments, the buffer is a citrate-phosphate buffer. In some embodiments, the buffer is a citrate-phosphate buffer comprising citric acid and  $\text{Na}_2\text{HPO}_4$ . In other embodiments, the buffer is a citrate-phosphate buffer comprising citric acid and  $\text{K}_2\text{HPO}_4$ . In some embodiments, the concentration of the buffer solution described above can be in the range of 10 to 250 mM, 10 to 200 mM, 10 to 150 mM, 10 to 100 mM, 25 to 100 mM, 25 to 75 mM, 10 to 50 mM, or 20 to 50 mM.

**[0286]** In a 2<sup>nd</sup> aspect, the reaction step (a) is carried out in the absence of a buffer solution (e.g., the buffers described in the 1<sup>st</sup> aspect). In some embodiments, the present method comprises the steps of: (a) reacting the imine-moiety in the imine-containing cytotoxic agent having a thiol-reactive group described above (*i.e.*, formula (C1a'), (C1a'1), (C1b'), (C1b'1), (C2a''), (C2a''1), (C2b'') or (C2b''1), wherein the double line

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between N and C represents a double bond, X is absent and Y is -H) with sulfur dioxide, a bisulfite salt or a metabisulfite salt in an aqueous solution to form a modified cytotoxic agent comprising a modified imine moiety represented by the following formula:



or a pharmaceutically acceptable salt thereof, wherein the aqueous solution does not comprise a buffer; and (b) reacting the modified cytotoxic agent with the anti-ADAM9 antibody or an ADAM9-binding fragment thereof described herein to form the immunoconjugate. In some embodiments, the reaction of step (a) is carried out in a mixture of an organic solvent and water. More specifically, the reaction of step (a) is carried out in a mixture of dimethylacetamide (DMA) and water. In some embodiments, the mixture of DMA and water comprises less than 60% of DMA by volume. Even more specifically, the volume ratio of DMA and water is 1:1.

**[0287]** In a 3<sup>rd</sup> aspect, for the methods described above or in the 1<sup>st</sup> or 2<sup>nd</sup> aspect, 0.5 to 5.0 equivalents of the bisulfite salt or 0.25 or 2.5 equivalents of the metabisulfite salt is used for every 1 equivalent of the imine-containing cytotoxic agent in the reaction of step (a). In some embodiments, 0.5 to 4.5, 0.5 to 4.0, 0.5 to 3.5, 0.5 to 4.0, 0.5 to 3.5, 0.5 to 3.0, 0.5 to 2.5, 0.8 to 2.0, 0.9 to 1.8, 1.0 to 1.7, 1.1 to 1.6, or 1.2 to 1.5 equivalents of the bisulfite salt or 0.25 to 2.25, 0.25 to 2.0, 0.25 to 1.75, 0.25 to 2.0, 0.25 to 1.75, 0.25 to 1.5, 0.25 to 1.25, 0.4 to 1.0, 0.45 to 0.9, 0.5 to 0.85, 0.55 to 0.8, or 0.6 to 0.75 equivalents of the metabisulfite salt is used for every 1

equivalent of the imine-containing cytotoxic agent. In other embodiments, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.0, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 3.0, 3.1, 3.2, 3.3, 3.4, 3.5, 4.0, 4.5 or 5.0 equivalents of the bisulfite salt or 0.25, 0.3, 0.35, 0.4, 0.45, 0.5, 0.55, 0.6, 0.65, 0.7, 0.75, 0.8, 0.85, 0.9, 0.95, 1.0, 1.05, 1.1, 1.15, 1.2, 1.25, 1.3, 1.35, 1.4, 1.45, 1.5, 1.55, 1.6, 1.65, 1.7, 1.75, 2.0, 2.25 or 2.5 equivalents of the metabisulfite salt is used for every 1 equivalent of the imine-containing cytotoxic agent. In yet other embodiments, 1.4 equivalents of the bisulfite salt or 0.7 equivalent of the metabisulfite salt is used for every 1 equivalent of the imine-containing cytotoxic agent. In other embodiments, 1.2 equivalents of the bisulfite salt or 0.6 equivalent of the metabisulfite salt is used for every 1 equivalent of the imine-containing cytotoxic agent.

**[0288]** As used herein, a specific equivalent means the specific value  $\pm 0.05$ .

**[0289]** In a 4<sup>th</sup> aspect, for methods described above, the reaction of step (a) is carried out at a pH of 2.9 to 3.7 and 1.0 to 1.8 equivalents of the bisulfite salt or 0.5 to 0.9 equivalents of the metabisulfite salt is reacted with 1 equivalent of the imine-containing cytotoxic agent. In some embodiments, the reaction of step (a) is carried out at a pH of 3.1 to 3.5 and 1.1 to 1.6 equivalents of the bisulfite salt or 0.55 to 0.8 equivalents of the metabisulfite salt is reacted with 1 equivalent of the imine-containing cytotoxic agent. In other embodiments, the reaction of step (a) is carried out at a pH of 3.2 to 3.4 and 1.3 to 1.5 equivalents of the bisulfite salt or 0.65 to 0.75 equivalents of the metabisulfite is reacted with 1 equivalent of the imine-containing cytotoxic agent. In other embodiments, the reaction of step (a) is carried out at a pH of 3.3 and 1.4 equivalents of the bisulfite salt or 0.7 equivalent of the metabisulfite salt is reacted with 1 equivalent of the imine-containing cytotoxic agent. In yet other embodiments, the reaction of step (a) is carried out at a pH of 3.3 and 1.4 equivalents of sodium bisulfite is reacted with 1 equivalent of the imine-containing cytotoxic agent.

**[0290]** In a 5<sup>th</sup> aspect, for the methods described above or in the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> or 4<sup>th</sup> aspect, the reaction of step (a) is carried out in a mixture of an organic solvent and water. Any suitable organic solvent can be used. Exemplary organic solvents include alcohols (e.g., methanol, ethanol, propanol, etc.), dimethylformamide (DMF), dimethylsulfoxide (DMSO), acetonitrile, acetone, methylene chloride, etc. In some embodiments, the organic solvent is miscible with water. In other embodiments, the organic solvent is not miscible with water, i.e., the reaction of step (a) is carried out in a biphasic solution. In some embodiments, the organic solvent is dimethylacetamide (DMA). The organic solvent (e.g., DMA) can be present in the amount of 1%-99%, 1-95%, 10-80%, 20-70%, 30-70%, 1-60%, 5-60%, 10-60%, 20-60%, 30-60%, 40-60%, 45-55%, 10-50%, or 20-40%, by volume of the total volume of water and the organic solvent. In some embodiments, the reaction of step (a) is carried out in a mixture of DMA and water, wherein the volume ratio of DMA and water is 1:1.

**[0291]** In a 6<sup>th</sup> aspect, for the methods described above or in the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> or 5<sup>th</sup> aspect, the reaction of step (a) can be carried out at any suitable temperature. In some embodiments, the reaction is carried out at a temperature from 0 °C to 50 °C, from 10 °C to 50 °C, from 10 °C to 40 °C, or from 10 °C to 30 °C. In other embodiments, the reaction is carried out at a temperature from 15 °C to 30 °C, from 20 °C to 30 °C, from 15 °C to 25 °C, from 16 °C to 24 °C, from 17 °C to

23 °C, from 18 °C to 22 °C or from 19 °C to 21 °C. In yet other embodiments, the reaction can be carried out at 15 °C, 16 °C, 17 °C, 18 °C, 19 °C, 20 °C, 21 °C, 22 °C, 23 °C, 24 °C or 25 °C. In some embodiments, the reaction can be carried out from 0 °C to 15 °C, from 0 °C to 10 °C, from 1 °C to 10 °C, 5 °C to 15 °C, or from 5 °C to 10 °C.

**[0292]** In a 7<sup>th</sup> aspect, for the methods described above or in the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup> or 6<sup>th</sup> aspect, the reaction of step (a) is carried out for 1 minute to 48 hours, 5 minutes to 36 hours, 10 minutes to 24 hours, 30 minutes to 24 hours, 30 minutes to 20 hours, 1 hour to 20 hours, 1 hour to 15 hours, 1 hour to 10 hours, 2 hours to 10 hours, 3 hours to 9 hours, 3 hours to 8 hours, 4 hours to 6 hours, or 1 hour to 4 hours. In some embodiments, the reaction is allowed to proceed for 4 to 6 hours. In other embodiments, the reaction is allowed to proceed for 10 minutes, 15 minutes, 20 minutes, 30 minutes, 1 hours, 2 hours, 3 hours, 4 hours, 5 hours, 6 hours, 7 hours, 8 hours, 9 hours, 10 hours, 11 hours, 12 hours, 13 hours, 14 hours, 15 hours, etc. In other embodiments, the reaction is allowed to proceed for 4 hours. In yet other embodiments, the reaction is allowed to proceed for 2 hours.

**[0293]** In a 8<sup>th</sup> aspect, for the methods of the present invention described herein or in the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup>, 6<sup>th</sup> or 7<sup>th</sup> aspect, the reaction of step (b) is carried out at a pH of 4 to 9. In some embodiments, the reaction of step (b) is carried out at a pH of 4.5 to 8.5, 5 to 8.5, 5 to 8, 5 to 7.5, 5 to 7, 5 to 6.5, or 5.5 to 6.5. In other embodiments, the reaction of step (b) is carried out at pH 5.0, 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 6.0, 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.0, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 7.9, or 8.0.

**[0294]** In some embodiments, for the methods described above or in the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup>, 6<sup>th</sup>, 7<sup>th</sup> or 8<sup>th</sup> aspect, the reaction of step (b) is carried out in an aqueous solution comprising a mixture of water and an organic solvent. Any suitable organic solvent described above can be used. More specifically, the organic solvent is DMA. In some embodiments, the aqueous solution comprises less than 50%, less than 40%, less than 30%, less than 25%, less than 20%, less than 15%, less than 10%, less than 5%, less than 3%, less than 2%, or less than 1% of the organic solvent (e.g. DMA) by volume.

**[0295]** In some embodiments, for the methods described herein or in the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup>, 6<sup>th</sup>, 7<sup>th</sup> or 8<sup>th</sup> aspect, the bisulfite salt is sodium or potassium bisulfite and the metabisulfite salt is sodium or potassium metabisulfite. In a specific embodiment, the bisulfite salt is sodium bisulfite and the metabisulfite salt is sodium metabisulfite.

**[0296]** In some embodiments, for the methods described herein or in the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup>, 6<sup>th</sup>, 7<sup>th</sup> or 8<sup>th</sup> aspect, the modified cytotoxic agent is not purified before reacting with the cell-binding agent in step (b). Alternatively, the modified cytotoxic agent is purified before reacting with the cell-binding agent in step (b). Any suitable methods described herein can be used to purify the modified cytotoxic agent.

**[0297]** In some embodiments, for the methods described above, the reaction of step (a) results in

no substantial sulfonation of the maleimide group. In some embodiments, less than 50%, 40%, 30%, 20%, 10%, 9%, 8%, 7%, 6%, 5%, 4%, 3%, 2%, or 1% of the maleimide group is sulfonated. The percentage of maleimide sulfonation is equal to the total amount of the maleimide-sulfonated cytotoxic agent (the cytotoxic agent having sulfonation on the maleimide only) and the di-sulfonated cytotoxic agent (the cytotoxic agent having sulfonation on both the maleimide and the imine moieties) divided by the starting amount of the imine-containing cytotoxic agent before its reaction with the bisulfite salt or the metabisulfite salt.

**[0298]** In some embodiments, the immunoconjugates prepared by any methods described above is subject to a purification step. In this regard, the immunoconjugate can be purified from the other components of the mixture using tangential flow filtration (TFF), non-adsorptive chromatography, adsorptive chromatography, adsorptive filtration, selective precipitation, or any other suitable purification process, as well as combinations thereof.

**[0299]** In some embodiments, the immunoconjugate is purified using a single purification step (e.g., TFF). Preferably, the conjugate is purified and exchanged into the appropriate formulation using a single purification step (e.g., TFF). In other embodiments of the invention, the immunoconjugate is purified using two sequential purification steps. For example, the immunoconjugate can be first purified by selective precipitation, adsorptive filtration, adsorptive chromatography or non-adsorptive chromatography, followed by purification with TFF. One of ordinary skill in the art will appreciate that purification of the immunoconjugate enables the isolation of a stable conjugate comprising the cell-binding agent chemically coupled to the cytotoxic agent.

**[0300]** Any suitable TFF systems may be utilized for purification, including a Pellicon type system (Millipore, Billerica, Mass.), a Sartocoon Cassette system (Sartorius AG, Edgewood, N.Y.), and a Centrasette type system (Pall Corp., East Hills, N.Y.)

**[0301]** Any suitable adsorptive chromatography resin may be utilized for purification. Preferred adsorptive chromatography resins include hydroxyapatite chromatography, hydrophobic charge induction chromatography (HCIC), hydrophobic interaction chromatography (HIC), ion exchange chromatography, mixed mode ion exchange chromatography, immobilized metal affinity chromatography (IMAC), dye ligand chromatography, affinity chromatography, reversed phase chromatography, and combinations thereof. Examples of suitable hydroxyapatite resins include ceramic hydroxyapatite (CHT Type I and Type II, Bio-Rad Laboratories, Hercules, Calif.), HA Ultrogel hydroxyapatite (Pall Corp., East Hills, N.Y.), and ceramic fluoroapatite (CFT Type I and Type II, Bio-Rad Laboratories, Hercules, Calif.). An example of a suitable HCIC resin is MEP Hypercel resin (Pall Corp., East Hills, N.Y.). Examples of suitable HIC resins include Butyl-Sepharose, Hexyl-Sepharose, Phenyl-Sepharose, and Octyl Sepharose resins (all from GE Healthcare, Piscataway, N.J.), as well as Macro-prep Methyl and Macro-Prep t-Butyl resins (Biorad Laboratories, Hercules, Calif.). Examples of suitable ion exchange resins include SP-Sepharose, CM-Sepharose, and Q-Sepharose resins (all from GE Healthcare, Piscataway, N.J.), and Unosphere S resin (Bio-Rad Laboratories, Hercules, Calif.). Examples of suitable mixed mode ion exchangers include Bakerbond ABx resin (JT Baker, Phillipsburg N.J.) Examples of suitable IMAC resins include Chelating Sepharose resin (GE Healthcare, Piscataway, N.J.) and Profinity

IMAC resin (Bio-Rad Laboratories, Hercules, Calif.). Examples of suitable dye ligand resins include Blue Sepharose resin (GE Healthcare, Piscataway, N.J.) and Affi-gel Blue resin (Bio-Rad Laboratories, Hercules, Calif.). Examples of suitable affinity resins include Protein A Sepharose resin (e.g., MabSelect, GE Healthcare, Piscataway, N.J.), where the cell-binding agent is an antibody, and lectin affinity resins, e.g. Lentil Lectin Sepharose resin (GE Healthcare, Piscataway, N.J.), where the cell-binding agent bears appropriate lectin binding sites. Alternatively an antibody specific to the cell-binding agent may be used. Such an antibody can be immobilized to, for instance, Sepharose 4 Fast Flow resin (GE Healthcare, Piscataway, N.J.). Examples of suitable reversed phase resins include C4, C8, and C18 resins (Grace Vydac, Hesperia, Calif.).

**[0302]** Any suitable non-adsorptive chromatography resin may be utilized for purification. Examples of suitable non-adsorptive chromatography resins include SEPHADEX™ G-25, G-50, G-100, SEPHACRYL™ resins (e.g., S-200 and S-300), SUPERDEX™ resins (e.g., SUPERDEX™ 75 and SUPERDEX™ 200), BIO-GEL® resins (e.g., P-6, P-10, P-30, P-60, and P-100), and others known to those of ordinary skill in the art.

## **VI. Uses of the Immunoconjugates of the Present Invention**

**[0303]** The present invention encompasses pharmaceutical compositions comprising the immunoconjugates of the present invention.

**[0304]** As provided herein, the immunoconjugates of the present invention, comprising the humanized/optimized anti-ADAM9-VL and/or VH Domains provided herein, have the ability to bind ADAM9 present on the surface of a cell and mediate cell killing. In particular, the immunoconjugates of the present invention comprising a pharmacological agent, are internalized and mediate cell killing via the activity of the pharmacological agent. Such cell killing activity may be augmented by the immunoconjugate inducing antibody-dependent cell-mediated cytotoxicity (ADCC) and/or complement dependent cytotoxicity (CDC)

**[0305]** Thus, immunoconjugates of the present invention, comprising the humanized/optimized anti-ADAM9-VL and/or VH Domains provided herein, have the ability to treat any disease or condition associated with or characterized by the expression of ADAM9. As discussed above, ADAM9 is an onco-embryonic antigen expressed in numerous blood and solid malignancies that is associated with high-grade tumors exhibiting a less-differentiated morphology, and is correlated with poor clinical outcomes. Thus, without limitation, the immunoconjugates of the present invention may be employed in the treatment of cancer, particularly a cancer characterized by the expression of ADAM9.

**[0306]** In other particular embodiments, immunoconjugates of the present invention may be useful in the treatment of lung cancer (e.g., non-small-cell lung cancer), colorectal cancer, bladder cancer, gastric cancer, pancreatic cancer, renal cell carcinoma, prostate cancer, esophageal cancer, breast cancer, head and neck cancer, uterine cancer, ovarian cancer, liver cancer, cervical cancer, thyroid cancer, testicular cancer, myeloid cancer, melanoma, and lymphoid cancer.



[0307] In further embodiments, immunoconjugates of the present invention may be useful in the treatment of non-small-cell lung cancer (squamous cell, adenocarcinoma, or large-cell undifferentiated carcinoma) and colorectal cancer (adenocarcinoma, gastrointestinal carcinoid tumors, gastrointestinal stromal tumors, primary colorectal lymphoma, leiomyosarcoma, or squamous cell carcinoma).

[0308] In addition to their utility in therapy, the immunoconjugates of the present invention may be detectably labeled and used in the diagnosis of cancer or in the imaging of tumors and tumor cells.

## VII. Pharmaceutical Compositions

[0309] The compositions of the invention include bulk drug compositions useful in the manufacture of pharmaceutical compositions (e.g., impure or non-sterile compositions) and pharmaceutical compositions (*i.e.*, compositions that are suitable for administration to a subject or patient) that can be used in the preparation of unit dosage forms. Such compositions comprise a prophylactically or therapeutically effective amount of the immunoconjugates of the present invention, or a combination of such agents and a pharmaceutically acceptable carrier. Preferably, compositions of the invention comprise a prophylactically or therapeutically effective amount of immunoconjugates of the present invention and a pharmaceutically acceptable carrier. The invention also encompasses such pharmaceutical compositions that additionally include a second therapeutic antibody (e.g., tumor-specific monoclonal antibody) that is specific for a particular cancer antigen, and a pharmaceutically acceptable carrier.

[0310] In a specific embodiment, the term "**pharmaceutically acceptable**" means approved by a regulatory agency of the Federal or a state government or listed in the U.S. Pharmacopeia or other generally recognized pharmacopeia for use in animals, and more particularly in humans. The term "**carrier**" refers to a diluent, adjuvant (e.g., Freund's adjuvant (complete and incomplete), excipient, or vehicle with which the therapeutic is administered. Generally, the ingredients of compositions of the invention are supplied either separately or mixed together in unit dosage form, for example, as a dry lyophilized powder or water free concentrate in a hermetically sealed container such as an ampoule or sachette indicating the quantity of active agent. Where the composition is to be administered by infusion, it can be dispensed with an infusion bottle containing sterile pharmaceutical grade water or saline. Where the composition is administered by injection, an ampoule of sterile water for injection or saline can be provided so that the ingredients may be mixed prior to administration.

[0311] The invention also provides a pharmaceutical pack or kit comprising one or more containers filled with an immunoconjugates of the present invention, alone or with such pharmaceutically acceptable carrier. Additionally, one or more other prophylactic or therapeutic agents useful for the treatment of a disease can also be included in the pharmaceutical pack or kit. The invention also provides a pharmaceutical pack or kit comprising one or more containers filled with one or more of the ingredients of the pharmaceutical compositions of the invention.

Optionally associated with such container(s) can be a notice in the form prescribed by a governmental agency regulating the manufacture, use or sale of pharmaceuticals or biological products, which notice reflects approval by the agency of manufacture, use or sale for human administration.

**[0312]** The present invention provides kits that can be used in the above methods. A kit can comprise any of the immunoconjugates of the present invention. The kit can further comprise one or more other prophylactic and/or therapeutic agents useful for the treatment of cancer, in one or more containers.

### **VIII. Methods of Administration**

**[0313]** The compositions of the present invention may be provided for use in the treatment, prophylaxis, and amelioration of one or more symptoms associated with a disease, disorder by administering to a subject an effective amount an immunoconjugate of the invention. In a preferred aspect, such compositions are substantially purified (*i.e.*, substantially free from substances that limit its effect or produce undesired side effects). In a specific embodiment, the subject is an animal, preferably a mammal such as non-primate (*e.g.*, bovine, equine, feline, canine, rodent, *etc.*) or a primate (*e.g.*, monkey such as, a cynomolgus monkey, human, *etc.*). In a preferred embodiment, the subject is a human.

**[0314]** Various delivery systems are known and can be used to administer the compositions, *e.g.*, encapsulation in liposomes, microparticles, microcapsules, recombinant cells capable of expressing the antibody or fusion protein, receptor-mediated endocytosis (See, *e.g.*, Wu et al. (1987) "Receptor-Mediated In Vitro Gene Transformation By A Soluble DNA Carrier System, " J. Biol. Chem. 262:4429-4432), construction of a nucleic acid as part of a retroviral or other vector, *etc.*

**[0315]** Methods of administering the immunoconjugates for use according to the invention include parenteral administration (*e.g.*, intradermal, intramuscular, intraperitoneal, intravenous and subcutaneous), epidural, and mucosal (*e.g.*, intranasal and oral routes). In a specific embodiment, the immunoconjugates for use according to the present invention are administered intramuscularly, intravenously, or subcutaneously. The compositions may be administered by any convenient route, for example, by infusion or bolus injection, and may be administered together with other biologically active agents. Administration can be systemic or local.

**[0316]** The invention also provides that preparations of the immunoconjugates of the present invention are packaged in a hermetically sealed container such as an ampoule or sachette indicating the quantity of the molecule. In one embodiment, such molecules are supplied as a dry sterilized lyophilized powder or water free concentrate in a hermetically sealed container and can be reconstituted, *e.g.*, with water or saline to the appropriate concentration for administration to a subject. Preferably, the immunoconjugates of the present invention are supplied as a dry sterile lyophilized powder in a hermetically sealed container.

**[0317]** The lyophilized preparations of the immunoconjugates of the present invention should be stored at between 2°C and 8°C in their original container and the molecules should be administered within 12 hours, preferably within 6 hours, within 5 hours, within 3 hours, or within 1 hour after being reconstituted. In an alternative embodiment, such molecules are supplied in liquid form in a hermetically sealed container indicating the quantity and concentration of the molecule, fusion protein, or conjugated molecule. Preferably, such immunoconjugates when provided in liquid form are supplied in a hermetically sealed container.

**[0318]** As used herein, an **"effective amount"** of a pharmaceutical composition is an amount sufficient to effect beneficial or desired results including clinical results such as decreasing symptoms resulting from the disease, attenuating a symptom of infection (e.g., viral load, fever, pain, sepsis, etc.) or a symptom of cancer (e.g., the proliferation, of cancer cells, tumor presence, tumor metastases, *etc.*), thereby increasing the quality of life of those suffering from the disease, decreasing the dose of other medications required to treat the disease, enhancing the effect of another medication such as via targeting and/or internalization, delaying the progression of the disease, and/ or prolonging survival of individuals.

**[0319]** An effective amount can be administered in one or more administrations. For purposes of this invention, an effective amount of drug, compound, or pharmaceutical composition is an amount sufficient: to kill and/or reduce the proliferation of cancer cells, and/or to eliminate, reduce and/or delay the development of metastasis from a primary site of cancer. In some embodiments, an effective amount of a drug, compound, or pharmaceutical composition may or may not be achieved in conjunction with another drug, compound, or pharmaceutical composition. Thus, an "effective amount" may be considered in the context of administering one or more chemotherapeutic agents, and a single agent may be considered to be given in an effective amount if, in conjunction with one or more other agents, a desirable result may be or is achieved.

**[0320]** For the immunoconjugates for use according to the invention, the dosage administered to a patient is preferably determined based upon the body weight (kg) of the recipient subject.

**[0321]** The dosage and frequency of administration of an immunoconjugate for use according to the present invention may be reduced or altered by enhancing uptake and tissue penetration of the molecule by modifications such as, for example, lipidation.

**[0322]** The dosage of an immunoconjugate for use according to the invention administered to a patient may be calculated for use as a single agent therapy. Alternatively, the molecule may be used in combination with other therapeutic compositions and the dosage administered to a patient are lower than when said molecules are used as a single agent therapy.

**[0323]** The pharmaceutical compositions for use according to the invention may be administered locally to the area in need of treatment; this may be achieved by, for example, local infusion, by injection, or by means of an implant, said implant being of a porous, nonporous, or gelatinous material, including membranes, such as sialastic membranes, or fibers. Preferably, when administering an immunoconjugate for use according to the invention, care must be taken to use materials to which the molecule does not absorb.

**[0324]** The compositions for use according to the invention can be delivered in a vesicle, in particular a liposome (See Langer (1990) "New Methods Of Drug Delivery," Science 249: 1527-1533); Treat et al., in LIPOSOMES IN THE THERAPY OF INFECTIOUS DISEASE AND CANCER, Lopez-Berestein and Fidler (eds.), Liss, New York, pp. 353- 365 (1989); Lopez-Berestein, *ibid.*, pp. 3 17-327).

**[0325]** Treatment of a subject with a therapeutically or prophylactically effective amount of an immunoconjugate of the present invention can include a single treatment or, preferably, can include a series of treatments. It will also be appreciated that the effective dosage of the molecules used for treatment may increase or decrease over the course of a particular treatment.

## EXAMPLES

**[0326]** Having now generally described the invention, the same will be more readily understood through reference to the following Examples. The following examples illustrate various methods for compositions in the diagnostic or treatment methods of the invention. The examples are intended to illustrate, but in no way limit, the scope of the invention.

### Example 1

#### Tumor Cell Specificity of the Anti-ADAM9 Antibody MAB-A

**[0327]** A murine anti-ADAM9 antibody (designated herein as MAB-A) was identified that: (1) blocks the target protein processing activity of ADAM9; (2) is internalized; and (3) has anti-tumor activity (see, *e.g.*, US Patent No. 8361475). The tumor cell specificity of MAB-A was investigated by IHC. Tumor tissue was contacted with MAB-A (0.4 µg/mL) or an isotype control (0.4 µg/mL) and the extent of staining was visualized. MAB-A was found to strongly label a variety of large cell carcinoma, squamous cell carcinoma, and adenocarcinoma non-small cell lung cancer cell types (**FIG. 1A**), breast cancer cells, prostate cancer cells, gastric cancer cells (**FIG. 1B**), as well as colon cancer samples (**FIG. 1C**). Normal tissue was contacted with MAB-A (1.25 µg/mL) and the extent of staining was visualized. As summarized in **Table 2** above, MAB-A exhibited little or no staining of a wide variety of normal tissues. It will be noted that the concentration of MAB-A used in these studies was nearly 3-times that used for staining of tumor cells. The results of these IHC studies indicate that MAB-A exhibits strong preferential binding to tumor cells over normal cells.

### Example 2

#### Species Cross Reactivity

**[0328]** The binding of MAB-A to human ADAM9 (huADAM9) and cynomolgus monkey ADAM9 (cynoADAM9) was examined. Briefly, 293-FT and CHO-K cells transiently expressing huADAM9, cynoADAM9, an unrelated antigen, or the untransfected parental cells were incubated with MAB-A followed by goat anti-murine-PE secondary antibody and analyzed by FACS. As shown in **FIG. 2**, MAB-A exhibits strong binding to huADAM9 transiently expressed on both cells types. MAB-A exhibits poor binding to cynoADAM9. MAB-A did not bind to the parental cells or cells expressing an irrelevant antigen. Similar low levels of binding to cynoADAM were seen in ELISA assays.

### Example 3

#### Humanization and Initial Optimization

**[0329]** Humanization of MAB-A yielded a humanized VH Domain, designated herein as "**hMAB-A VH(1)**" and a humanized VL Domain designated herein as "**hMAB-A VL(1)**." The humanized Variable Domains were then optimized to enhance binding activity and/or to remove potentially labile amino acid residues as described in more detail below. This first round of optimization yielded three additional humanized VH Domains, designated herein as "**hMAB-A VH(2)**," "**hMAB-A VH(3)**," and "**hMAB-A VH(4)**," and three additional humanized VL Domains designated herein as "**hMAB-A VL(2)**," "**hMAB-A VL(3)**," and "**hMAB-A VL(4)**." In addition, a chimeric version of MAB-A ("**chMAB-A**") having the murine VH and VL Domains and human constant regions was generated. The amino acid sequences of the murine and the humanized/optimized VH and VL Domains are provided above, an alignment is provided in **FIGs. 3A** and **3B**. The consensus sequence of these humanized/optimized VH and VL Domains is provided above. Where multiple humanized Variable Domains were generated the humanized heavy and light chain Variable Domains of a particular anti-ADAM9 antibody (e.g., MAB-A) may be used in any combination and particular combinations of humanized chains are referred to by reference to the specific VH/VL Domains, for example an antibody comprising hMAB-A VH(1) and hMAB-A VL(2) is specifically referred to as "hMAB-A (1.2)."

**[0330]** In the following examples, any immunoconjugate comprising the following VH Domains is shown for illustration purposes only and does not form part of the presently-claimed invention:

- |           |      |
|-----------|------|
| hMAB-A VH | (1)  |
| hMAB-A VH | (2)  |
| hMAB-A VH | (3)  |
| hMAB-A VH | (4). |

**[0331]** In the following examples, any immunoconjugate comprising the chimeric version of MAB-A (chMAB-A) is shown for illustration purposes only and does not form part of the presently-claimed invention.

**[0332]** hMAB-A VH(1) was generated having framework regions derived from human germlines VH3-21 and VH3-64, and hMAB-A VL(1) was generated having framework regions derived from human germlines B3 and L6. The murine CDRs were retained in these humanized variable domains.

**[0333]** A potential deamidation site was identified in the CDR<sub>H2</sub> (shown in single underlining in **FIG. 3A**) and a potential aspartic acid isomerization site was identified in CDR<sub>L1</sub> (shown in single underlining in **FIG. 3B**). Amino acid substitutions at these positions were examined to identify substitutions to remove these sites while maintaining binding affinity. A substitution of phenylalanine at position 54 (N54F) of CDR<sub>H2</sub> (present in hMAB-A VH(2)) and at serine at position 28 (D28S) of CDR<sub>L1</sub> (present in hMAB-A VL(2)) were selected, wherein the numbering is accordingly to Kabat. The identified substitutions may be used separately or in combination. Surprisingly, antibodies comprising the N54F substitution were found to exhibit about a 2-fold increase in affinity for human ADAM9 (see, e.g., **Table 3**, below) and slightly improved binding to cynomolgus ADAM9.

**[0334]** Additional, optimized variants were generated to minimize the number of lysine residues present in the CDRs. Two lysine residues are present in CDR<sub>H2</sub> (indicated with a double underline in **FIG. 3A**), and one lysine is present in CDR<sub>L1</sub> (indicated with a double underline in **FIG. 3B**). Amino acid substitutions at these positions were examined to identify substitutions that maintained binding affinity. Substitutions of arginine at position 62 (K62R), of glutamine at position 64 (K64Q), and serine at position 65 (S65G) were selected for CDR<sub>H2</sub> (present in hMAB-A VH(3)), wherein the numbering is accordingly to Kabat. A substitution of an arginine at position 24 (K24R) was selected for CDR<sub>L1</sub> (present in hMAB-A VL(3)). The identified substitutions may be used separately or in combination.

**[0335]** Other potentially labile residues present in the CDRs were identified (indicated with a dotted underline in **FIGs. 3A-3B**), one methionine residue within CDR<sub>H1</sub> at position 34 (M34), one methionine residue within CDR<sub>L1</sub> at position 33 (M33), and histidine, glutamic acid, and aspartic acid residues at positions 92 (H93), 93 (E93), and 94 (D94), within CDR<sub>L3</sub>, wherein the numbering is accordingly to Kabat. Amino acid substitutions at these positions were examined to identify substitutions that maintained binding affinity. Substitution of isoleucine at position 34 (M34I) was selected for CDR<sub>H1</sub> and substitutions of leucine, tyrosine, serine and threonine were selected for positions 33 (M33L), 92 (H93Y), 93 (E93S), and 94 (D94T) of CDR<sub>L3</sub>, wherein the numbering is according to Kabat. Each of these positions could readily be substituted in combination with all of the substitutions detailed above to yield hMAB-A VH(4) and hMAB-A VL(4), which when paired together generate an antibody that retained a small improvement in affinity as compared to the parental murine antibody, and that has a greatly reduced potential for deamidation or oxidation and no lysine residues in the CDRs.

**[0336]** The relative binding affinity of the humanized/optimized antibodies hMAB-A (1.1), hMAB-A (2.2), hMAB-A (2.3), hMAB-A (3.3), hMAB-A (4.4) and the chimeric chMAB-A (having murine VH/VL Domains) to huADAM9 was investigated using BIACORE® analysis, in which His-tagged soluble human ADAM9 ("**shADAM9-His**," containing an extracellular portion of human ADAM9 fused to a histidine-containing protein) was passed over a surface coated with immobilized antibody. Briefly, each antibody was captured on a Fab2 goat anti-human Fc surface and then incubated in the presence of different concentrations (6.25-100 nM) of the shADAM9-His protein. The kinetics of binding were determined via BIACORE® analysis binding (normalized 1:1 Langmuir binding model). The calculated  $k_a$ ,  $k_d$  and  $K_D$  from these studies are presented in **Table 3**. Binding to cynoADAM9 was examined by FACS as described above and by ELISA.

**Table 3.**

Antibody	pI	huADAM9		
		$k_a$ ( $\times 10^6$ )	$k_d$ ( $\times 10^{-3}$ )	$K_D$ (nM)
chMAB-A	6.61	1.3	4.7	3.6
hMAB-A (1.1)	6.44	1.5	5.2	3.5
hMAB-A (2.2)	6.58	1.1	1.5	1.4
hMAB-A (2.3)	6.58	1.3	1.7	1.3
hMAB-A (3.3)	6.44	1.1	1.5	1.4
hMAB-A (4.4)	6.73	1.0	2.0	2.0

**[0337]** The results of these studies demonstrate that the humanized/optimized antibodies have the same or higher binding affinity to human ADAM9 than the parental murine antibody. In particular, it was observed that the introduction of the N54F mutation in the humanized antibodies resulted in improved binding to huADAM9 (i.e., hMAB-A (2.2), hMAB-A (2.3), and hMAB-A (3.3)). This mutation also provided a slight improvement in binding to cynoADAM9 as determined by FACS and ELISA, however, these antibodies continued to exhibit poor binding to cynoADAM9. These studies also identified additional substitutions that could be introduced to remove lysine residues from the CDRs without reducing affinity. Additional substitutions were identified to remove other potentially labile residues with a minimal impact on affinity.

#### Example 4

##### Optimization of Binding to Non-Human Primate ADAM9

**[0338]** Random mutagenesis was used to introduce substitutions within the Heavy Chain CDR<sub>H2</sub> (Kabat positions 53-58) and CDR<sub>H3</sub> (Kabat positions 95-100 and 100a-100f) domains of hMAB-A (2.2). The mutants were screened to identify clones having enhanced binding to non-human primate ADAM9 (e.g., cynoADAM9) and that retained high affinity binding to huADAM9. 48 clones

were selected from two independent screens of mutations within CDR<sub>H</sub>3 (Kabat positions 100a-100f). **Table 4** provides an alignment of the amino acid sequence of CDR<sub>H</sub>3 Kabat residues 100a-f from hMAB-A (2.2) clones selected for enhanced binding to cynoADAM9 from two independent screens. Additional clone alignments are provided in **Table 5**. As indicated in such Tables, similar clones emerged in each experiment, which fell into discrete substitution patterns.

<b>Table 4 Substitutions within Sub-Domain of the Heavy Chain CDRH3 of MAB-A (Kabat Positions 100a-100f)</b>					
<b>Screen 1</b>			<b>Screen 2</b>		
<b>Clone ID</b>	<b>SEQ ID NO</b>	<b>CDR<sub>H</sub>3 Sub-Domain Sequence</b>	<b>Clone ID</b>	<b>SEQ ID NO</b>	<b>CDR<sub>H</sub>3 Sub-Domain Sequence</b>
MAB-A	81	GSRDYF	MAB-A	81	GSRDYF
1	82	DGEGVM	1	112	DGKAVL
2	82	DGEGVM	2	113	FNKAVL
3	83	FHSGLL	3	84	FNSATL
4	84	FNSATL	4	114	FNSGTW
5	85	FNSGTL	5	115	FNTGVF
6	86	FNSSTL	6	116	GKSRFH
7	87	GKSKWL	7	91	IGKGVF
8	88	GMGGTL	8	92	IGKGVL
9	89	HAKGGM	9	117	IGKNVY
10	90	IGEAVL	10	118	MGKGVM
11	91	IGKGVF	11	119	NGESVF
12	91	IGKGVF	12	120	PDFGWM
13	92	IGKGVL	13	121	PGSGVM
14	93	KHDSVL	14	122	PKDAWL
15	94	LNTAVM	15	99	PKFGWK
16	95	NGEGTL	16	99	PKFGWK
17	96	NGKNTL	17	123	PKFGWL
18	97	NSAGIL	18	124	PKIGWH
19	98	PKEGWM	19	124	PKIGWH
20	99	PKFGWK	20	124	PKIGWH
21	100	PKMGWV	21	125	PKMGWA
22	101	PRLGHL	22	126	PKMGWM
23	102	PSFGWA	23	126	PKMGWM
24	103	QAKGTM	24	126	PKMGWM
25	104	RGMGVM	25	126	PKMGWM
26	105	RKEGWM	26	127	PQMGWL
27	106	TGKGVL	27	128	PRFGWL



**Table 4 Substitutions within Sub-Domain of the Heavy Chain CDRH3 of MAB-A (Kabat Positions 100a-100f)**

Screen 1			Screen 2		
Clone ID	SEQ ID NO	CDR <sub>H</sub> 3 Sub-Domain Sequence	Clone ID	SEQ ID NO	CDR <sub>H</sub> 3 Sub-Domain Sequence
28	107	TGMGTL	28	128	PRFGWL
29	108	TGNGVM	29	128	PRFGWL
30	108	TGNGVM	30	129	PRMGFL
31	109	WNAGTF	31	130	PRMGFM
32	110	YHHTPL	32	131	PSFGWM
33	110	YHHTPL	33	132	RREGWM
34	111	YQSATL	34	133	SGEGVL
			35	134	SGNGVM
			36	135	VGKAVL

**Table 5 Substitutions within Sub-Domain of the Heavy Chain CDRH3 of MAB-A (Kabat Positions 100a-100f)**

Clone ID	SEQ ID NO	CDR <sub>H</sub> 3 Sub-Domain Sequence
MAB-A VH (2A)	85	FNSGTL
MAB-A VH (2B)	92	IGKGV L
MAB-A VH (2C)	128	PRFGWL
MAB-A VH (2D)	106	TGKGV L
MAB-A VH (2E)	136	DSNAVL
MAB-A VH (2F)	137	FHSGTL
MAB-A VH (2G)	113	FNKAVL
MAB-A VH (2H)	138	GGSGVL
MAB-A VH (2I)	139	PRQGFL
MAB-A VH (2J)	140	YNSGTL

**[0339]** For all the clones examined, Gly and Ala are the preferred amino acid residues at position 4 (P4) and Leu, Met, and Phe are the preferred amino acid residues at position 6 (P6). The preferred amino acid residues at other positions (e.g., position 2 (P2), position 3 (P3) and position 5 (P5)) depend on the amino acid residue found at P1. For clones having a Pro residue at position 1 (P1), Lys and Arg were preferred at P2, Phe and Met at P3, Gly at P4, and Trp or Phe at P5. For clones having a Phe, Tyr or Trp at P1, Asn and His were preferred at P2, Ser and His at P3, and Leu at P6. For clones having Ile, Leu or Val at P1, Gly was preferred at P2, Lys at P3, Val at P5 and hydrophobic at P6. In addition, as can be seen in **Table 4**, for clones having a Thr residue at P1, Gly was preferred at P2, Lys, Met, and Asn were preferred at P3, Gly was preferred at P4, Val or Thr were preferred at P5 and Leu and Met at P6. Additional clones having an Asp, Gly, Arg,

His, or Ser residue at P1 were also identified at lower frequencies (see **Table 4** and **Table 5**).

**[0340]** The VH Domain of the ten clones shown in **Table 5** were used to generate further optimized variants of hMAB-A (2.2) designated hMAB-A (2A.2)-(2J.2). The binding of the selected clones was examined by ELISA assay. Briefly, antibodies that bind to histidine-containing peptides, and that had been coated onto microtiter plates, were used to capture His peptide-tagged soluble cynoADAM9 ("**cynoADAM9-His**") (1 µg/mL) or His peptide-tagged soluble huADAM9 (1 µg/mL), and the binding of serial dilutions of the parental hMAB-A (2.2) and the ten CDR<sub>H3</sub> hMAB-A (2A.2) variants was examined. The binding curves cynoADAM9 and huADAM9 are presented in **FIG. 4A** and **FIG. 4B**, respectively. hMAB-A (2A.2) variants comprising each of the selected VH Domains exhibited improved binding to cynoADAM9 with MAB-A VH(2B), MAB-A VH(2C), MAB-A VH(2D), and MAB-A VH(2I), showing the greatest enhancement in cynoADAM9 binding while maintaining similar binding to huADAM9 as the parental hMAB-A (2.2) antibody.

**[0341]** The relative binding affinity of the humanized/further optimized antibodies MAB-A VH(2B.2), MAB-A VH(2C.2), MAB-A VH(2D.2), and MAB-A VH(2I.2), and the parental hMAB-A (2.2), to huADAM9-His and cynoADAM9-His was investigated using BIACORE® analysis essentially as described above. The calculated  $k_a$ ,  $k_d$  and  $K_D$  from these studies are presented in

**Table 6.**

<b>Table 6</b>						
Antibody	huADAM9			cynoADAM9		
	$k_a$ ( $\times 10^5$ ) ( $M^{-1}s^{-1}$ )	$k_d$ ( $\times 10^{-4}$ ) ( $s^{-1}$ )	$K_D$ (nM)	$k_a$ ( $\times 10^5$ ) ( $M^{-1}s^{-1}$ )	$k_d$ ( $\times 10^{-4}$ ) ( $s^{-1}$ )	$K_D$ (nM)
hMAB-A (2.2)	9.0	5.5	0.6	2.0	220	110
hMAB-A (2B.2)	6.1	3.9	0.6	3.4	0.66	0.2
hMAB-A (2C.2)	5.9	8.1	1.4	3.5	<0.1	<0.3
hMAB-A (2D.2)	6.9	5.8	0.8	4.2	3.0	0.7
hMAB-A (2I.2)	6.6	2.3	0.4	4.0	0.85	0.2

**[0342]** The binding studies demonstrate that the four top clones exhibited between 150-550-fold enhancement in binding affinity to cynoADAM9 while maintaining the same high affinity binding to huADAM9 as the parental antibody. hMAB-A (2C.2) and hMAB-A (2I.2) was selected for further studies.

#### Example 5

**Immunohistochemistry Study of Antibody hMAB-A (21.2)**

**[0343]** The cell specificity of hMAB-A (21.2) was investigated by IHC. Positive and negative control cells, and normal human and cynomolgus monkey tissues were contacted with hMAB-A (21.2) (2.5 µg/mL) or an isotype control (2.5 µg/mL) and the extent of staining was visualized. The results of the study are summarized in **Table 7**.

<b>Table 7</b>		
<b>Cell/Tissue</b>	<b>hMAB-A (21.2) (2.5 µg/ml)</b>	<b>IgG1 Negative Control (2.5 µg/ml)</b>
Cho-K parental cells	-	-
Cho-K/huADAM9 medium expression P:1	2-4+ (gr c > m) rare to occasional and 1+ (gr c > m) occasional	-
Cho-K/huADAM9 high expression	2-4+ (gr c > m) frequent	-
Cho-K/cynoADAM9 clone 2	2-4+ (gr c > m) frequent	-
Cho-K/cynoADAM9 clone #16	2-4+ (gr c > m) frequent	-
A498 cells	2-4+ (gr c > m) rare to occasional and 1+ (gr c > m) occasional to frequent	-
Colon MG06-CHTN-96 B	-	numerous 2-4+ (gr c) cells consistent with macrophages
Lung MG06-CHtN-162B1 A	-	occasional 2-4+ (gr c) cells consistent with macrophages
Liver ILS11103 B	-	hepatocytes 1+ (gr c) rare to occasional
Pancreas ILS10266	-	-
Heart Life Legacy 0910035D	-	cardiac muscle cells with numerous 1-3+ small foci of (gr c) consistent with lipofuscin pigment
Kidney ILS10241 B	-	tubule epi 1+ (gr c) rare
Bladder ILSD8011 J	-	occasional 2-4+ (gr c) cells consistent with macrophages
Cyno Colon #1	-	mucosal epi (luminal m) 2-4+ rare to occasional and 1+ rare to occasional; numerous 2-3+ (gr c) cells consistent with

Table 7		
Cell/Tissue	hMAB-A (2I.2) (2.5 µg/ml)	IgG1 Negative Control (2.5 µg/ml)
		macrophages predominantly within LP
Cyno Lung #1	-	very rare 2-4+ (gr c) cells consistent with macrophages
Cyno Liver #1	-	-
Cyno Pancreas #1	-	-
Cyno Heart #1	-	-
Cyno Kidney #070368M	-	tubule epi 2+ (gr c) rare and 1+ (gr c) rare to occasional
Cyno Bladder #1	transitional cell epi ± (gr c) rare	rare 1-4+ (gr c) cells consistent with macrophages
Lung CA ILS10108	H score 150	tu -
Lung CA ILS7223	H score 180	tu -
Lung CA ILS2156 A	H score 80	tu -
Lung CA ILS7295 A	H score 60	tu -

**[0344]** IHC studies were also conducted to assess binding of humanized/optimized hMAB-A (2I.2) at a concentration of 12.5 µg/mL (5x optimal staining concentration). Positive and negative control cells, and normal human and cynomolgus monkey tissues were employed in this study. The results of the study are summarized in **Table 8**.

Table 8		
Cell/Tissue	hMAB-A (2I.2) (12.5 µg/ml)	IgG1 Negative Control (12.5 µg/ml)
Cho-K parental cells	-	-
Cho-K/huADAM9 medium expression P: 1	2-4+ (gr c > m) occasional to frequent	-
Cho-K/huADAM9 high expression	3-4+ (gr c > m) occasional to frequent	-
Cho-K/cynoADAM9 clone 2	3-4+ (gr c > m) frequent	-

<b>Table 8</b>		
<b>Cell/Tissue</b>	<b>hMAB-A (2I.2) (12.5 µg/ml)</b>	<b>IgG1 Negative Control (12.5 µg/ml)</b>
Cho-K/cynoADAM9 clone #16	3-4+ (gr c > m) frequent	-
A498 cells	2-4+ (gr c > m) occasional to frequent	-
Colon MG06-CHTN-96 B	epi ± - 1+ rare to occasional	numerous 2-4+ (gr c) cells consistent with macrophages predominantly within LP in test article and negative control
Lung MG06-CHtN-162B1 A	alveolar cells (favor pneumocytes) 2-3+ (gr c > m) rare, 1+ (gr c > m) rare to occasional; EC 2-4+ (c,m) rare, 1+ (c,m) rare	occasional scattered 2-4+ (gr c) cells consistent with macrophages in test article and negative control
Liver ILS11103 B	-	occasional scattered 2-4+ (gr c) cells consistent with macrophages in test article and negative control
Pancreas ILS10266	ductal epi 1+ (gr c > m) very rare	cells (favor acinar cells) 1+ (gr c) very rare; occasional scattered 2-4+ (gr c) cells consistent with macrophages in test article and negative
Heart Life Legacy 0910035D	-	numerous small foci 1-3+ granular staining with cardiac muscle cells consistent with lipofuscin pigment consistent with artifact in test article and negative control
Kidney ILS10241 B	tubule epi 1+ (gr c) rare to occasional	tubule epi ± (gr c) rare
Bladder ILSD8011 J	transitional cell epi 1+ (gr c) rare	rare 2-4+ (gr c) cells consistent with macrophages in test article and negative control
Cyno Colon #1	-	mucosal epi (luminal m) 2-4+ occasional and 1+ rare to occasional
Cyno Lung #1	bronchial epi 1+ (gr c > m) rare to occasional and ± (gr c > m) occasional to frequent	-
Cyno Liver #1	-	-
Cyno Pancreas #1	-	-
Cyno Heart #1	-	-
Cyno Kidney #070368M	-	tubule epi 1+ (gr c) rare and ± (gr c) rare

Table 8		
Cell/Tissue	hMAB-A (2I.2) (12.5 µg/ml)	IgG1 Negative Control (12.5 µg/ml)
Cyno Bladder #1	transitional cell epi 2+ (gr c > m) rare and 1+ (gr c > m) rare to occasional	-
Lung CA ILS10108	H score 180	tu -
Lung CA ILS7223	H score 180	tu -
Lung CA ILS2156 A	H score 115	tu -
Lung CA ILS7295 A	H score 115	tu -

[0345] A comparative IHC study was conducted in order to assess differences in binding by hMAB-A (2.2), hMAB-A (2.3), hMAB-A (2C.2), and hMAB-A (2I.2) at 2.5 µg/mL or 5 µg/mL. Positive and negative control cells, and normal human and cynomolgus monkey tissues were employed in this study. The results of the study are summarized in **Table 9**.

Table 9					
Tissue	hMAB-A (2.3) 5 µg/mL	hMAB-A (2.2) 2.5 µg/mL	hMAB-A (2C.2) 2.5 µg/mL	hMAB-A (2I.2) 2.5 µg/mL	Isotype control 5 µg/mL
Cho-K parental P:3	-	-	-	-	-
Cho-K/hu ADAM9.2 medium expression P:1	1+ (c) occasional	2-4+ (gr c > m) rare and 1+ (gr c > m) rare to occasional	2-4+ (gr c > m) rare to occasional and 1+ (gr c > m) rare to occasional	2-4+ (gr c > m) rare to occasional and 1+ (gr c > m) occasional	-
Cho-K/hu ADAM9.18 high expression P:1	3+ (m,c) frequent	2-4+ (gr c > m) occasional to frequent and 1+ (gr c > m) occasional	2-4+ (gr c > m) occasional to frequent and 1+ (gr c > m) occasional	2-4+ (gr c > m) frequent	-
Cho-K Cyno #2	1+(c) occasional	-	3-4+ (gr c > m) frequent	2-4+ (gr c > m) frequent	-
Cho-K Cyno #16	2+ (c,m) occasional to frequent	2-4+ (gr c > m) rare and 1+ (gr c > m) rare to occasional	3-4+ (gr c > m) frequent	2-4+ (gr c > m) frequent	-
A498 072210	3-4+ (c,m) frequent	2-4+ (gr c > m) rare and 1+ (gr c > m) rare to occasional	2-4+ (gr c > m) rare and 1+ (gr c > m) rare to occasional	2-4+ (gr c > m) rare to	-

Table 9					
Tissue	hMAB-A (2.3) 5 ug/mL	hMAB-A (2.2) 2.5 µg/mL	hMAB-A (2C.2) 2.5 µg/mL	hMAB-A (2I.2) 2.5 µg/mL	Isotype control 5 µg/mL
		c > m) occasional to frequent	> m) occasional	occasional and 1+ (gr c > m) occasional to frequent	
Lung CA ILS10108	IHC score 3	H Score 55	H Score 17	H score 150	-
Lung CA ILS7223	IHC score 3	H Score 205	H Score 160	H score 180	-
Lung CA ILS2156 A	IHC score 1	H Score 5	H Score 0	H score 80	-
Lung CA ILS7295 A	IHC score 1	H Score 1	H Score 0	H score 60	-

**[0346]** A further comparative IHC study was conducted in order to assess differences in binding by hMAB-A (2.2), hMAB-A (2.3), hMAB-A (2C.2), and hMAB-A (2I.2) and murine MAB-A at 2.5 µg/mL 5 µg/mL or 12.5 µg/mL. Positive and negative control cells, and normal human and cynomolgus monkey tissues were employed in this study. The results of the study are summarized in **Table 10**.

Table 10					
Tissue	hMAB-A (2.3) 5 ug/mL	hMAB-A (2.2) 2.5 µg/mL	hMAB-A (2C.2) 2.5 µg/mL	hMAB-A (2I.2) 12.5 µg/ml	MAB-A 5 µg/mL
Colon MG06-CHTN-96 B	epi 1+ (c,m) rare; sm negative	-	-	epi ± - 1+ rare to occasional	Epithelium 1-3+ [m, c] (occas to freq); Others (Neg)
Lung MG06-CHtN-162B1 A	pneumocytes/macrophages 2+ (c,m) occasional	-	-	alveolar cells (favor pneumocytes) 2-3+ (gr c > m) rare, 1+ (gr c > m) rare to occasional; EC 2-4+ (c,m) rare, 1+ (c,m) rare	Monocytes 1+ [c] (rare to occas); Others (Neg)
Liver ILS11103	hepatocytes 1+ (c) rare to occasional	hepatocytes 1+ (gr c)	hepatocytes 2+ (gr c)	-	Kupffer cells 3+ [c]

Table 10					
Tissue	hMAB-A (2.3) 5 ug/mL	hMAB-A (2.2) 2.5 ug/mL	hMAB-A (2C.2) 2.5 ug/mL	hMAB-A (2I.2) 12.5 ug/ml	MAB-A 5 ug/mL
B		frequent	rare and 1+ (gr c) frequent		(occas); Others (Neg)
Pancreas ILS 10266	epi 1+ (c) rare; Islet Cells 1+ (c) very rare	-	-	ductal epi 1+ (gr c > m) very rare	Ductal epithelium 1-2+ [c, m] (rare to occas); Fibril 2+ (rare); Others (Neg)
Heart Life Legacy 0910035D	±	-	-	-	Neg
Kidney ILS10241 B	epi 2-3+ (c,m) frequent	tubule epi 2+ (gr c) rare to occasional and 1+ (gr c) occasional to frequent	tubule epi 2+ (gr c) rare to occasional and 1+ (gr c) occasional to frequent	tubule epi 1+ (gr c) rare to occasional	Epithelium 1+ [c] (rare); Others (Neg)
Bladder ILSD8011 J	transitional epi 1+ (c) rare to occasional	-	-	transitional cell epi 1+ (gr c) rare	Transitional epithelium 2+ [c, m] (occas to freq); Stromal cells 3+ [c] (rare); Others (Neg)
Cyno Colon #1	epi 1+ (c,m) rare	-	-	-	
Cyno Lung #1	Macrophage and pneumocytes 1+ (c) very rare	-	bronchial epi 3-4+ (gr c) rare, 2+ (gr c) occasional, and 1+ (gr c) occasional	bronchial epi 1+ (gr c > m) rare to occasional and ± (gr c > m) occasional to frequent	-
Cyno Liver #1	hepatocytes 1+ (c) frequent	hepatocytes 2+ (gr c)	hepatocytes 2+ (gr c)	-	-



Table 10					
Tissue	hMAB-A (2.3) 5 ug/mL	hMAB-A (2.2) 2.5 µg/mL	hMAB-A (2C.2) 2.5 µg/mL	hMAB-A (2I.2) 12.5 µg/ml	MAB-A 5 µg/mL
		rare to occasional and 1+ (gr c) rare to occasional	rare to occasional and 1+ (gr c) occasional; ductal epi 1+ (gr c) occasional		
Cyno Pancreas #1	epi and Islet Cells 1+ (c) very rare	-	islet cells ± (gr c) frequent; ductal epi 1+ (gr c) rare to occasional	-	positive
Cyno Heart #1	myocardium 1+ (c) frequent	-	-	-	-
Cyno Kidney #070368M	epi 2+ (c) frequent	tubule epi 2+ (gr c) rare to occasional and 1+ (gr c) rare to occasional	tubule epi 2+ (gr c) rare to occasional and 1+ (gr c) occasional to frequent	-	positive
Cyno Bladder #1	transitional epi ± (c); macrophages very rare	-	transitional cell epi 2-3+ (gr c > m) rare and 1+ (gr c > m) occasional	transitional cell epi 2+ (gr c > m) rare and 1+ (gr c > m) rare to occasional	

**[0347]** The results thus demonstrate that hMAB-A (2.2) exhibited an overall low level staining of human hepatocytes and kidney tubules at optimal concentration, with a lower staining intensity/frequency of reactivity in hepatocytes and kidney tubules observed in the negative control. hMAB-A (2.2) exhibited similar low level staining of cyno hepatocytes and kidney tubules at optimal concentration, with lower staining intensity/frequency of reactivity in kidney tubules observed in the negative control.

**[0348]** The results also demonstrate that hMAB-A (2C.2) exhibited an overall low level staining of human hepatocytes and kidney tubules at optimal concentration, with lower staining intensity/frequency of reactivity in hepatocytes and kidney tubules observed in the negative control. hMAB-A (2C.2) exhibited similar low level staining in cyno hepatocytes and kidney tubules

at optimal concentration. Additional minimal findings in cyno lung epithelium, pancreas islets/epithelium and bladder epithelium for hMAB-A (2C.2) was not observed in the corresponding human tissue; lower staining intensity/frequency of reactivity was observed in lung epithelium, kidney tubules, bladder epithelium in negative control. The results also demonstrate that hMAB-A (21.2) exhibited no staining of human or cyno tissues at optimal concentration, with rare +/- bladder transitional cell epithelium staining. hMAB-A (21.2) also exhibited overall low level and frequency staining of human lung alveolar cells, pancreas ductal epithelium, kidney tubule, bladder transitional cell epithelium at 5x optimal concentration, and overall low level staining of cyno bronchial epithelium and bladder transitional cell epithelium at 5x optimal concentration. hMAB-A (21.2) exhibits an overall favorable IHC profile on the human normal tissues tested and a similar profile on corresponding cynomolgus monkey tissues.

#### Example 6

##### hMAB-A (21.2) Comprising Variant Fc Regions

**[0349]** hMAB-A (21.2) comprises a light chain (**SEQ ID NO:68**) having a kappa light chain constant region and a heavy chain (**SEQ ID NO:52**) having wild-type IgG heavy chain constant regions. Fc variants were generated by introducing the following substitutions into the Fc Region: L234A/L235A (see, e.g., **SEQ ID NO: 78**) designated hMAB-A (21.2)(AA); S442C (see, e.g., **SEQ ID NO: 79**) designated hMAB-A (21.2)(C); and L234A/L235A/S442C (see, e.g., **SEQ ID NO: 80**) designated hMAB-A (21.2)(AA/C). The binding of each Fc variant to huADAM9-His and cynoADAM9-His was examined by ELISA assay. Briefly, antibodies that bind to histidine-containing peptides, and that had been coated onto microtiter plates, were used to capture His peptide-tagged soluble cynoADAM9 or His peptide-tagged soluble huADAM9 (0.5 µg/mL), and the binding of serial dilutions of the parental hMAB-A (2.2) and the Fc variants was examined. The binding curves huADAM9 and cynoADAM9 are presented in **FIG. 5A** and **FIG. 5B**, respectively and show that each of the Fc variants retained the binding affinity of hMAB-A (21.2) having a wild-type Fc region.

#### Example 7

##### Target Expression Analysis

**[0350]** To evaluate ADAM9 expression across different indications, a tissue microarray (TMA) with 20 different tumor types was first evaluated using an ADAM9 IHC assay developed at ImmunoGen for preliminary research use.

**[0351]** All samples analyzed were FFPE (Formalin fixed & paraffin embedded) samples. The 500 core 20 carcinoma TMA was purchased from Folio Biosciences (Cat# ARY-HH0212). The NSCLC

TMA with 80 cores for adenocarcinoma and 80 cores for squamous cell carcinoma was purchased from US Biomax (Cat# LC1921A). The colorectal cancer TMA with 80 cores for adenocarcinoma was purchased from Pantomics Inc. (Cat# COC1261). The gastric cancer samples were purchased from Avaden Biosciences.

**[0352]** Immunohistochemical staining for ADAM9 was carried out using the Ventana Discovery Ultra autostainer. The primary antibody for ADAM9 was a commercially available rabbit monoclonal antibody. All samples were evaluated and scored by a board certified pathologist trained in the scoring algorithm. The presence of at least 100 viable tumor cells was required for scoring. Staining intensity was scored on a semi-quantitative integer scale from 0 to 3, with 0 representing no staining, 1 representing weak staining, 2 representing moderate and 3 representing strong staining. The percentage of cells staining positively at each intensity level was recorded. Scoring was based on localization of Adam9 to the cell membrane only, as well as evaluation of localization to both cytoplasm and membrane. The staining results were analyzed by H score, which combines components of staining intensity with the percentage of positive cells. It has a value between 0 and 300 and is defined as:

1 \* (percentage of cells staining at 1+ intensity)

+ 2 \* (percentage of cells staining at 2+ intensity)

+ 3 \* (percentage of cells staining at 3+ intensity)

= H score.

**[0353]** The 500 core 20 carcinoma TMA with 5 normal tissue controls for each tumor type was stained and scored in two different ways: (1) based on membrane staining alone or (2) based on membrane and cytoplasmic staining. Table 11 below and FIG. 6A summarize the prevalence of ADAM9 based on membrane staining for all twenty indications and Table 12 and FIG. 6B summarize the results of membrane and cytoplasmic staining for eight selected indications.

**[0354]** Based on the results from the multi carcinoma TMA, three indications for an expanded prevalence analysis were chosen: non-small cell lung cancer (NSCLC), colorectal cancer (CRC) and gastric cancer. For NSCLC, one TMA with 80 cores for adenocarcinoma and 80 cores for squamous cell carcinoma was stained and evaluated. For CRC, one TMA with 80 cores for adenocarcinoma was analyzed, of which 78 were evaluable. For gastric cancer, 15 whole tissue sections of adenocarcinoma were analyzed. All of these samples were scored for membrane and cytoplasmic staining, and the results are summarized in Table 13. The results of these preliminary studies show that ADAM9 is expressed in a wide range of solid cancers and support the use of anti-ADAM9 drug conjugates in many different ADAM9-expressing solid tumors.

**Table 11: Prevalence of ADAM9 in 20 different indications based on membrane staining**

Tumor type	% Positive (H score >=1)	H score: 1-100	H score: 101-200
Pancreas (n=17)	95%	24%	71%
Uterus (n=18)	89%	67%	22%
Thyroid (n=17)	88%	88%	0%
Kidney (n=17)	88%	59%	29%

<b>Tumor type</b>	<b>% Positive (H score <math>\geq 1</math>)</b>	<b>H score: 1-100</b>	<b>H score: 101-200</b>
Testis (n=17)	83%	65%	18%
Prostate (n=20)	80%	45%	35%
Colon (n=16)	76%	38%	38%
Bladder (n=16)	76%	63%	13%
Breast(n=20)	75%	65%	10%
Brain (n=19)	68%	63%	5%
Stomach (n=17)	59%	24%	35%
Lung (n=19)	58%	58%	0%
Esophagus (n=19)	43%	32%	11%
Cervix (n=20)	40%	40%	0%
Ovary (n=18)	39%	33%	6%
Head and Neck (n=20)	35%	30%	2%
Liver (n=19)	32%	32%	0%
Skin (n=20)	10%	10%	0%
Soft Tissue (n=20)	0%	0%	0%
Lymphoma (n=20)	0%	0%	0%

**Table 12: Prevalence of ADAM9 in 8 selected indications based on membrane and cytoplasmic staining**

<b>Tumor type</b>	<b>% Positive (H score <math>\geq 1</math>)</b>	<b>H score: 1-100</b>	<b>H score: 101-200</b>	<b>H score: 201-300</b>
Colon	100%	31%	63%	6%
Lung	100%	58%	42%	0%
Pancreas	100%	18%	76%	6%
Prostate	95%	25%	55%	15%
Esophagus	95%	58%	37%	0%
Stomach	94%	18%	71%	6%
Breast	70%	50%	20%	0%
Ovarian	61%	44%	17%	0%

**Table 13: Prevalence of ADAM9 in additional samples for NSCLC, CRC and Gastric Cancer based on membrane and cytoplasmic staining**

<b>Tumor Type</b>	<b>Number of Samples</b>	<b>% positive (H score <math>\geq 1</math>)</b>	<b>H-Score Distribution</b>		
			<b>1-100</b>	<b>101-200</b>	<b>201-300</b>
NSCLC Adenocarcinoma	80	90%	46%	39%	5%
NSCLC Squamous	80	81%	65%	13%	3%

Tumor Type	Number of Samples	% positive (H score $\geq 1$ )	H-Score Distribution		
			1-100	101-200	201-300
CRC Adenocarcinoma	78	91%	51%	41%	0%
Gastric Adenocarcinoma	15	100%	27%	53%	20%

**Example 8****Anti-ADAM9 Antibody Internalization Studies**

**[0355]** To assess the internalization of the anti-ADAM9 antibodies of the invention, flow cytometry-based internalization experiments were performed on hMAB-A(2.2), hMAB-A(21.2), and hMAB-A(21.2)-S442C antibodies conjugated to Alexa Fluor 488.

**[0356]** Anti-ADAM9 Alexa488 antibody conjugates for hMAB-A(2.2), hMAB-A(21.2), hMAB-A(21.2)-S442C were generated using Alexa Fluor 488 tetrafluorophenyl ester according to the manufacturer's instructions (Thermofisher). The conjugates were eluted in sodium azide free PBS, pH7.2 to enable internalization assays. The concentration and degree of labeling were calculated from absorption measurements at 280 nm and 494 nm. FACS binding assays were performed to ensure that Alexa488-labeling did not adversely affect target binding.

**[0357]** The internalization of anti-ADAM9-Alexa488 conjugates was determined following both continuous and pulse exposure to the fluorescent conjugates. For continuous experiments, NCI-HI703 cells were treated with a saturating concentration of the indicated Alexa488-labeled antibody on ice or at 37°C for the entire time indicated. While for pulse experiments anti-ADAM9-Alexa488 conjugates were prebound to the cells on ice and the excess conjugate washed away before shifting to 37°C and monitoring internalization. At the indicated time points following either continuous or pulse exposure, cells were lifted with versene (Thermofisher) and washed with ice-cold PBS twice, and replicate wells were resuspended in ice-cold PBS without (unquenched samples) or with 300nM anti-A488 antibody (quenched samples). All samples were incubated for 30 m on ice. Cells were then pelleted, fixed in 1% paraformaldehyde and analyzed by flow cytometry. The fluorescence of cells incubated on ice for 30 minutes and then incubated with anti-Alexa488 antibody represents the unquenchable fluorescent fraction and was subtracted from all other samples prior to calculating internalization. The percent internalization was calculated as fluorescence of quenched samples corrected for incomplete surface quenching (intracellular fluorescence) divided by that of unquenched cells (total fluorescence). The internalization of anti-ADAM9 antibody conjugates were graphed and the data was fitted using a single-phase exponential decay equation (GraphPad Prism, ver. 5.01).

**[0358]** The internalization of surface bound Alexa488-labeled anti-ADAM9 antibodies was

evaluated after both pulse and continuous treatment in NCI-H1703 cells. All three anti-ADAM9-Alexa488 conjugates tested showed rapid internalization, with ~39% of the conjugates internalized in the first 15 minutes and a total of ~77% internalized after 6 hours (FIG. 7A). Interestingly, after continuous exposure for 24 hours, the internalized fluorescent signal was ~7-fold greater than the total initial fluorescent signal bound to the cell surface after 30 minutes (FIG. 7B). Thus, ADAM9 is likely replenished at the cell surface from an intracellular pool during incubations at 37°C, allowing for multiple rounds of anti-ADAM9 antibody conjugate internalization. The efficacy of anti-ADAM9 immunoconjugates rely on of the internalization, intracellular trafficking, and degradation of the immunoconjugates. The potency of anti-ADAM9 immunoconjugates can in part be explained by the high internalization of anti-ADAM9 immunoconjugates which likely leads to generation of high amounts of cytotoxic catabolites.

### Example 9

#### Anti-ADAM9 Antibody Cell Processing Studies

**[0359]** To assess the on-cell target binding, uptake and lysosomal degradation of chMAB-A, a previously-described  $^3\text{H}$ -propionamide-labeled antibody processing method was used (Lai et al., Pharm Res. 2015 Nov; 32(11):3593-603). Using this method, the ADAM9-targeting chMAB-A antibody was trace labeled with tritiated propionate via lysine residues. It has previously been shown that upon cellular binding, uptake, and trafficking to the lysosome, [ $^3\text{H}$ ]propionate labeled-Ab ( $^3\text{H}$ -Ab) is degraded and lysine- $^3\text{H}$ propionamide is released into the cell growth medium. Addition of organic solvent precipitates the intact, labeled antibody and leaves the lysine- $^3\text{H}$ propionamide in solution, allowing convenient and accurate measurement of the extent of antibody processing.

**[0360]** chMAB-A was labeled with [ $^3\text{H}$ ]-propionate as previously described. The NSCLC line, NCI-H1703, and the CRC line, DLD-1, were treated with 10 nM  $^3\text{H}$ -chMAB-A antibody after determination of antigen saturation via binding curve. Some cell samples were treated with the non-targeting, tritiated isotype control antibody,  $^3\text{H}$ -chKTI, while others were untreated. Cells were plated and grown overnight in 6-well plates and then pulse-treated with reagent(s) as previously described. Briefly, cells were incubated with either  $^3\text{H}$ -chMAB-A antibody or  $^3\text{H}$ -chKTI for 20 minutes before washing 3 times in fresh media. Cells were incubated overnight at 37°C with 5%  $\text{CO}_2$ . After a 20-24 hour incubation cells were harvested and protein precipitated with 4:3 volume acetone: media/cell mixture. Samples were frozen at -80 °C for a minimum of 1 hour before thawing and separating by centrifuge. Pellets were treated to solubilize protein prior to counting for 5 minutes in a Tri-Carb liquid scintillation counter (LSC). Per manufacturer's protocol, 1 mL of SOLVABLE (Perkin Elmer) was added to each pellet sample and incubated in a 50 °C water bath overnight. Samples were removed from the water bath, transferred to 20 mL glass scintillation vials and EDTA and  $\text{H}_2\text{O}_2$  were added to samples followed by an additional 1 hour 50 °C incubation. Samples were quenched with HCl, 15 mL of Optima Gold liquid scintillation fluid

(Perkin Elmer) was added, and samples were vortexed thoroughly. Samples were kept in the dark for a minimum of 4 hour before counting by LSC. Protein-free acetone extract samples were dried to <1 mL volumes under vacuum and processed using Solvable as described above prior to LSC. The amount of bound, degraded, and intact labeled antibody were calculated from the resulting sample CPM values.

**[0361]** The level of processing of  $^3\text{H}$ -chMAB-A antibody was determined after pulse-treatment and overnight incubation at 37 °C. NCI-H1703 cells showed 93% of  $^3\text{H}$ -chMAB-A processed within 24 hours, and DLD-1 cells showed 92% of  $^3\text{H}$ -chMAB-A processed in the same time period. Binding and processing of  $^3\text{H}$ -chKTI was negligible (>100-fold lower total CPM than for targeted antibody). The processing values for these cell lines are high, especially compared to the 24 hour pulse processing values previously reported for other ADC targets/antibodies supporting the anti-ADAM9 antibodies described herein as effective drug conjugates.

#### Example 10

#### Binding Affinity Studies of Humanized/Optimized Anti-ADAM9 Antibodies and Drug Conjugates

**[0362]** To evaluate the consequence of conjugation on antigen binding, the relative binding affinity of each anti-ADAM9 immunoconjugate and its respective unconjugated antibody to ADAM9 was determined by FACS analysis on 300-19 cells ectopically-expressing either human ADAM9 or cynomolgus ADAM9. Briefly, the ADAM9-expressing 300-19 cells were incubated with dilution series of anti-ADAM9 antibodies or immunoconjugates for 30 min @ 4°C in FACS buffer (PBS, 0.1% BSA, 0.01% NaN<sub>3</sub>). Samples were then washed and incubated with fluorescently-labeled secondary antibody for 30 minutes at 4°C. The normalized mean of fluorescence intensity at each concentration was plotted and the EC<sub>50</sub> of binding was calculated using a nonlinear regression analysis (GraphPad Prims 4.0). The results from this study are summarized in Table 14.

**[0363]** All of the anti-ADAM9 antibodies and immunoconjugates tested bound with similar affinity to human ADAM9 with an EC<sub>50</sub> of approximately 1.4 nM measured by flow cytometry, indicating that conjugation did not appreciably alter antibody binding affinity (see,

**[0364]** FIGs. 8A-8D). While humanization improved binding to cynomolgus ADAM9 relative to the chimeric antibody (chMAB-A), further optimized variants (hMAB-A(2C.2), hMAB-A(21.2), and hMAB-A(21.2) S442C) and their immunoconjugates exhibited dramatically improved binding to cynomolgus ADAM9. The dramatic improvement in binding to cynomolgus ADAM9 facilitates toxicology and safety studies to validate the use of ADAM9 immunoconjugates as drug therapies.

**Table 14**

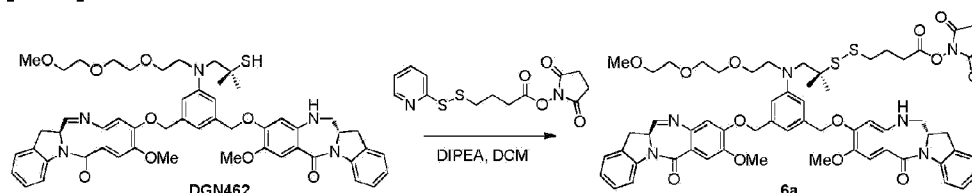
Anti-ADAM9 antibody/immunoconjugate	EC <sub>50</sub> (nM) by FACS		
	300-19: human ADAM9	300-19: cynoADAM9	cyno/ human ADAM9

	huADAM9	9	human
<b>chMAB-A</b>	0.41	112.2	273
chMAB-A-sSPDB-DM4	0.95	275.3	290
chMAB-A-DGN-549	1.24	153.2	123
<b>hMAB-A(2.2)</b>	0.69	32.7	47
hMAB-A(2.2)-sSPDB-DM4	1.11	13.3	12
hMAB-A(2.2)-DGN549	1.55	22.3	14
<b>hMAB-A(2C.2)</b>	1.22	3.8	3
hMAB-A(2C.2)-sSPDB-DM4	1.50	4.4	3
hMAB-A(2C.2)-DGN549	1.99	5.6	3
<b>hMAB-A(2I.2)</b>	1.49	4.1	3
hMAB-A(2I.2)-sSPDB-DM4	1.55	4.9	3
hMAB-A(2I.2)-DGN549	2.25	6.6	3
<b>hMAB-A(2I.2) S442C</b>	1.33	3.8	3
hMAB-A(2I.2) S442C-DGN549	2.49	6.2	2

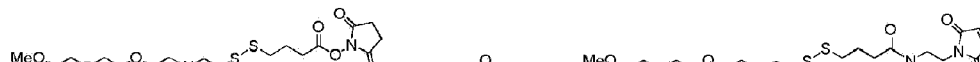
### Example 11

**Synthesis of N-(2-(2,5-dioxo-2,5-dihydro-1H-pyrrol-1-yl)ethyl)-11-(3-(((S)-8-methoxy-6-oxo-11,12,12a,13-tetrahydro-6H-benzo[5,6][1,4]diazepino[1,2-a]indol-9-yl)oxy)methyl)-5-(((S)-8-methoxy-6-oxo-12a,13-dihydro-6H-benzo[5,6][1,4]diazepino[1,2-a]indol-9-yl)oxy)methyl)phenyl)-13,13-dimethyl-2,5,8-trioxa-14,15-dithia-11-azanonadecan-19-amide, Compound D6**

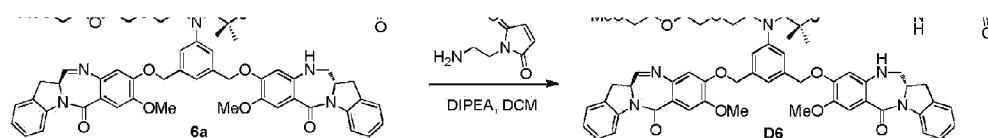
#### [0365]



**[0366]** Step 1: To a solution of the free thiol DGN462 (40 mg, 0.042 mmol) and NHS 4-(2-pyridyldithio)butanate (35 mg, 80% purity, 0.085 mmol) in anhydrous dichloromethane (0.5 mL) was added anhydrous diisopropylethylamine (0.015 mL, 0.085 mmol) and was stirred at room temperature for 16 hours. The reaction mixture was quenched with saturated ammonium chloride and diluted with dichloromethane. The obtained mixture was separated in a separatory funnel. The organic layer was washed with brine, dried over anhydrous sodium sulfate, filtered and stripped under reduced pressure. The residue was purified by semi-preparative reverse phase HPLC (C18 column, CH<sub>3</sub>CN/H<sub>2</sub>O). The fractions that contained pure product were combined, frozen and lyophilized to give the desired NHS ester, compound 6a (29.7 mg, 60% yield). LCMS = 9.1 min (15 min method). MS (m/z): 1157.3 (M + 1)<sup>+</sup>.





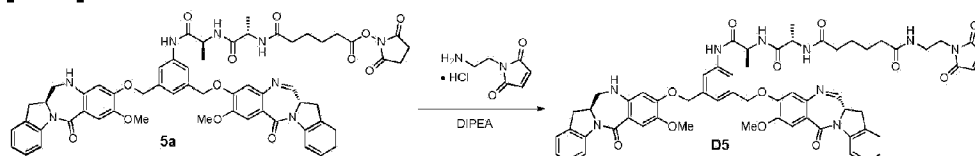


**[0367]** Step 2: To a solution of the NHS ester, compound 6a (12.3 mg, 0.011 mmol) and N-(2-aminoethyl)maleimide hydrochloride (2.0 mg, 0.011 mmol) in anhydrous dichloromethane (0.3 mL) was added DIPEA (0.0022 mL, 0.013 mmol). The mixture was stirred at room temperature for 3 hours then it was stripped under reduced pressure. The residue was purified by semi-preparative reverse phase HPLC (C18 column, CH<sub>3</sub>CN/H<sub>2</sub>O). The fractions that contained pure product were combined, frozen and lyophilized to give the desired maleimide, compound D6 (10 mg, 80% yield). LCMS = 8.3 min (15 min method). MS (m/z): 1181.8 (M + 1)<sup>+</sup>.

### Example 12

**Synthesis of N1-(2-(2,5-dioxo-2,5-dihydro-1H-pyrrol-1-yl)ethyl)-N6-(((S)-1-(((S)-1-((3-(((S)-8-methoxy-6-oxo-11,12,12a,13-tetrahydro-6H-benzo[5,6][1,4]diazepino[1,2-a]indol-9-yl)oxy)methyl)-5-(((S)-8-methoxy-6-oxo-12a,13-dihydro-6H-benzo[5,6][1,4]diazepino[1,2-a]indol-9-yl)oxy)methyl)phenyl)amino)-1-oxopropan-2-yl)amino)-1-oxopropan-2-yl)adipamide, compound D5**

### [0368]



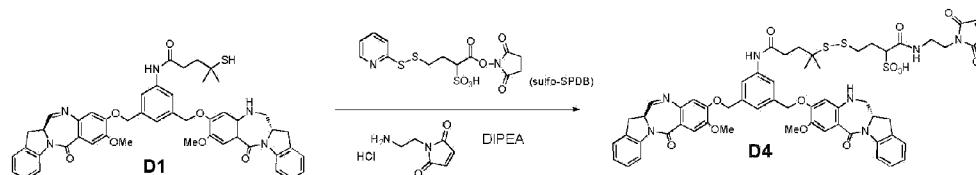
**[0369]** NHS ester, compound 5a (8.2 mg, 7.6 μmol) and 1-(2-aminoethyl)-1H-pyrrole-2,5-dione hydrochloride (2.2 mg, 0.011 mmol) were dissolved in anhydrous dichloromethane (305 μL) at room temperature. DIPEA (2.66 μL, 0.015 mmol) was added and the reaction was stirred for 3.5 hours. The reaction mixture was concentrated and was purified by RPHPLC (C18 column, CH<sub>3</sub>CN/H<sub>2</sub>O, gradient, 35% to 55%). The desired product fractions were frozen and lyophilized to give maleimide, compound D5 as a solid white powder (5.3 mg, 58% yield). LCMS = 5.11 min (8 min method). MS (m/z): 1100.6 (M + 1)<sup>+</sup>.

### Example 13

**Synthesis of 1-((2-(2,5-dioxo-2,5-dihydro-1H-pyrrol-1-yl)ethyl)amino)-4-(((S)-1-((3-(((S)-8-methoxy-6-oxo-11,12,12a,13-tetrahydro-6H-benzo[5,6][1,4]diazepino[1,2-a]indol-9-yl)oxy)methyl)-5-(((S)-8-methoxy-6-oxo-12a,13-dihydro-6H-benzo[5,6][1,4]diazepino[1,2-**

**a[indol-9-yl)oxy)methyl)phenyl)amino)-2-methyl-5-oxopentan-2-yl)disulfanyl)-1-oxobutane-2-sulfonic acid, compound D4**

[0370]

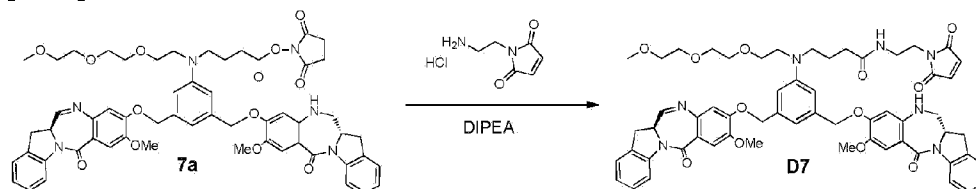


**[0371]** To a suspension of the free thiol, D1 (88 mg, 0.105 mmol) and 1-((2,5-dioxopyrrolidin-1-yl)oxy)-1-oxo-4-(pyridin-2-yl)butane-2-sulfonic acid (sulfo-SPDB) (64.0 mg, 0.158 mmol) in anhydrous dichloromethane (2.10 mL) was added DIPEA (55.0  $\mu$ L, 0.315 mmol) under nitrogen at room temperature. The mixture stirred for 16 hours and then 1-(2-aminoethyl)-1H-pyrrole-2,5-dione hydrochloride (55.6 mg, 0.315 mmol), anhydrous dichloromethane (1.0 mL) and DIPEA (0.055 mL, 0.315 mmol) were added. The mixture stirred for an additional 5 hours at room temperature upon which the reaction was concentrated *in vacuo*. The resulting residue was purified by RP-HPLC (C18, CH<sub>3</sub>CN/H<sub>2</sub>O). Fractions containing desired product were frozen and lyophilized to give maleimide, D4 (20 mg, 16% yield) as a white solid. LCMS = 4.92 min (8 min method). MS (*m/z*): 1158.6 (*M* + 1)<sup>+</sup>.

**Example 14**

**Synthesis of N-(2-(2,5-dioxo-2,5-dihydro-1H-pyrrol-1-yl)ethyl)-11-(3-(((S)-8-methoxy-6-oxo-11,12,12a,13-tetrahydro-6H-benzo[5,6][1,4]diazepino[1,2-a]indol-9-yl)oxy)methyl)-5-(((S)-8-methoxy-6-oxo-12a,13-dihydro-6H-benzo[5,6][1,4]diazepino[1,2-a]indol-9-yl)oxy)methyl)phenyl)-2,5,8-trioxo-11-azapentadecan-15-amide, compound D7**

[0372]



**[0373]** To a solution of NHS ester, 7a (5 mg, 4.82  $\mu$ mol) and 1-(2-aminoethyl)-1H-pyrrole-2,5-dione hydrochloride (1.7 mg, 9.64  $\mu$ mol) in anhydrous dichloromethane (200  $\mu$ L) was added DIPEA (1.512  $\mu$ L, 8.68  $\mu$ mol) under nitrogen. The mixture was stirred at room temperature for 4 hours and then concentrated *in vacuo*. The resulting residue was purified by RP-HPLC (C18, CH<sub>3</sub>CN / H<sub>2</sub>O). Fractions containing desired product were frozen and lyophilized to give

maleimide, compound **D7** (3.5 mg, 68% yield). LCMS = 4.61 min (15 min method). MS (m/z): 1062.8 (M + 1)<sup>+</sup>.

#### Example 15

##### Preparation of Cysteine Site-Specific Conjugate of the anti-ADAM9 Antibody hMAB-A(2I.2)-S442C-DGN549

**[0374]** hMAB-A(2I.2)-S442C is a humanized/optimized antibody with a light chain sequence of SEQ ID NO:68 (comprising a VL sequence of SEQ ID NO:55), and a heavy chain sequence of SEQ ID NO:142 (comprising a VH sequence of SEQ ID NO:28), which includes an engineered Cys corresponding to the 6<sup>th</sup> to the last residue of SEQ ID NO:142, when X is a lysine, or corresponding to the 5<sup>th</sup> to the last residue of SEQ ID NO: 142, when X is absent.

**[0375]** The two unpaired cysteine residues in the hMAB-A(2I.2)-S442C antibody were reduced using standard procedures. To a solution of this intermediate in phosphate buffered saline (PBS), 5 mM *N,N,N',N'*-ethylenediaminetetracetic acid (EDTA) pH 6.0 was added *N,N*-dimethylacetamide (DMA), propylene glycol, and 10 molar equivalents of DGN549-C (compound D5) as a stock solution in DMA to give a reaction mixture with a final solvent composition of 2% v/v DMA and 38% v/v propylene glycol in PBS 5mM EDTA pH 6.0 and the reaction was allowed to proceed overnight at 25°C.

**[0376]** The conjugate was purified into 20 mM succinate, 8.5% sucrose, 0.01% Tween-20, 50 μM sodium bisulfite, pH 4.2 using a fast protein liquid chromatography (FPLC) system fitted with Sephadex G-25 Fine desalting columns with the flow rate set to 5 mL/min. The conjugate was then filtered through a 0.22 μm syringe filter. The conjugate was found to have an average of 1.9 mol DGN549/mol antibody by UV-vis, 97.6% monomer by SEC, and 0.8% unconjugated DGN549 by tandem SEC/RP-UPLC. LC-MS of the deglycosylated conjugate is not shown.

#### Example 16

##### Preparation of Lysine-Linked IGN Conjugates of anti-ADAM9 Antibodies

###### a. Preparation of hMAB-A(2I.2)-DGN549

**[0377]** hMAB-A(2I.2) is a humanized/optimized antibody with a light chain sequence of SEQ ID NO:68 and a heavy chain sequence of SEQ ID NO:52. To a solution containing the hMAB-A(2I.2)antibody buffered at pH 8.5 with 15 mM 2-[4-(hydroxyethyl)piperzin-1-yl]ethanesulfonic

acid (HEPES), N,N-dimethylacetamide (DMA) was added along with 4.8 equivalents of DGN549-L (compound D2) as a stock solution in DMA such that the final solvent composition was 10% (v/v) DMA and 90% (v/v) aqueous buffer. The reaction was allowed to proceed for 4 hr. at 25°C.

**[0378]** The conjugate was purified into 20 mM succinate, 8.5% sucrose, 0.01% Tween-20, 50 µM sodium bisulfite, pH 5.2 over Sephadex G-25 desalting columns, dialyzed against this buffer using a membrane with a 10 kDa molecular weight cutoff, and filtered through a 0.22 µm syringe filter.

**[0379]** The conjugate had an average of 2.8 mol DGN549/mol antibody by UV-vis, 98.6% monomer by SEC, and < 0.5% unconjugated DGN549 by tandem SEC/RP-UPLC. LC-MS of the deglycosylated conjugate is not shown.

#### **b. Preparation of hMAB-A(2.2)-DGN549**

**[0380]** hMAB-A(2.2) is a humanized antibody with a light chain sequence of SEQ ID NO:68 and a heavy chain sequence of SEQ ID NO:50. The hMAB-A(2.2) antibody was conjugated to DGN549 using the same conditions as those described for hMAB-A(2I.2)-DGN549, except that 4.4 equivalents of DGN549-L (compound D2) were added to the reaction. hMAB-A(2.2)-DGN549 was purified in the same manner as described for hMAB-A(2I.2)-DGN549.

**[0381]** Purified hMAB-A(2.2)-DGN549 had an average of 2.7 mol DGN549/mol antibody by UV-vis, 95.6% monomer by SEC, and 0.6% unconjugated DGN549 by tandem SEC/RP-UPLC. LC-MS of the deglycosylated conjugate is not shown.

#### **c. Preparation of hMAB-A(2C.2)-DGN549**

**[0382]** hMAB-A(2C.2) is a humanized/optimized antibody with a light chain sequence of SEQ ID NO:68 and a heavy chain sequence of SEQ ID NO:51.

**[0383]** The hMAB-A(2C.2) antibody was conjugated to DGN549 using the same conditions as those described for hMAB-A(2I.2)-DGN549, except that 4.9 equivalents of DGN549-L (compound D2) were added to the reaction. hMAB-A(2C.2)-DGN549 was purified in the same manner as described for hMAB-A(2I.2)-DGN549.

**[0384]** Purified hMAB-A(2C.2)-DGN549 had an average of 2.8 mol DGN549/mol antibody by UV-vis, 98.6% monomer by SEC, and < 0.6% unconjugated DGN549 by tandem SEC/RP-UPLC. LC-MS of the deglycosylated conjugate is not shown.

#### **d. Preparation of chMAB-A-DGN549, chMAB-A-sSPDB-IGN137, chMAB-A-IGN23, and chMAB-A-sSPDB-DGN462**

**[0385]** The chMAB-A antibody was conjugated to DGN549 using the same conditions as those described for hMAB-A(2I.2)-DGN549, except that 3.4 equivalents of DGN549-L (compound D2) were added to the reaction. chMAB-A-DGN549 was purified in the same manner as described for hMAB-A(2I.2)-DGN549, except that the conjugate was purified into 20 mM histidine, 50 mM sodium chloride, 8.5% sucrose, 0.01% Tween-20, 50  $\mu$ M sodium bisulfite, pH 6.2. Purified chMAB-A-DGN549 had an average of 2.7 mol DGN549/mol antibody by UV-vis, 94.4% monomer by SEC, and < 0.4% unconjugated DGN549 by tandem SEC/RP-UPLC. LC-MS of the deglycosylated conjugate is not shown.

**[0386]** The chMAB-A antibody was conjugated to IGN137 (compound D1) via the sulfo-SPDB linker as described previously in U.S. Patent No. 9,381,256. The conjugate was purified in the same manner as described for hMAB-A(2I.2)-DGN549, except that the conjugate was purified into 20 mM histidine, 50 mM sodium chloride, 8.5% sucrose, 0.01% Tween-20, 50  $\mu$ M sodium bisulfite, pH 6.2. The conjugate had an average of 2.9 mol IGN137/mol antibody by UV-vis, 88.4% monomer by SEC, and  $\leq$ 0.4% unconjugated IGN137 by tandem SEC/RP-UPLC. LC-MS of the deglycosylated conjugate is not shown.

**[0387]** The chMAB-A antibody was conjugated to IGN23 (compound D3) as described previously in U.S. Patent No. 8,426,402. The conjugate was purified in the same manner as described for hMAB-A(2I.2)-DGN549, except that the conjugate was purified into 20 mM histidine, 50 mM sodium chloride, 8.5% sucrose, 0.01% Tween-20, 50  $\mu$ M sodium bisulfite, pH 6.2 and dialysis was not performed. The conjugate had an average of 3.2 mol IGN23/mol antibody by UV-vis, 97.9% monomer by SEC, and 1.2% unconjugated IGN23 by reversed phase HPLC analysis. LC-MS of the deglycosylated conjugate is not shown.

**[0388]** The chMAB-A antibody was conjugated to DGN462 via sulfo-SPDB as described previously in U.S. Patent No. 8,765,740. The conjugate was purified in the same manner as described for hMAB-A(2I.2)-DGN549, except that the conjugate was purified into 20 mM histidine, 50 mM sodium chloride, 8.5% sucrose, 0.01% Tween-20, 50  $\mu$ M sodium bisulfite, pH 6.2 and dialysis was not performed. The conjugate had an average of 2.8 mol DGN462/mol antibody by UV-vis, 95.6% monomer by SEC, and 0.5% unconjugated DGN462 by reversed phase HPLC analysis. LC-MS of the deglycosylated conjugate is not shown.

## **Example 17**

### **Preparation of Lysine-Linked DM Conjugates of anti-ADAM9 Antibodies**

#### **a. Preparation of hMAB-A(2I.2)-sSPDB-DM4**

**[0389]** hMAB-A(2I.2) is a humanized/optimized antibody with a light chain sequence of SEQ ID NO:68 and a heavy chain sequence of SEQ ID NO:52.

**[0390]** To prepare the **hMAB-A(2I.2)-sSPDB-DM4** conjugate, sulfo-SPDB (sSPDB) and DM4 additions were performed in a step-wise manner. First, a solution containing hMAB-A(2I.2) antibody buffered at pH 8.1 with 50 mM 4-(2-Hydroxyethyl)-1-piperazinepropanesulfonic acid (EPPS), 50 mM sodium chloride was mixed with DMA and 11.5 equivalents of sSPDB from a DMA stock solution such that the final solvent composition was 10% (v/v) DMA and 90% (v/v) aqueous buffer. After allowing the first reaction step to proceed for 4 hr. at 25°C, 17.3 equivalents of DM4 from a DMA stock solution, DMA, and 500 mM EPPS/500 mM sodium chloride pH 8.1 buffer were added to the reaction mixture such that the final solvent composition of 10% (v/v) DMA and 90% (v/v) aqueous buffer from the first reaction step was maintained. The second reaction step was allowed to proceed overnight at 25°C.

**[0391]** The conjugate was purified into 10 mM succinate, 250 mM glycine, 0.5% sucrose, 0.01% Tween-20, pH 5.5 over Sephadex G-25 desalting columns, dialyzed against this buffer using a membrane with a 10 kDa molecular weight cutoff, and filtered through a 0.22 µm syringe filter.

**[0392]** The conjugate had an average of 3.5 mol DM4/mol antibody by UV-vis, 99.2% monomer by SEC, and ≤ 1.7% unconjugated DM4 by mixed-mode HPLC. LC-MS of the deglycosylated conjugate is not shown.

#### **b. Preparation of hMAB-A(2C.2)-sSPDB-DM4**

**[0393]** hMAB-A(2C.2) is a humanized/optimized antibody with a light chain sequence of SEQ ID NO:68 and a heavy chain sequence of SEQ ID NO:51.

**[0394]** The hMAB-A(2C.2) antibody was conjugated to DM4 via the sSPDB linker using the same method as that described for hMAB-A(2I.2)-sSPDB-DM4. The conjugate was purified in the same manner as that described for hMAB-A(2I.2)-sSPDB-DM4.

**[0395]** The conjugate had an average of 3.2 mol DM4/mol antibody by UV-vis, 98.9% monomer by SEC, and 2.6% unconjugated DM4 by mixed-mode HPLC. LC-MS of the deglycosylated conjugate is not shown.

#### **c. Preparation of hMAB-A(2.2)-sSPDB-DM4**

**[0396]** hMAB-A(2.2) is a humanized antibody with a light chain sequence of SEQ ID NO:68 and a heavy chain sequence of SEQ ID NO:50.

**[0397]** The hMAB-A(2.2) antibody was conjugated to DM4 via the sSPDB linker using the same method as that described for hMAB-A(2I.2)-sSPDB-DM4. The conjugate was purified into 10 mM succinate, 250 mM glycine, 0.5% sucrose, 0.01% Tween-20, pH 5.5 using a fast protein liquid chromatography (FPLC) system fitted with Sephadex G-25 Fine desalting columns and then filtered through a 0.22 µm syringe filter

**[0398]** The conjugate had an average of 3.2 mol DM4/mol antibody by UV-vis, 97.4% monomer by SEC, and  $\leq 1.1\%$  unconjugated DM4 by mixed-mode HPLC. LC-MS of the deglycosylated conjugate is not shown.

#### **d. Preparation of chMAB-A-sSPDB-DM4 and chMAB-A-SMCC-DM1**

**[0399]** The chMAB-A antibody was conjugated to DM4 via the sulfo-SPDB linker using the same method as that described for hMAB-A(2I.2)-sSPDB-DM4, except that 6.4 equivalents of sSPDB and 9.6 equivalents of DM4 were used in the respective reaction steps. The conjugate was purified in the same manner as that described for hMAB-A(2I.2)-sSPDB-DM4, except that dialysis was not performed. The conjugate had an average of 3.4 mol DM4/mol antibody by UV-vis, 97.0% monomer by SEC, and 4.7% unconjugated DM4 by mixed-mode HPLC. LC-MS of the deglycosylated conjugate is not shown.

**[0400]** The chMAB-A antibody was conjugated to DM1 via the SMCC linker using previously described methods in U.S. Patent No. 8624003. The conjugate was purified in the same manner as that described for hMAB-A(2I.2)-sSPDB-DM4, except that dialysis was not performed. The conjugate had an average of 3.9 mol DM1/mol antibody by UV-vis, 99.7% monomer by SEC, and 4.9% unconjugated DM1 by mixed-mode HPLC. LC-MS of the deglycosylated conjugate is not shown.

#### **Example 18**

#### ***In vitro* Cytotoxicity of anti-ADAM9 Antibody Drug Conjugates**

**[0401]** The *in vitro* cytotoxicity of various anti-ADAM9 antibody immunoconjugates against a panel of ADAM9-expressing cell lines was compared to non-targeting IgG1 conjugates. Specifically, 500 to 2000 cells/well were plated in 96-well plates 24 hours prior to treatment. Conjugates were diluted into the culture medium using 3-fold dilution series and 100 $\mu$ L were added per well. Control wells containing cells but lacking conjugate, as well as wells contained medium only, were included in each assay plate. Assays were performed in triplicate for each data point. The plates were incubated at 37°C in a humidified 5% CO<sub>2</sub> incubator for 4 to 5 days. Then the relative number of viable cells in each well was determined using the WST-8 based Cell Counting Kit-8 (Dojindo Molecular Technologies). The surviving fraction of cells in each well was calculated by first correcting for the medium background absorbance, and then dividing each value by the average of the values in the control wells (non-treated cells). The percentage of surviving cells was plotted against conjugate concentration and the EC<sub>50</sub> of activity was calculated using a nonlinear regression analysis (GraphPad Prims 4.0).

**[0402]** These results show that anti-ADAM9 immunoconjugates can kill a broad panel of ADAM9-positive tumor cell lines, including lung, pancreatic, renal, prostate, and colon tumor cell lines (see

FIGs. 9A-9H). In each case tested, a good specificity window is observed, suggesting that cytotoxicity is a result of specific anti-ADAM9 antibody binding to target cells. In particular, the anti-ADAM9-DGN549 conjugates (hMAB-A(2.2)-DGN549 and hMAB-A(2I.2)-S442C-DGN549) were extremely potent with IC<sub>50</sub> values ranging from 1 to 115 pM and were ~3 logs more active than a non-targeting IgG1 conjugate (see, Table 15).

**Table 15**

Cell Line	Disease Type	anti-ADAM9 ADC	In Vitro Cytotoxicity (IC <sub>50</sub> nM)	Fold-specificity (IC <sub>50</sub> control ADC/IC <sub>50</sub> anti-ADAM9 ADC)
<b>NCI-H1703</b>	NSCLS - Squamous Cell	hMAB-A(2.2)-sSPDB-DM4	0.024	152
		hMAB-A(2I.2)-sSPDB-DM4	0.028	132
		hMAB-A(2.2)-DGN549	0.002	>1000
		hMAB-A(2I.2) S442C-DGN549	0.004	>1000
<b>DLD-1</b>	Colorectal Adenocarcinoma	hMAB-A(2.2)-sSPDB-DM4	2.729	9
		hMAB-A(2I.2)-sSPDB-DM4	0.386	63
		hMAB-A(2.2)-DGN549	0.010	>1000
		hMAB-A(2I.2) S442C-DGN549	0.045	>1000
<b>A498</b>	Kidney Carcinoma	hMAB-A(2.2)-sSPDB-DM4	0.119	27
		hMAB-A(2I.2)-sSPDB-DM4	0.108	30
		hMAB-A(2.2)-DGN549	0.001	>1000
		hMAB-A(2I.2) S442C-DGN549	0.004	>1000
<b>DU145</b>	Prostate Carcinoma	hMAB-A(2.2)-sSPDB-DM4	0.570	25
		hMAB-A(2I.2)-sSPDB-DM4	0.439	32
		hMAB-A(2.2)-DGN549	0.002	>1000
		hMAB-A(2I.2) S442C-DGN549	0.004	>1000
<b>HPAF2</b>	Pancreatic Adenocarcinoma	hMAB-A(2.2)-sSPDB-DM4	0.622	9
		hMAB-A(2I.2)-sSPDB-DM4	0.422	13
		hMAB-A(2.2)-DGN549	0.043	>1000
		hMAB-A(2I.2) S442C-DGN549	0.115	>1000
<b>IGROV1</b>	Ovarian Adenocarcinoma	hMAB-A(2.2)-sSPDB-DM4	4.078	3
		hMAB-A(2I.2)-sSPDB-DM4	1.411	8
		hMAB-A(2.2)-DGN549	0.001	>1000
		hMAB-A(2I.2) S442C-DGN549	0.003	>1000
<b>KATO III</b>	Gastric Carcinoma	hMAB-A(2.2)-sSPDB-DM4	1.154	5
		hMAB-A(2I.2)-sSPDB-DM4	0.480	11
		hMAB-A(2.2)-DGN549	0.031	>1000
		hMAB-A(2I.2) S442C-DGN549	0.065	>1000
<b>HS578T</b>	Breast Carcinoma	hMAB-A(2.2)-sSPDB-DM4	0.119	16
		hMAB-A(2I.2)-sSPDB-DM4	0.094	20
		hMAB-A(2.2)-DGN549	0.009	>1000
		hMAB-A(2I.2) S442C-DGN549	0.017	646

#### Example 19



### Anti-tumor Activity of anti-ADAM9 Antibody Drug Conjugates in SCID Mice Bearing Calu3 Human Non-Small Cell Lung Adenocarcinoma Xenografts

**[0403]** The antitumor activity of varying doses of hMAB-A(2.2)-sSPDB-DM4 and a single dose of chMAB-A-DGN549 conjugates was evaluated in female SCID mice bearing Calu3 cells, a human lung adenocarcinoma subcutaneous xenograft model.

**[0404]** Calu3 cells were harvested for inoculation, with 99% viability determined by trypan blue exclusion. Mice were inoculated with  $5 \times 10^6$  Calu3 cells in 0.2ml 50% Matrigel/ 50% serum free medium by subcutaneous injection in the area on the right hind flank. Eighty-four female SCID Mice (6 weeks of age) were obtained from Charles River Laboratories. Upon receipt, the animals were observed for 9 days prior to study initiation. Animals showed no sign of disease or illness upon arrival, or prior to treatment.

**[0405]** Eighty-four mice were randomized into 8 groups (8 mice per group) by tumor volume. The tumor volumes ranged from 74.09 to 150.21 ( $106.41 \pm 18.69$ , Mean  $\pm$  SD)  $\text{mm}^3$ . The mice were measured and randomized based on the tumor volume on day 6 post implantation. The mice were dosed on day 7 post implantation. Body weight of the mice ranged from 16.05 to 21.72 ( $18.64 \pm 1.03$ , Mean  $\pm$  SD) grams. Mice in each group were identified by punch method. Administration of the test agents and vehicle were carried out intravenously by using a 1.0 ml syringe fitted with a 27 gauge,  $\frac{1}{2}$  inch needle. The groups included: a control group dosed with vehicle (PBS), chKTI-sSPDB-DM4 at 5 mg/kg, qdx1, hMAB-A(2.2)-sSPDB-DM4 at 1.25 mg/kg (by antibody), qdx1, hMAB-A(2.2)-sSPDB-DM4 at 2.5 mg/kg (by antibody), qdx1, hMAB-A(2.2)-sSPDB-DM4 at 5 mg/kg (by antibody), qdx1, and chMAB-A-DGN549 at 10 $\mu$ g/kg (by payload; 0.6 mg/kg by antibody), qdx1.

**[0406]** Tumor size was measured two times per week in three dimensions using a caliper. The tumor volume was expressed in  $\text{mm}^3$  using the formula  $V = \text{Length} \times \text{Width} \times \text{Height} \times \frac{1}{2}$ . A mouse was considered to have a partial regression (PR) when tumor volume was reduced by 50% or greater, complete tumor regression (CR) when no palpable tumor could be detected and tumor-free survivor (TFS) is the number of mice tumor free at the end of the study. Tumor volume and body weight were determined by StudyLog software. Log<sub>10</sub> cell kill (LCK) was calculated with the formula  $\text{LCK} = (T - C) / T_d \times 3.32$ , where  $(T - C)$ , or tumor growth delay (TGD), is the median time (in days) for the treatment group and control group tumors to reach a predetermined size of 815  $\text{mm}^3$  (tumor-free survivors excluded) <sup>1</sup>,  $T_d$  is the tumor doubling time in mice (estimated from nonlinear exponential curve fit of daily median of control tumor growth) and  $x$  is the number of cell doublings per log of cell growth. %T/C (tumor growth inhibition) is the ratio of the median tumor volume (TV) of the treatment group at a predetermined time (i.e., time when median TV for control tumors reach to the maximum tumor volume, i.e.,  $\text{TV}@ \sim 1000\text{mm}^3$ , or when tumors became necrotic, thus this is the time point when all control group mice came off the study) to the

median TV of the controls at the end point for controls.

**[0407]** Body weight of all the mice was measured two times per week as a rough index of drug toxicity. Body weights (BW) of mice were expressed as percent change in body weight from the pre-treatment body weight as follows: % BW change =  $[(\text{BW post} / \text{BW pre}) - 1] \times 100$ , where BW post is weight after treatment and BW pre is the starting body weight prior to treatment. Percent body weight loss (BWL) was expressed as the mean change in body weight post treatment. Animals were sacrificed when the tumor volume was larger than 1000 mm<sup>3</sup> or necrotic, or if body weight dropped by 20% more at any point in the study.

**[0408]** The results of the study are shown in FIG. 10. hMAB-A(2.2)-sSPDB-DM4 conjugate was active at all doses tested. hMAB-A(2.2)-sSPDB-DM4 conjugate had a tumor growth inhibition (T/C) value of 39%, T-C value of 17, and LCK value of 0.5 at 1.25mg/kg dose (with 3 partial regression out of 8 mice and complete regressions); a T/C value of 25%, T-C value of 22, and LCK value of 0.7 at 2.5mg/kg (with 3 partial regression out of 8 mice and no complete regressions), and a T/C value of 14%, T-C value of 36, and LCK value of 1.1 at 5mg/kg dose (with 4 partial regressions out of 8 mice and 1 complete regressions out of 8 mice). chMAB-A-DGN549 was highly active at 10µg/kg (by payload; 0.6 mg/kg by antibody) with 8 complete regressions out of 8 mice. No significant body weight loss was observed with either the hMAB-A(2.2)-sSPDB-DM4, or the chMAB-DGN549, or the chKTI-sSPDB-DM4 conjugates at the indicated doses, and thus all three conjugates were well tolerated in mice at the indicated doses in this study. The results show that hMAB-A(2.2)-sSPDB-DM4 conjugate is active at varying doses in this model. The results also show that chMAB-A-DGN549 is highly active at 10 µg/kg (by payload; 0.6 mg/kg by antibody).

**[0409]** The antitumor activity of various doses of hMAB-A(2.2)-S442C-DGN549 as a single i.v. dose was also evaluated in female SCID mice bearing Calu-3 tumor xenografts, a NSCLC model. Six days post inoculation, mice were randomized into 8 groups (n=8 per group) by tumor volume. The treatment groups included a control group dosed with vehicle (PBS), hMAB-A(2.2)-S442C-DGN549 conjugate dosed at 0.5 (by payload; 0.04 mg/kg by antibody), 1 (by payload; 0.08 mg/kg by antibody), 3 (by payload; 0.25 mg/kg by antibody) and 10µg/kg (by payload; 0.8 mg/kg by antibody) as a single i.v. dose, as well as a non-targeting control of huKTI-S442C-DGN549 conjugate at 1 (by payload; 0.08 mg/kg by antibody), 3 (by payload; 0.25 mg/kg by antibody) and 10µg/kg (by payload; 0.8 mg/kg by antibody) dosed as a single i.v. dose.

**[0410]** Tumor volumes and body weights were measured as described above and the results are shown in FIG. 11. Briefly, hMAB-A(2.2)-S442C-DGN549 was highly active at even the lowest dose of 0.5µg/kg (by payload; 0.04 mg/kg by antibody) and potent activity was observed at 1 (by payload; 0.08 mg/kg by antibody), 3 (by payload; 0.25 mg/kg by antibody), 10µg/kg (by payload; 0.8 mg/kg by antibody) doses. Non-targeting control, huKTI-S442C-DGN549 was inactive in this model at all three doses tested, i.e. 1 (by payload; 0.08 mg/kg by antibody), 3 (by payload; 0.25 mg/kg by antibody) and 10ug/kg (by payload; 0.8 mg/kg by antibody). hMAB-A(2.2)-S442C-DGN549 at 0.5µg/kg (by payload; 0.04 mg/kg by antibody) had a T/C of 7 %, with 7/8 PR, and 0/8 CR at the study endpoint. hMAB-A(2.2)-S442C-DGN549 at 1µg/kg (by payload; 0.08 mg/kg by antibody) had a T/C of 2 %, with 8/8 PR, and 2/8 CR at the study endpoint. hMAB-A(2.2)-S442C-DGN549 at 3µg/kg (by payload; 0.25 mg/kg by antibody) had a T/C of 0 %, with 8/8 PR, and 8/8

CR at the study endpoint, and hMAB-A(21.2)-S442C-DGN549 at 10µg/kg (by payload; 0.8 mg/kg by antibody) had a T/C of 0 %, with 8/8 PR, and 8/8 CR at the study endpoint.

**[0411]** Both hMAB-A(21.2)-S442C-DGN549 (at 0.5, 1, 3, 10µg/kg, by payload), and huKTI-S442C-DGN549 (at 1,3,10µg/kg, by payload) were well tolerated in mice at all the doses indicated in this study. No significant body weight loss was observed with any of the two conjugates at the indicated doses. The results from this study suggest that hMAB-A(21.2)-S442C-DGN549 conjugate demonstrated compelling anti-tumor activity and is highly efficacious in Calu-3 non-small cell lung cancer tumor xenograft model.

#### **Example 20**

#### **Anti-tumor Activity of anti-ADAM9 Antibody Drug Conjugates in SCID Mice Bearing H1703 Non-Small Cell Lung Squamous Cell Carcinoma Xenografts**

**[0412]** The antitumor activity of varying doses of hMAB-A(2.2)-sSPDB-DM4 conjugate was evaluated in female SCID mice bearing H1703 cells, a NSCLC squamous cell carcinoma xenograft model.

**[0413]** H1703 cells were harvested for inoculation, with 100% viability determined by trypan blue exclusion. Mice were inoculated with  $5 \times 10^6$  H1703 cells in 0.2ml 50% Matrigel/ 50% serum free medium by subcutaneous injection in the area on the right hind flank. Seventy-two female nude mice (6 weeks of age) were obtained from Charles River Laboratories on 3/24/16. Upon receipt, the animals were observed for 8 days prior to study initiation. Animals showed no sign of disease or illness upon arrival, or prior to treatment. Forty eight mice were randomized into 8 groups (6 mice per group) by tumor volume. The tumor volumes ranged from 76.18 to 159.00 ( $115.19 \pm 22.08$ , Mean  $\pm$  SD) mm<sup>3</sup>. The mice were measured and randomized based on the tumor volume on day 19 post implantation. The mice were dosed on day 20 post implantation (4/21/16). Body weight of the mice ranged from 20.20 to 29.15 ( $23.88 \pm 1.95$ , Mean  $\pm$  SD) grams. Mice in each group were identified by punch method. Administration of the test agents and vehicle were carried out intravenously by using a 1.0 ml syringe fitted with a 27 gauge, ½ inch needle. The groups included: a control group dosed with vehicle (PBS) at 150µL/mouse, qdx1, chKTI-sSPDB-DM4 at 5 mg/kg, qdx1, hMAB-A(2.2)-sSPDB-DM4 at 1.25 mg/kg, qdx1, hMAB-A(2.2)-sSPDB-DM4 at 2.5 mg/kg, qdx1, and hMAB-A(2.2)-sSPDB-DM4 at 5 mg/kg, qdx1.

**[0414]** Tumor size and body weight measurements were determined as described in Example 19. The results of the study are shown in FIG. 12. hMAB-A(2.2)-sSPDB-DM4 was highly active at a low dose of 2.5 mg/kg with a T/C of 6%, T-C of 28, and LCK of 1.4 (with 3 partial regressions out of 6 mice and no complete regressions). and highly active at 5mg/kg doses with a T/C of 1%, T-C of 63, and LCK of 3.2 (with 6 partial regressions out of 6 mice, 3 complete regressions out of 6 mice and 1 tumor free survivor). hMAB-A(2.2)-sSPDB-DM4 conjugate was inactive at 1.25mg/kg dose, and had a tumor growth inhibition (T/C) of 79%, T-C of 4, and LCK of 0.2 (with 1 partial

regression out of 6 mice and no complete regressions). No significant body weight loss was observed with either the hMAB-A(2.2)-sSPDB-DM4 or the chKTI-sSPDB-DM4 conjugates at the indicated doses, and thus both conjugates were well tolerated in mice at the indicated doses in this study. The results show that hMAB-A(2.2)-sSPDB-DM4 conjugate is highly active at doses as low as 2.5 mg/kg in this model.

#### **Example 21**

##### **Anti-tumor Activity of anti-ADAM9 Antibody Drug Conjugates in SCID Mice Bearing Detroit562 Squamous Cell Carcinoma of the Head and Neck Xenografts**

**[0415]** The antitumor activity of varying doses of chMAB-A-sSPDB-DM4 conjugates was evaluated in female CD-1 immunodeficient mice bearing Detroit562 cells, a pharyngeal carcinoma xenograft model.

**[0416]** Mice (6 weeks of age) were obtained from Charles River Laboratories on 7/1/14. Upon receipt, the animals were observed for 15 days prior to study initiation. Animals showed no sign of disease or illness upon arrival, or prior to study start. Detroit562 cells were harvested for inoculation, with greater than 90% viability determined by trypan blue exclusion. Mice were inoculated with  $5 \times 10^6$  Detroit562 cells in 0.2ml 50% Matrigel/50% serum free medium by subcutaneous injection in the area on the right hind flank.

**[0417]** Forty-two mice were randomized into 6 groups (7 mice per group) by tumor volume. The tumor volume ranged from 95.76 to 450.83 mm<sup>3</sup>. The mice were measured and randomized based on the tumor volume on day 26 post implantation. Administration of the test agents and vehicle were carried out on the day following randomization (Study Day 0) by intraperitoneal injection using a 1.0 ml syringe fitted with a 27 gauge, ½ inch needle. The groups included: a control group dosed with vehicle (PBS), chKTI-sSPDB-DM4 at 5 mg/kg, qdx1, chKTI-sSPDB-DM4 at 2.5 mg/kg, qdx1, chMAB-A-sSPDB-DM4 at 5 mg/kg, qdx1, chMAB-A-sSPDB-DM4 at 2.5 mg/kg, qdx1, chMAB-A-sSPDB-DM4 at 1.25 mg/kg, qdx1.

**[0418]** Tumor size and body weight measurements were determined as described in Example 19. The results of the study are shown in FIG. 13. Briefly, chMAB-A-sSPDB-DM4 was active at all 3 of the tested dose levels (5, 2.5 and 1.25 mg/kg) over the course of the study. chMAB-A-sSPDB-DM4 at 5 mg/kg had a T/C of 32%, and 6/7 PR and 1/7 CR at the study endpoint. chMAB-A-sSPDB-DM4 at 2.5 mg/kg had a T/C of 27%, and 6/7 PR and 2/7 CR at the study endpoint. chMAB-A-sSPDB-DM4 at 1.25 mg/kg had a T/C of 37%, and 5/7 PR and 0/7 CR at the study endpoint. chKTI-sSPDB-DM4 at 5 mg/kg had a T/C of 89%, and 3/7 PR and 0/7 CR at the study endpoint. chKTI-sSPDB-DM4 at 5 mg/kg had a T/C of 80%, and 3/7 PR and 1/7 CR at the study endpoint.

**[0419]** chMAB-A-sSPDB-DM4 was well tolerated in mice at all doses examined in this study. No

significant body weight loss was observed at the indicated doses. The results from this study suggest that chMAB-A-sSPDB-DM4 conjugate demonstrates anti-tumor activity and is efficacious in Detroit562 pharyngeal carcinoma tumor xenograft model.

**[0420]** In a second study, the antitumor activity of varying doses of chMAB-A-sSPDB-DM4 conjugates was evaluated in female CD-1 immunodeficient mice bearing larger volume Detroit562 tumor xenografts.

**[0421]** Mice (5 weeks of age) were obtained from Charles River Laboratories on 9/17/14. Upon receipt, the animals were observed for 7 days prior to study initiation. Animals showed no sign of disease or illness upon arrival, or prior to study start. Detroit562 cells were harvested for inoculation, with greater than 90% viability determined by trypan blue exclusion. Mice were inoculated with  $5 \times 10^6$  Detroit562 cells in 0.2ml 50% Matrigel/50% serum free medium by subcutaneous injection in the area on the right hind flank.

**[0422]** Eighteen mice were randomized into 3 groups (6 mice per group) by tumor volume. The tumor volume ranged from 277.51 to 503.49 mm<sup>3</sup>. The mice were measured and randomized based on the tumor volume on day 35 post implantation. Administration of the test agents and vehicle were carried out two days following randomization (Study Day 1) by intraperitoneal injection using a 1.0 ml syringe fitted with a 27 gauge, ½ inch needle. The groups included: a control group dosed with vehicle (PBS), chMAB-A-sSPDB-DM4 at 5 mg/kg, qdx1 and chMAB-A-sSPDB-DM4 at 1.25 mg/kg, qdx1.

**[0423]** Tumor size and body weight measurements were determined as described in Example 19. The results of the study are shown in FIG. 14. Briefly, chMAB-A-sSPDB-DM4 was active at the 2 tested dose levels (5 and 1.25 mg/kg) over the course of the study. chMAB-A-sSPDB-DM4 at 5 mg/kg had a T/C of 3%, and 6/6 PR and 1/7 CR at the study endpoint. chMAB-A-sSPDB-DM4 at 1.25 mg/kg had a T/C of 14%, and 6/6 PR and 0/7 CR at the study endpoint.

**[0424]** chMAB-A-sSPDB-DM4 was well tolerated in mice at both doses examined in this study. No significant body weight loss was observed at the indicated doses. The results from this study suggest that chMAB-A-sSPDB-DM4 conjugate demonstrates anti-tumor activity and is efficacious in larger volume Detroit562 pharyngeal carcinoma tumor xenograft model.

## **Example 22**

### **Anti-tumor Activity of anti-ADAM9 Antibody Drug Conjugates in Nude Mice Bearing SNU-5 Gastric Carcinoma Xenografts**

**[0425]** The antitumor activity of varying doses of huMAB-A(2.2)-sSPDB-DM4 and a single dose of huMAB-A(21.2)-S442C-DGN549 conjugates was evaluated in female Nude mice bearing Snu-5 cells, a human gastric carcinoma xenograft model.

**[0426]** Snu-5 cells were harvested for inoculation, with 100% viability determined by trypan blue exclusion. Mice were inoculated with  $5 \times 10^6$  Snu-5 cells in 0.1ml 50% Matrigel/ 50% serum free medium by subcutaneous injection in the area on the right hind flank. Fifty-six female Nude Mice (6 weeks of age) were obtained from Charles River Laboratories on 1/25/17. Upon receipt, the animals were observed for 8 days prior to study initiation. Animals showed no sign of disease or illness upon arrival, or prior to treatment.

**[0427]** Fifty-six mice were randomized into 7 groups (8 mice per group) by tumor volume. The tumor volumes ranged from 76.29 to 129.12 ( $130.58 \pm 13.28$ , Mean  $\pm$  SD) mm<sup>3</sup>. The mice were measured and randomized based on the tumor volume on day 13 post implantation. The mice were dosed on day 14 post implantation (2/17/17). Body weight of the mice ranged from 19.50 to 26.35 ( $22.69 \pm 1.40$ , Mean  $\pm$  SD) grams. Mice in each group were identified by punch method. Administration of the test agents and vehicle were carried out intravenously by using a 1.0 ml syringe fitted with a 27 gauge, ½ inch needle. The groups included: a control group dosed with vehicle (PBS), chKTI-sSPDB-DM4 at 5 mg/kg, huMAB-A(2.2)-sSPDB-DM4 at 2.5 mg/kg, huMAB-A(2.2)-sSPDB-DM4 at 5 mg/kg, huKTI-S442C-DGN549 at 10µg/kg, huMAB-A(2L.2)-S442C-DGN549 at 3µg/kg and huMAB-A(2L.2)-S442C-DGN549 at 10µg/kg.

**[0428]** Tumor size was measured two times per week in three dimensions using a caliper. The tumor volume was expressed in mm<sup>3</sup> using the formula  $V = \text{Length} \times \text{Width} \times \text{Height} \times \frac{1}{2}$ . A mouse was considered to have a partial regression (PR) when tumor volume was reduced by 50% or greater, complete tumor regression (CR) when no palpable tumor could be detected and tumor-free survivor (TFS) is the number of mice tumor free at the end of the study. Tumor volume and body weight were determined by StudyLog software. Log<sub>10</sub> cell kill (LCK) was calculated with the formula  $LCK = (T - C) / T_d \times 3.32$ , where  $(T - C)$ , or tumor growth delay (TGD), is the median time (in days) for the treatment group and control group tumors to reach a predetermined size of 798 mm<sup>3</sup> (tumor-free survivors excluded) <sup>1</sup>,  $T_d$  is the tumor doubling time in mice (estimated from nonlinear exponential curve fit of daily median of control tumor growth) and  $x$  is the number of cell doublings per log of cell growth. %T/C (tumor growth inhibition) is the ratio of the median tumor volume (TV) of the treatment group at a predetermined time (i.e., time when median TV for control tumors reach to the maximum tumor volume, i.e.,  $TV@ \sim 1000\text{mm}^3$ , or when tumors became necrotic, thus this is the time point when all control group mice came off the study) to the median TV of the controls at the end point for controls.

**[0429]** Body weight of all the mice was measured two times per week as a rough index of drug toxicity. Body weights (BW) of mice were expressed as percent change in body weight from the pre-treatment body weight as follows: % BW change =  $[(\text{BW post} / \text{BW pre}) - 1] \times 100$ , where BW post is weight after treatment and BW pre is the starting body weight prior to treatment. Percent body weight loss (BWL) was expressed as the mean change in body weight post treatment. Animals were sacrificed when the tumor volume was larger than 1000 mm<sup>3</sup> or necrotic, or if body weight dropped by 20% more at any point in the study.

**[0430]** The results of the study are shown in FIG. 15 and FIG. 16. huMAB-A(2.2)-sSPDB-DM4

conjugate was highly active at both doses tested. huMAB-A(2.2)-sSPDB-DM4 conjugate had a tumor growth inhibition (T/C) value of 5%, at 2.5mg/kg dose (with 8 partial regression out of 8 mice and 2 complete regressions); a T/C value of 1%, 5mg/kg (with 8 partial regression out of 8 mice and 6 complete regressions). huMAB-A(2L2)-S442C-DGN549 was highly active at both doses tested. huMAB-A(2L2)-S442C-DGN549 conjugate had a (T/C) value of 7%, at 3µg/kg dose (with 8 partial regression out of 8 mice and 4 complete regressions); a T/C value of 4%, 5mg/kg (with 8 partial regression out of 8 mice and 5 complete regressions). No significant body weight loss was observed with either the huMAB-A(2.2)-sSPDB-DM4, or the huMAB-A(2L2)-S442C-DGN549, or the chKTI-sSPDB-DM4, or the huKTI-S442C-DGN549 conjugates at the indicated doses, and thus all conjugates were well tolerated in mice at the indicated doses in this study.

### **Example 23**

#### **Anti-tumor Activity of anti-ADAM9 Antibody Drug Conjugates in Mice Bearing SW48 Colorectal Cancer Cell Line Xenografts**

**[0431]** The antitumor activity of varying doses of hMAB-A(2.2)-sSPDB-DM4 and huMAB-A(2L2)-S442C-DGN649 conjugates were evaluated in female Nude mice bearing SW48 cells, a colorectal cancer cell line xenograft model.

**[0432]** SW48 cells were harvested for inoculation. Mice were inoculated with SW48 cells by subcutaneous injection in the area on the right hind flank. Animals showed no sign of disease or illness upon arrival from laboratories, or prior to treatment.

**[0433]** Forty-two mice were randomized into 7 groups (6 mice per group) by tumor volume. The tumor volumes ranged from 89 to 169 mm<sup>3</sup>. The mice were measured, randomized and dosed based on the tumor volume on day 17 post implantation. Mice in each group were identified by ear tags. Administration of the test agents and vehicle were carried out intravenously. The groups included: a control group dosed with vehicle (PBS), chKTI-sSPDB-DM4 at 10 mg/kg, huMAB-A(2.2)-sSPDB-DM4 at 5 mg/kg, huMAB-A(2.2)-sSPDB-DM4 at 10mg/kg, huKTI-S442C-DGN549 at 5µg/kg, huMAB-A(2L2)-S442C-DGN549 at 2.5 µg/kg and huMAB-A(2L2)-S442C-DGN549 at 5µg/kg.

**[0434]** Tumor size and body weight measurements were determined as described in Example 22. The results of the study are shown in FIG. 17 and FIG. 18. huMAB-A(2.2)-sSPDB-DM4 conjugate was active at both doses tested. huMAB-A(2.2)-sSPDB-DM4 conjugate had a tumor growth inhibition (T/C) value of 13%, at 5mg/kg dose (with no partial or complete regressions); a T/C value of 5%, 10mg/kg (with 6 partial regression out of 6 mice). huMAB-A(2L2)-S442C-DGN549 was active at 5µg/kg dose and inactive at 2.5µg/kg dose tested. huMAB-A(2L2)-S442C-DGN549 conjugate had a (T/C) value of 92%, at 2.5µg/kg dose; a T/C value of 41%, 5µg/kg (with 2 partial regression out of 6 mice). No significant body weight loss was observed with either the huMAB-A(2.2)-sSPDB-DM4, or the huMAB-A(2L2)-S442C-DGN549, or the chKTI-sSPDB-DM4, or the huKTI-S442C-DGN549 conjugates at the indicated doses, and thus all conjugates were well

tolerated in mice at the indicated doses in this study (needs to be confirmed by MGNX).

#### **Example 24**

#### **Extending the Exposure of Anti-ADAM9 Antibody Maytansinoid Conjugates by Improving FcRn Binding**

**[0435]** To maximize the potential of anti-ADAM9 antibody maytansinoid conjugates to drive efficacy, substitutions M252Y, S254T, and T256E ("the YTE mutation") were introduced in the Fc region of anti-ADAM9 antibodies, hMAB-A(2I.2) and hMAB-A(2I.2)-S442C, to extend exposure of the antibody drug conjugates by improving FcRn binding. FcRn plays a major role in the maintenance of serum IgG levels. IgGs that are non-specifically endocytosed bind to FcRn in the endosome due to a pH-dependent interaction. FcRn-bound IgG is then sorted into recycling endosomes and transported back to the cell surface where the IgG is released due to the neutral pH. Enhancing FcRn binding can improve sorting and improved pharmacokinetics.

**[0436]** hMAB-A(2I.2)-YTE-sSPDB-DM4 conjugate was prepared as detailed in Example 17a. hMAB-A(2I.2)-S442C-YTE-sSPDB-DM4 conjugate was prepared as previously described in PCT Publication No. WO2017/004025. As seen in Figures 19A and 19B, the YTE mutation increased binding affinity and avidity of the hMAB-A(2I.2) antibody to human and cyno FcRn. Moreover, the hMAB-A(2I.2)-YTE-sSPDB-DM4 conjugate showed similar in vitro and in vivo activity in NCI-H1703, SNU5, and Calu3 as the parental hMAB-A(2I.2)-sSPDB-DM4 conjugate.

**[0437]** Cynomolgus PK and tolerability studies were performed to characterize the tolerability and pharmacokinetic profile of the hMAB-A(2I.2)-YTE-sSPDB-DM4 conjugate compared to the parental hMAB-A(2I.2)-sSPDB-DM4 conjugate. Both conjugates were administered as 10-minute IV infusions to male cynomolgus monkeys at a dose of 4 and 12 mg/kg (antibody dose) to assess both PK profile and acute tolerability. In addition, the naked antibodies, hMAB-A(2I.2) and hMAB-A(2I.2)-YTE, were administered to male cynomolgus monkeys at a dose of 4 mg/kg to address potential effects of conjugation on PK parameters. Blood was collected over the course of 28 days to allow for the measurement of ADC, total antibody and free payload concentrations. Tolerability was determined based on survival, clinical observations, body weights, and clinical pathology.

**[0438]** As seen in Figures 20, cynomolgus PK data of hMAB-A(2I.2)-YTE-sSPDB-DM4 conjugate compared to parental conjugate revealed that the YTE mutation increased the exposure compared to the parental conjugate. In addition, cynomolgus PK data of the naked hMAB-A(2I.2) antibody and hMAB-A(2I.2)-YTE antibody showed that conjugation has minimal effect on the PK parameters and that the YTE mutation improves both naked antibody and conjugate PK parameters. Furthermore, hMAB-A(2I.2)-sSPDB-DM4 and hMAB-A(2I.2)-YTE-sSPDB-DM4 conjugate were well tolerated up to a dose of 12 mg/kg with minimal skin clinical observations and dose dependent effects on hematology parameters.

**[0439]** While the invention has been described in connection with specific embodiments thereof, it



will be understood that it is capable of further modifications within the scope of the appended claims.

## SEQUENCE LISTING

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 Ala Gly Lys Ile Cys Arg Asn Phe Gln Cys Val Asp Ala Ser Val Leu  
 625 630 635 640

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020          030          035          040
Asn Tyr Asp Cys Asp Val Gln Lys Lys Cys His Gly His Gly Val Cys
645                      650                      655

Asn Ser Asn Lys Asn Cys His Cys Glu Asn Gly Trp Ala Pro Pro Asn
660                      665                      670

Cys Glu Thr Lys Gly Tyr Gly Gly Ser Val Asp Ser Gly Pro Thr Tyr
675                      680                      685

Asn Glu Met Asn Thr Ala Leu Arg Asp Gly Leu Leu Val Phe Phe Phe
690                      695                      700

Leu Ile Val Pro Leu Ile Val Cys Ala Ile Phe Ile Phe Ile Lys Arg
705                      710                      715                      720

Asp Gln Leu Trp Arg Ser Tyr Phe Arg Lys Lys Arg Ser Gln Thr Tyr
725                      730                      735

Glu Ser Asp Gly Lys Asn Gln Ala Asn Pro Ser Arg Gln Pro Gly Ser
740                      745                      750

Val Pro Arg His Val Ser Pro Val Thr Pro Pro Arg Glu Val Pro Ile
755                      760                      765

Tyr Ala Asn Arg Phe Ala Val Pro Thr Tyr Ala Ala Lys Gln Pro Gln
770                      775                      780

Gln Phe Pro Ser Arg Pro Pro Pro Pro Gln Pro Lys Val Ser Ser Gln
785                      790                      795                      800

Gly Asn Leu Ile Pro Ala Arg Pro Ala Pro Ala Pro Pro Leu Tyr Ser
805                      810                      815

Ser Leu Thr

<210> 6
<211> 819
<212> PRT
<213> Macaca fascicularis

<400> 6
Met Gly Ser Gly Val Gly Ser Pro Ser Gly Thr Leu Arg Val Arg Trp
1          5          10          15

Leu Leu Leu Leu Cys Leu Val Gly Pro Val Leu Gly Ala Ala Arg Pro
20          25          30

Gly Phe Gln Gln Thr Ser His Leu Ser Ser Tyr Glu Ile Ile Thr Pro
35          40          45

Trp Arg Leu Thr Arg Glu Arg Arg Glu Ala Pro Arg Pro Tyr Ser Lys
50          55          60

Gln Val Ser Tyr Leu Ile Gln Ala Glu Gly Lys Glu His Ile Ile His
65          70          75          80

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Leu Glu Arg Asn Lys Asp Leu Leu Pro Glu Asp Phe Val Val Tyr Thr  
 85 90 95

Tyr Asn Lys Glu Gly Thr Val Ile Thr Asp His Pro Asn Ile Gln Asn  
 100 105 110

His Cys His Phe Arg Gly Tyr Val Glu Gly Val Tyr Asn Ser Ser Val  
 115 120 125

Ala Leu Ser Asn Cys Phe Gly Leu Arg Gly Leu Leu His Leu Glu Asn  
 130 135 140

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

Ile Ile Tyr Arg Met Asp Asp Val His Lys Glu Pro Leu Lys Cys Gly  
 165 170 175

Val Ser Asn Lys Asp Ile Glu Lys Glu Thr Thr Lys Asp Glu Glu Glu  
 180 185 190

Glu Pro Pro Ser Met Thr Gln Leu Leu Arg Arg Arg Arg Ala Val Leu  
 195 200 205

Pro Gln Thr Arg Tyr Val Glu Leu Phe Ile Val Val Asp Lys Glu Arg  
 210 215 220

Tyr Asp Met Met Gly Arg Asn Gln Thr Ala Val Arg Glu Glu Met Ile  
 225 230 235 240

Leu Leu Ala Asn Tyr Leu Asp Ser Met Tyr Ile Met Leu Asn Ile Arg  
 245 250 255

Ile Val Leu Val Gly Leu Glu Ile Trp Thr Asn Gly Asn Leu Ile Asn  
 260 265 270

Ile Ala Gly Gly Ala Gly Asp Val Leu Gly Asn Phe Val Gln Trp Arg  
 275 280 285

Glu Lys Phe Leu Ile Thr Arg Arg Arg His Asp Ser Ala Gln Leu Val  
 290 295 300

Leu Lys Lys Gly Phe Gly Gly Thr Ala Gly Met Ala Phe Val Gly Thr  
 305 310 315 320

Val Cys Ser Arg Ser His Ala Gly Gly Ile Asn Val Phe Gly His Ile  
 325 330 335

Thr Val Glu Thr Phe Ala Ser Ile Val Ala His Glu Leu Gly His Asn  
 340 345 350

Leu Gly Met Asn His Asp Asp Gly Arg Asp Cys Ser Cys Gly Ala Lys  
 355 360 365

Ser Cys Ile Met Asn Ser Gly Ala Ser Gly Ser Arg Asn Phe Ser Ser  
 370 375 380

Cys Ser Ala Glu Asp Phe Glu Lys Leu Thr Leu Asn Lys Gly Gly Asn  
 385 390 395 400  
 Cys Leu Leu Asn Ile Pro Lys Pro Asp Glu Ala Tyr Ser Ala Pro Ser  
 405 410 415  
 Cys Gly Asn Lys Leu Val Asp Ala Gly Glu Glu Cys Asp Cys Gly Thr  
 420 425 430  
 Pro Lys Glu Cys Glu Leu Asp Pro Cys Cys Glu Gly Ser Thr Cys Lys  
 435 440 445  
 Leu Lys Ser Phe Ala Glu Cys Ala Tyr Gly Asp Cys Cys Lys Asp Cys  
 450 455 460  
 Arg Phe Leu Pro Gly Gly Thr Leu Cys Arg Gly Lys Thr Ser Glu Cys  
 465 470 475 480  
 Asp Val Pro Glu Tyr Cys Asn Gly Ser Ser Gln Phe Cys Gln Pro Asp  
 485 490 495  
 Val Phe Ile Gln Asn Gly Tyr Pro Cys Gln Asn Asn Lys Ala Tyr Cys  
 500 505 510  
 Tyr Asn Gly Met Cys Gln Tyr Tyr Asp Ala Gln Cys Gln Val Ile Phe  
 515 520 525  
 Gly Ser Lys Ala Lys Ala Ala Pro Lys Asp Cys Phe Ile Glu Val Asn  
 530 535 540  
 Ser Lys Gly Asp Arg Phe Gly Asn Cys Gly Phe Ser Gly Asn Glu Tyr  
 545 550 555 560  
 Lys Lys Cys Ala Thr Gly Asn Ala Leu Cys Gly Lys Leu Gln Cys Glu  
 565 570 575  
 Asn Val Gln Glu Ile Pro Val Phe Gly Ile Val Pro Ala Ile Ile Gln  
 580 585 590  
 Thr Pro Ser Arg Gly Thr Lys Cys Trp Gly Val Asp Phe Gln Leu Gly  
 595 600 605  
 Ser Asp Val Pro Asp Pro Gly Met Val Asn Glu Gly Thr Lys Cys Gly  
 610 615 620  
 Ala Asp Lys Ile Cys Arg Asn Phe Gln Cys Val Asp Ala Ser Val Leu  
 625 630 635 640  
 Asn Tyr Asp Cys Asp Ile Gln Lys Lys Cys His Gly His Gly Val Cys  
 645 650 655  
 Asn Ser Asn Lys Asn Cys His Cys Glu Asn Gly Trp Ala Pro Pro Asn  
 660 665 670  
 Cys Glu Thr Lys Gly Tyr Gly Gly Ser Val Asp Ser Gly Pro Thr Tyr  
 675 680 685  
 Asn Glu Met Asn Thr Ala Leu Arg Asn Gly Leu Leu Val Phe Phe Phe

690  
 695  
 700  
 Leu Ile Val Pro Leu Ile Val Cys Ala Ile Phe Ile Phe Ile Lys Arg  
 705 710 715 720  
 Asp Gln Leu Trp Arg Arg Tyr Phe Arg Lys Lys Arg Ser Gln Thr Tyr  
 725 730 735  
 Glu Ser Asp Gly Lys Asn Gln Ala Asn Pro Ser Arg Gln Pro Val Ser  
 740 745 750  
 Val Pro Arg His Val Ser Pro Val Thr Pro Pro Arg Glu Val Pro Ile  
 755 760 765  
 Tyr Ala Asn Arg Phe Pro Val Pro Thr Tyr Ala Ala Lys Gln Pro Gln  
 770 775 780  
 Gln Phe Pro Ser Arg Pro Pro Pro Pro Gln Pro Lys Val Ser Ser Gln  
 785 790 795 800  
 Gly Asn Leu Ile Pro Ala Arg Pro Ala Pro Ala Pro Pro Leu Tyr Ser  
 805 810 815  
 Ser Leu Thr  
 <210> 7  
 <211> 123  
 <212> PRT  
 <213> Artificial Sequence  
 <220>  
 <221> source  
 <223> /note="Description of Artificial Sequence: Synthetic polypeptide  
 <400> 7  
 Gln Val Gln Leu Gln Gln Pro Gly Ala Glu Leu Val Lys Pro Gly Ala  
 1 5 10 15  
 Ser Val Lys Leu Ser Cys Lys Ala Ser Gly Tyr Thr Phe Thr Ser Tyr  
 20 25 30  
 Trp Met His Trp Val Lys Gln Arg Pro Gly Gln Gly Leu Glu Trp Ile  
 35 40 45  
 Gly Glu Ile Ile Pro Ile Asn Gly His Thr Asn Tyr Asn Glu Lys Phe  
 50 55 60  
 Lys Ser Lys Ala Thr Leu Thr Leu Asp Lys Ser Ser Ser Thr Ala Tyr  
 65 70 75 80  
 Met Gln Leu Ser Ser Leu Ala Ser Glu Asp Ser Ala Val Tyr Tyr Cys  
 85 90 95  
 Ala Arg Gly Gly Tyr Tyr Tyr Tyr Gly Ser Arg Asp Tyr Phe Asp Tyr  
 100 105 110

Trp Gly Gln Gly Thr Thr Leu Thr Val Ser Ser  
 115 120

<210> 8

<211> 5

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 8

Ser Tyr Trp Met His

1 5

<210> 9

<211> 17

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 9

Glu Ile Ile Pro Ile Asn Gly His Thr Asn Tyr Asn Glu Lys Phe Lys  
 1 5 10 15

Ser

<210> 10

<211> 14

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 10

Gly Gly Tyr Tyr Tyr Gly Ser Arg Asp Tyr Phe Asp Tyr

1 5 10

<210> 11

<211> 111

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"

<400> 11

Asp Ile Val Leu Thr Gln Ser Pro Ala Ser Leu Ala Val Ser Leu Gly  
1 5 10 15

Gln Arg Ala Thr Ile Ser Cys Lys Ala Ser Gln Ser Val Asp Tyr Asp  
20 25 30

Gly Asp Ser Tyr Met Asn Trp Tyr Gln Gln Ile Pro Gly Gln Pro Pro  
35 40 45

Lys Leu Leu Ile Tyr Ala Ala Ser Asp Leu Glu Ser Gly Ile Pro Ala  
50 55 60

Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe Thr Leu Asn Ile His  
65 70 75 80

Pro Val Glu Glu Glu Asp Ala Ala Thr Tyr Tyr Cys Gln Gln Ser His  
85 90 95

Glu Asp Pro Phe Thr Phe Gly Gly Gly Thr Lys Leu Glu Ile Lys  
100 105 110

<210> 12

<211> 15

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 12

Lys Ala Ser Gln Ser Val Asp Tyr Asp Gly Asp Ser Tyr Met Asn  
1 5 10 15

<210> 13

<211> 7

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 13

Ala Ala Ser Asp Leu Glu Ser  
1 5

<210> 14

<211> 9

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 14

Gln Gln Ser His Glu Asp Pro Phe Thr

1 5

<210> 15

<211> 123

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"

<220>

<221> VARIANT

<222> (34)..(34)

<223> /replace="Ile"

<220>

<221> VARIANT

<222> (55)..(55)

<223> /replace="Phe"

<220>

<221> VARIANT

<222> (63)..(63)

<223> /replace="Arg"

<220>

<221> VARIANT

<222> (65)..(65)

<223> /replace="Gln"

<220>

<221> VARIANT

<222> (66)..(66)

<223> /replace="Gly"

<220>

<221> VARIANT

<222> (105)..(105)

<223> /replace="Phe" or "Tyr" or "Trp" or "Ile" or "Leu" "Val" or "Thr" or "Gly" or "Asp"

<220>

<221> VARIANT

<222> (106)..(106)

<223> /replace="Arg" or "Asn" or "His" or "Gly" or "Ser"

<220>

<221> VARIANT

<222> (107)..(107)

<223> /replace="Met" or "Ser" or "Lys" or "Asn"

<220>

<221> VARIANT

<222> (108)..(108)

<223> /replace="Ala"

<220>

<221> VARIANT

<222> (109)..(109)

<223> /replace="Phe" or "Thr" or "Val"

<220>

<221> VARIANT

<222> (110)..(110)

<223> /replace="Leu" or "Lys"

<220>

<221> MISC\_FEATURE

<222> (1)..(123)

<223> /note="Variant residues given in the sequence have no preference with respect to those in the annotations for variant positions"

<220>

<221> source

<223> /note="See specification as filed for detailed description of substitutions and preferred embodiments"

<400> 15

Glu	Val	Gln	Leu	Val	Glu	Ser	Gly	Gly	Gly	Leu	Val	Lys	Pro	Gly	Gly
1				5					10					15	

Ser	Leu	Arg	Leu	Ser	Cys	Ala	Ala	Ser	Gly	Phe	Thr	Phe	Ser	Ser	Tyr
			20					25					30		

Trp	Met	His	Trp	Val	Arg	Gln	Ala	Pro	Gly	Lys	Gly	Leu	Glu	Trp	Val
		35					40					45			

Gly	Glu	Ile	Ile	Pro	Ile	Asn	Gly	His	Thr	Asn	Tyr	Asn	Glu	Lys	Phe
	50					55					60				

Lys Ser Arg Phe Thr Ile Ser Leu Asp Asn Ser Lys Asn Thr Leu Tyr  
65 70 75 80

Leu Gln Met Gly Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys  
85 90 95

Ala Arg Gly Gly Tyr Tyr Tyr Tyr Pro Lys Phe Gly Trp Met Asp Tyr  
100 105 110

Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser  
115 120

<210> 16

<211> 123

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"

<400> 16

Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Lys Pro Gly Gly  
1 5 10 15

Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe Ser Ser Tyr  
20 25 30

Trp Met His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val  
35 40 45

Gly Glu Ile Ile Pro Ile Asn Gly His Thr Asn Tyr Asn Glu Lys Phe  
50 55 60

Lys Ser Arg Phe Thr Ile Ser Leu Asp Asn Ser Lys Asn Thr Leu Tyr  
65 70 75 80

Leu Gln Met Gly Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys  
85 90 95

Ala Arg Gly Gly Tyr Tyr Tyr Tyr Gly Ser Arg Asp Tyr Phe Asp Tyr  
100 105 110

Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser  
115 120

<210> 17

<211> 123

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"



&lt;400&gt; 17

Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Lys Pro Gly Gly  
 1 5 10 15

Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe Ser Ser Tyr  
 20 25 30

Trp Met His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val  
 35 40 45

Gly Glu Ile Ile Pro Ile Phe Gly His Thr Asn Tyr Asn Glu Lys Phe  
 50 55 60

Lys Ser Arg Phe Thr Ile Ser Leu Asp Asn Ser Lys Asn Thr Leu Tyr  
 65 70 75 80

Leu Gln Met Gly Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys  
 85 90 95

Ala Arg Gly Gly Tyr Tyr Tyr Tyr Gly Ser Arg Asp Tyr Phe Asp Tyr  
 100 105 110

Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser  
 115 120

&lt;210&gt; 18

&lt;211&gt; 123

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;221&gt; source

&lt;223&gt; /note="Description of Artificial Sequence: Synthetic polypeptide"

&lt;400&gt; 18

Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Lys Pro Gly Gly  
 1 5 10 15

Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe Ser Ser Tyr  
 20 25 30

Trp Met His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val  
 35 40 45

Gly Glu Ile Ile Pro Ile Phe Gly His Thr Asn Tyr Asn Glu Arg Phe  
 50 55 60

Gln Gly Arg Phe Thr Ile Ser Leu Asp Asn Ser Lys Asn Thr Leu Tyr  
 65 70 75 80

Leu Gln Met Gly Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys  
 85 90 95

Ala Arg Gly Gly Tyr Tyr Tyr Tyr Gly Ser Arg Asp Tyr Phe Asp Tyr  
 100 105 110

Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser  
115 120

<210> 19

<211> 123

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"

<400> 19

Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Lys Pro Gly Gly  
1 5 10 15

Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe Ser Ser Tyr  
20 25 30

Trp Ile His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val  
35 40 45

Gly Glu Ile Ile Pro Ile Phe Gly His Thr Asn Tyr Asn Glu Arg Phe  
50 55 60

Gln Gly Arg Phe Thr Ile Ser Leu Asp Asn Ser Lys Asn Thr Leu Tyr  
65 70 75 80

Leu Gln Met Gly Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys  
85 90 95

Ala Arg Gly Gly Tyr Tyr Tyr Tyr Gly Ser Arg Asp Tyr Phe Asp Tyr  
100 105 110

Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser  
115 120

<210> 20

<211> 123

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"

<400> 20

Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Lys Pro Gly Gly  
1 5 10 15

Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe Ser Ser Tyr  
20 25 30

Trp Met His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val  
35 40 45

Gly Glu Ile Ile Pro Ile Phe Gly His Thr Asn Tyr Asn Glu Lys Phe  
50 55 60

Lys Ser Arg Phe Thr Ile Ser Leu Asp Asn Ser Lys Asn Thr Leu Tyr  
65 70 75 80

Leu Gln Met Gly Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys  
85 90 95

Ala Arg Gly Gly Tyr Tyr Tyr Tyr Phe Asn Ser Gly Thr Leu Asp Tyr  
100 105 110

Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser  
115 120

<210> 21

<211> 123

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"

<400> 21

Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Lys Pro Gly Gly  
1 5 10 15

Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe Ser Ser Tyr  
20 25 30

Trp Met His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val  
35 40 45

Gly Glu Ile Ile Pro Ile Phe Gly His Thr Asn Tyr Asn Glu Lys Phe  
50 55 60

Lys Ser Arg Phe Thr Ile Ser Leu Asp Asn Ser Lys Asn Thr Leu Tyr  
65 70 75 80

Leu Gln Met Gly Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys  
85 90 95

Ala Arg Gly Gly Tyr Tyr Tyr Tyr Ile Gly Lys Gly Val Leu Asp Tyr  
100 105 110

Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser  
115 120

<210> 22

<211> 123

<212> PRT

<213> Artificial Sequence

<220>

&lt;221&gt; source

&lt;223&gt; /note="Description of Artificial Sequence: Synthetic polypeptide"

&lt;400&gt; 22

Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Lys Pro Gly Gly  
 1 5 10 15

Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe Ser Ser Tyr  
 20 25 30

Trp Met His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val  
 35 40 45

Gly Glu Ile Ile Pro Ile Phe Gly His Thr Asn Tyr Asn Glu Lys Phe  
 50 55 60

Lys Ser Arg Phe Thr Ile Ser Leu Asp Asn Ser Lys Asn Thr Leu Tyr  
 65 70 75 80

Leu Gln Met Gly Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys  
 85 90 95

Ala Arg Gly Gly Tyr Tyr Tyr Tyr Pro Arg Phe Gly Trp Leu Asp Tyr  
 100 105 110

Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser  
 115 120

&lt;210&gt; 23

&lt;211&gt; 123

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;221&gt; source

&lt;223&gt; /note="Description of Artificial Sequence: Synthetic polypeptide"

&lt;400&gt; 23

Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Lys Pro Gly Gly  
 1 5 10 15

Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe Ser Ser Tyr  
 20 25 30

Trp Met His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val  
 35 40 45

Gly Glu Ile Ile Pro Ile Phe Gly His Thr Asn Tyr Asn Glu Lys Phe  
 50 55 60

Lys Ser Arg Phe Thr Ile Ser Leu Asp Asn Ser Lys Asn Thr Leu Tyr  
 65 70 75 80

Leu Gln Met Gly Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys  
 85 90 95

Ala Arg Gly Gly Tyr Tyr Tyr Tyr Thr Gly Lys Gly Val Leu Asp Tyr  
 100 105 110

Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser  
 115 120

<210> 24

<211> 123

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"

<400> 24

Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Lys Pro Gly Gly  
 1 5 10 15

Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe Ser Ser Tyr  
 20 25 30

Trp Met His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val  
 35 40 45

Gly Glu Ile Ile Pro Ile Phe Gly His Thr Asn Tyr Asn Glu Lys Phe  
 50 55 60

Lys Ser Arg Phe Thr Ile Ser Leu Asp Asn Ser Lys Asn Thr Leu Tyr  
 65 70 75 80

Leu Gln Met Gly Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys  
 85 90 95

Ala Arg Gly Gly Tyr Tyr Tyr Tyr Asp Ser Asn Ala Val Leu Asp Tyr  
 100 105 110

Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser  
 115 120

<210> 25

<211> 123

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"

<400> 25

Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Lys Pro Gly Gly  
 1 5 10 15

Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe Ser Ser Tyr  
 20 25 30

Trp Met His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val  
35 40 45

Gly Glu Ile Ile Pro Ile Phe Gly His Thr Asn Tyr Asn Glu Lys Phe  
50 55 60

Lys Ser Arg Phe Thr Ile Ser Leu Asp Asn Ser Lys Asn Thr Leu Tyr  
65 70 75 80

Leu Gln Met Gly Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys  
85 90 95

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

Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser  
115 120

<210> 26

<211> 123

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"

<400> 26

Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Lys Pro Gly Gly  
1 5 10 15

Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe Ser Ser Tyr  
20 25 30

Trp Met His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val  
35 40 45

Gly Glu Ile Ile Pro Ile Phe Gly His Thr Asn Tyr Asn Glu Lys Phe  
50 55 60

Lys Ser Arg Phe Thr Ile Ser Leu Asp Asn Ser Lys Asn Thr Leu Tyr  
65 70 75 80

Leu Gln Met Gly Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys  
85 90 95

Ala Arg Gly Gly Tyr Tyr Tyr Tyr Phe Asn Lys Ala Val Leu Asp Tyr  
100 105 110

Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser  
115 120

<210> 27

<211> 123

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;221&gt; source

&lt;223&gt; /note="Description of Artificial Sequence: Synthetic polypeptide"

&lt;400&gt; 27

Glu	Val	Gln	Leu	Val	Glu	Ser	Gly	Gly	Gly	Leu	Val	Lys	Pro	Gly	Gly
1			5					10						15	

Ser	Leu	Arg	Leu	Ser	Cys	Ala	Ala	Ser	Gly	Phe	Thr	Phe	Ser	Ser	Tyr
		20						25					30		

Trp	Met	His	Trp	Val	Arg	Gln	Ala	Pro	Gly	Lys	Gly	Leu	Glu	Trp	Val
		35					40					45			

Gly	Glu	Ile	Ile	Pro	Ile	Phe	Gly	His	Thr	Asn	Tyr	Asn	Glu	Lys	Phe
	50					55					60				

Lys	Ser	Arg	Phe	Thr	Ile	Ser	Leu	Asp	Asn	Ser	Lys	Asn	Thr	Leu	Tyr
65					70				75					80	

Leu	Gln	Met	Gly	Ser	Leu	Arg	Ala	Glu	Asp	Thr	Ala	Val	Tyr	Tyr	Cys
			85					90						95	

Ala	Arg	Gly	Gly	Tyr	Tyr	Tyr	Tyr	Gly	Gly	Ser	Gly	Val	Leu	Asp	Tyr
		100						105					110		

Trp	Gly	Gln	Gly	Thr	Thr	Val	Thr	Val	Ser	Ser
	115					120				

&lt;210&gt; 28

&lt;211&gt; 123

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;221&gt; source

&lt;223&gt; /note="Description of Artificial Sequence: Synthetic polypeptide"

&lt;400&gt; 28

Glu	Val	Gln	Leu	Val	Glu	Ser	Gly	Gly	Gly	Leu	Val	Lys	Pro	Gly	Gly
1			5					10						15	

Ser	Leu	Arg	Leu	Ser	Cys	Ala	Ala	Ser	Gly	Phe	Thr	Phe	Ser	Ser	Tyr
		20						25					30		

Trp	Met	His	Trp	Val	Arg	Gln	Ala	Pro	Gly	Lys	Gly	Leu	Glu	Trp	Val
		35					40					45			

Gly	Glu	Ile	Ile	Pro	Ile	Phe	Gly	His	Thr	Asn	Tyr	Asn	Glu	Lys	Phe
	50					55					60				

Lys	Ser	Arg	Phe	Thr	Ile	Ser	Leu	Asp	Asn	Ser	Lys	Asn	Thr	Leu	Tyr
65					70				75					80	

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      80      85      90      95
Leu Gln Met Gly Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys
      85      90      95

Ala Arg Gly Gly Tyr Tyr Tyr Tyr Pro Arg Gln Gly Phe Leu Asp Tyr
      100      105      110

Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser
      115      120

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&lt;210&gt; 29

&lt;211&gt; 123

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;221&gt; source

&lt;223&gt; /note="Description of Artificial Sequence: Synthetic polypeptide"

&lt;400&gt; 29

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Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Lys Pro Gly Gly
1          5          10          15

Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe Ser Ser Tyr
      20      25      30

Trp Met His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val
      35      40      45

Gly Glu Ile Ile Pro Ile Phe Gly His Thr Asn Tyr Asn Glu Lys Phe
      50      55      60

Lys Ser Arg Phe Thr Ile Ser Leu Asp Asn Ser Lys Asn Thr Leu Tyr
      65      70      75      80

Leu Gln Met Gly Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys
      85      90      95

Ala Arg Gly Gly Tyr Tyr Tyr Tyr Tyr Asn Ser Gly Thr Leu Asp Tyr
      100      105      110

Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser
      115      120

```

&lt;210&gt; 30

&lt;211&gt; 30

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;221&gt; source

&lt;223&gt; /note="Description of Artificial Sequence: Synthetic polypeptide"

&lt;400&gt; 30

```

Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Lys Pro Gly Gly

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Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Lys Pro Gly Gly  
 1 5 10 15

Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe Ser  
 20 25 30

<210> 31

<211> 14

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 31

Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val Gly  
 1 5 10

<210> 32

<211> 32

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"

<400> 32

Arg Phe Thr Ile Ser Leu Asp Asn Ser Lys Asn Thr Leu Tyr Leu Gln  
 1 5 10 15

Met Gly Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys Ala Arg  
 20 25 30

<210> 33

<211> 11

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 33

Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser  
 1 5 10

<210> 34

<211> 5

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 34

Ser Tyr Trp Ile His

1 5

<210> 35

<211> 17

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 35

Glu Ile Ile Pro Ile Phe Gly His Thr Asn Tyr Asn Glu Lys Phe Lys  
1 5 10 15

Ser

<210> 36

<211> 17

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 36

Glu Ile Ile Pro Ile Phe Gly His Thr Asn Tyr Asn Glu Arg Phe Gln  
1 5 10 15

Gly

<210> 37

<211> 14

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 37

Gly Gly Tyr Tyr Tyr Tyr Phe Asn Ser Gly Thr Leu Asp Tyr  
1 5 10

<210> 38

<211> 14

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 38

Gly	Gly	Tyr	Tyr	Tyr	Tyr	Ile	Gly	Lys	Gly	Val	Leu	Asp	Tyr
1				5					10				

<210> 39

<211> 14

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 39

Gly	Gly	Tyr	Tyr	Tyr	Tyr	Pro	Arg	Phe	Gly	Trp	Leu	Asp	Tyr
1				5					10				

<210> 40

<211> 14

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 40

Gly	Gly	Tyr	Tyr	Tyr	Tyr	Thr	Gly	Lys	Gly	Val	Leu	Asp	Tyr
1				5					10				

<210> 41

<211> 14

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 41

Gly	Gly	Tyr	Tyr	Tyr	Tyr	Asp	Ser	Asn	Ala	Val	Leu	Asp	Tyr
1				5					10				

<210> 42

<211> 14

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 42

Gly	Gly	Tyr	Tyr	Tyr	Tyr	Phe	His	Ser	Gly	Thr	Leu	Asp	Tyr
1				5					10				

<210> 43

<211> 14

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 43

Gly	Gly	Tyr	Tyr	Tyr	Tyr	Phe	Asn	Lys	Ala	Val	Leu	Asp	Tyr
1				5					10				

<210> 44

<211> 14

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 44

Gly	Gly	Tyr	Tyr	Tyr	Gly	Gly	Ser	Gly	Val	Leu	Asp	Tyr
1				5				10				

<210> 45

<211> 14

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 45

Gly	Gly	Tyr	Tyr	Tyr	Tyr	Pro	Arg	Gln	Gly	Phe	Leu	Asp	Tyr
1				5					10				

<210> 46

<211> 14

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 46

Gly	Gly	Tyr	Tyr	Tyr	Tyr	Tyr	Asn	Ser	Gly	Thr	Leu	Asp	Tyr
1				5					10				

<210> 47

<211> 5

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<220>

<221> VARIANT

<222> (4)..(4)

<223> /replace="Ile"

<220>

<221> MISC\_FEATURE

<222> (1)..(5)

<223> /note="Variant residues given in the sequence have no preference with respect to those in the annotations for variant positions"

<400> 47

Ser Tyr Trp Met His

1 5

<210> 48

<211> 17

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<220>

<221> VARIANT

<222> (6)..(6)

<223> /replace="Phe"

<220>

<221> VARIANT

<222> (14)..(14)

<223> /replace="Arg"

<220>

<221> VARIANT

<222> (16)..(16)

<223> /replace="Gln"

<220>

<221> VARIANT

<222> (17)..(17)

<223> /replace="Gly"

<220>

<221> MISC\_FEATURE

<222> (1)..(17)

<223> /note="Variant residues given in the sequence have no preference with respect to those in the annotations for variant positions"

<400> 48

Glu	Ile	Ile	Pro	Ile	Asn	Gly	His	Thr	Asn	Tyr	Asn	Glu	Lys	Phe	Lys
1				5					10					15	
Ser															

<210> 49

<211> 14

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<220>

<221> VARIANT

<222> (7)..(7)

<223> /replace="Phe" or "Tyr" or "Trp" or "Ile" or "Leu" "Val" or "Thr" or "Gly" or "Asp"

<220>

<221> VARIANT

<222> (8)..(8)

<223> /replace="Arg" or "Asn" or "His" or "Gly" or "Ser"

<220>

<221> VARIANT

<222> (9)..(9)

<223> /replace="Met" or "Ser" or "Lys" or Asn"

<220>

<221> VARIANT  
 <222> (10)..(10)  
 <223> /replace="Ala"

<220>  
 <221> VARIANT  
 <222> (11)..(11)  
 <223> /replace="Phe" or "Thr" or "Val"

<220>  
 <221> VARIANT  
 <222> (12)..(12)  
 <223> /replace="Leu" or "Lys"

<220>  
 <221> MISC\_FEATURE  
 <222> (1)..(14)  
 <223> /note="Variant residues given in the sequence have no preference with respect to those in the annotations for variant positions"

<220>  
 <221> source  
 <223> /note="See specification as filed for detailed description of substitutions and preferred embodiments"

<400> 49  
 Gly Gly Tyr Tyr Tyr Tyr Pro Lys Phe Gly Trp Met Asp Tyr  
 1 5 10

<210> 50  
 <211> 453  
 <212> PRT  
 <213> Artificial Sequence

<220>  
 <221> source  
 <223> /note="Description of Artificial Sequence: Synthetic polypeptide"

<220>  
 <221> VARIANT  
 <222> (453)..(453)  
 <223> /replace=" "

<220>  
 <221> MISC\_FEATURE  
 <222> (1)..(453)  
 <223> /note="Variant residues given in the sequence have no preference with respect to those in the annotations for variant positions"

&lt;400&gt; 50

Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Lys Pro Gly Gly  
 1 5 10 15

Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe Ser Ser Tyr  
 20 25 30

Trp Met His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val  
 35 40 45

Gly Glu Ile Ile Pro Ile Phe Gly His Thr Asn Tyr Asn Glu Lys Phe  
 50 55 60

Lys Ser Arg Phe Thr Ile Ser Leu Asp Asn Ser Lys Asn Thr Leu Tyr  
 65 70 75 80

Leu Gln Met Gly Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys  
 85 90 95

Ala Arg Gly Gly Tyr Tyr Tyr Tyr Gly Ser Arg Asp Tyr Phe Asp Tyr  
 100 105 110

Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser Ala Ser Thr Lys Gly  
 115 120 125

Pro Ser Val Phe Pro Leu Ala Pro Ser Ser Lys Ser Thr Ser Gly Gly  
 130 135 140

Thr Ala Ala Leu Gly Cys Leu Val Lys Asp Tyr Phe Pro Glu Pro Val  
 145 150 155 160

Thr Val Ser Trp Asn Ser Gly Ala Leu Thr Ser Gly Val His Thr Phe  
 165 170 175

Pro Ala Val Leu Gln Ser Ser Gly Leu Tyr Ser Leu Ser Ser Val Val  
 180 185 190

Thr Val Pro Ser Ser Ser Leu Gly Thr Gln Thr Tyr Ile Cys Asn Val  
 195 200 205

Asn His Lys Pro Ser Asn Thr Lys Val Asp Lys Arg Val Glu Pro Lys  
 210 215 220

Ser Cys Asp Lys Thr His Thr Cys Pro Pro Cys Pro Ala Pro Glu Leu  
 225 230 235 240

Leu Gly Gly Pro Ser Val Phe Leu Phe Pro Pro Lys Pro Lys Asp Thr  
 245 250 255

Leu Met Ile Ser Arg Thr Pro Glu Val Thr Cys Val Val Val Asp Val  
 260 265 270

Ser His Glu Asp Pro Glu Val Lys Phe Asn Trp Tyr Val Asp Gly Val  
 275 280 285

Glu Val His Asn Ala Lys Thr Lys Pro Arg Glu Glu Gln Tyr Asn Ser

290

295

300



Thr Tyr Arg Val Val Ser Val Leu Thr Val Leu His Gln Asp Trp Leu  
305 310 315 320

Asn Gly Lys Glu Tyr Lys Cys Lys Val Ser Asn Lys Ala Leu Pro Ala  
325 330 335

Pro Ile Glu Lys Thr Ile Ser Lys Ala Lys Gly Gln Pro Arg Glu Pro  
340 345 350

Gln Val Tyr Thr Leu Pro Pro Ser Arg Glu Glu Met Thr Lys Asn Gln  
355 360 365

Val Ser Leu Thr Cys Leu Val Lys Gly Phe Tyr Pro Ser Asp Ile Ala  
370 375 380

Val Glu Trp Glu Ser Asn Gly Gln Pro Glu Asn Asn Tyr Lys Thr Thr  
385 390 395 400

Pro Pro Val Leu Asp Ser Asp Gly Ser Phe Phe Leu Tyr Ser Lys Leu  
405 410 415

Thr Val Asp Lys Ser Arg Trp Gln Gln Gly Asn Val Phe Ser Cys Ser  
420 425 430

Val Met His Glu Ala Leu His Asn His Tyr Thr Gln Lys Ser Leu Ser  
435 440 445

Leu Ser Pro Gly Lys  
450

<210> 51

<211> 453

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"

<220>

<221> VARIANT

<222> (453)..(453)

<223> /replace=" "

<220>

<221> MISC\_FEATURE

<222> (1)..(453)

<223> /note="Variant residues given in the sequence have no preference with respect to those in the annotations for variant positions"

<400> 51

Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Lys Pro Gly Gly  
1 5 10 15

Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe Ser Ser Tyr  
 20 25 30  
 Trp Met His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val  
 35 40 45  
 Gly Glu Ile Ile Pro Ile Phe Gly His Thr Asn Tyr Asn Glu Lys Phe  
 50 55 60  
 Lys Ser Arg Phe Thr Ile Ser Leu Asp Asn Ser Lys Asn Thr Leu Tyr  
 65 70 75 80  
 Leu Gln Met Gly Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys  
 85 90 95  
 Ala Arg Gly Gly Tyr Tyr Tyr Tyr Pro Arg Phe Gly Trp Leu Asp Tyr  
 100 105 110  
 Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser Ala Ser Thr Lys Gly  
 115 120 125  
 Pro Ser Val Phe Pro Leu Ala Pro Ser Ser Lys Ser Thr Ser Gly Gly  
 130 135 140  
 Thr Ala Ala Leu Gly Cys Leu Val Lys Asp Tyr Phe Pro Glu Pro Val  
 145 150 155 160  
 Thr Val Ser Trp Asn Ser Gly Ala Leu Thr Ser Gly Val His Thr Phe  
 165 170 175  
 Pro Ala Val Leu Gln Ser Ser Gly Leu Tyr Ser Leu Ser Ser Val Val  
 180 185 190  
 Thr Val Pro Ser Ser Ser Leu Gly Thr Gln Thr Tyr Ile Cys Asn Val  
 195 200 205  
 Asn His Lys Pro Ser Asn Thr Lys Val Asp Lys Arg Val Glu Pro Lys  
 210 215 220  
 Ser Cys Asp Lys Thr His Thr Cys Pro Pro Cys Pro Ala Pro Glu Leu  
 225 230 235 240  
 Leu Gly Gly Pro Ser Val Phe Leu Phe Pro Pro Lys Pro Lys Asp Thr  
 245 250 255  
 Leu Met Ile Ser Arg Thr Pro Glu Val Thr Cys Val Val Val Asp Val  
 260 265 270  
 Ser His Glu Asp Pro Glu Val Lys Phe Asn Trp Tyr Val Asp Gly Val  
 275 280 285  
 Glu Val His Asn Ala Lys Thr Lys Pro Arg Glu Glu Gln Tyr Asn Ser  
 290 295 300  
 Thr Tyr Arg Val Val Ser Val Leu Thr Val Leu His Gln Asp Trp Leu  
 305 310 315 320

Asn Gly Lys Glu Tyr Lys Cys Lys Val Ser Asn Lys Ala Leu Pro Ala  
                   325                  330                  335

Pro Ile Glu Lys Thr Ile Ser Lys Ala Lys Gly Gln Pro Arg Glu Pro  
                   340                  345                  350

Gln Val Tyr Thr Leu Pro Pro Ser Arg Glu Glu Met Thr Lys Asn Gln  
                   355                  360                  365

Val Ser Leu Thr Cys Leu Val Lys Gly Phe Tyr Pro Ser Asp Ile Ala  
                   370                  375                  380

Val Glu Trp Glu Ser Asn Gly Gln Pro Glu Asn Asn Tyr Lys Thr Thr  
                   385                  390                  395                  400

Pro Pro Val Leu Asp Ser Asp Gly Ser Phe Phe Leu Tyr Ser Lys Leu  
                   405                  410                  415

Thr Val Asp Lys Ser Arg Trp Gln Gln Gly Asn Val Phe Ser Cys Ser  
                   420                  425                  430

Val Met His Glu Ala Leu His Asn His Tyr Thr Gln Lys Ser Leu Ser  
                   435                  440                  445

Leu Ser Pro Gly Lys  
                   450

<210> 52

<211> 453

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"

<220>

<221> VARIANT

<222> (453)..(453)

<223> /replace="

<220>

<221> MISC\_FEATURE

<222> (1)..(453)

<223> /note="Variant residues given in the sequence have no preference with respect to those in the annotations for variant positions"

<400> 52

Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Lys Pro Gly Gly  
   1                  5                  10                  15

Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe Ser Ser Tyr  
                   20                  25                  30

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

Pro Ile Glu Lys Thr Ile Ser Lys Ala Lys Gly Gln Pro Arg Glu Pro  
                   340                  345                  350

Gln Val Tyr Thr Leu Pro Pro Ser Arg Glu Glu Met Thr Lys Asn Gln  
                   355                  360                  365

Val Ser Leu Thr Cys Leu Val Lys Gly Phe Tyr Pro Ser Asp Ile Ala  
                   370                  375                  380

Val Glu Trp Glu Ser Asn Gly Gln Pro Glu Asn Asn Tyr Lys Thr Thr  
                   385                  390                  395                  400

Pro Pro Val Leu Asp Ser Asp Gly Ser Phe Phe Leu Tyr Ser Lys Leu  
                   405                  410                  415

Thr Val Asp Lys Ser Arg Trp Gln Gln Gly Asn Val Phe Ser Cys Ser  
                   420                  425                  430

Val Met His Glu Ala Leu His Asn His Tyr Thr Gln Lys Ser Leu Ser  
                   435                  440                  445

Leu Ser Pro Gly Lys  
                   450

<210> 53

<211> 111

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"

<220>

<221> VARIANT

<222> (24)..(24)

<223> /replace="Arg"

<220>

<221> VARIANT

<222> (32)..(32)

<223> /replace="Ser"

<220>

<221> VARIANT

<222> (37)..(37)

<223> /replace="Leu"

<220>

<221> VARIANT

<222> (96)..(96)

<223> /replace="Tyr"

&lt;220&gt;

&lt;221&gt; VARIANT

&lt;222&gt; (97)..(97)

&lt;223&gt; /replace="Ser"

&lt;220&gt;

&lt;221&gt; VARIANT

&lt;222&gt; (98)..(98)

&lt;223&gt; /replace="Thr"

&lt;220&gt;

&lt;221&gt; MISC\_FEATURE

&lt;222&gt; (1)..(111)

&lt;223&gt; /note="Variant residues given in the sequence have no preference with respect to those in the annotations for variant positions"

&lt;400&gt; 53

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

Glu	Arg	Ala	Thr	Ile	Ser	Cys	Lys	Ala	Ser	Gln	Ser	Val	Asp	Tyr	Asp
			20					25					30		

Gly	Asp	Ser	Tyr	Met	Asn	Trp	Tyr	Gln	Gln	Lys	Pro	Gly	Gln	Pro	Pro
	35					40						45			

Lys	Leu	Leu	Ile	Tyr	Ala	Ala	Ser	Asp	Leu	Glu	Ser	Gly	Ile	Pro	Ala
	50					55					60				

Arg	Phe	Ser	Gly	Ser	Gly	Ser	Gly	Thr	Asp	Phe	Thr	Leu	Thr	Ile	Ser
65					70					75					80

Ser	Leu	Glu	Pro	Glu	Asp	Phe	Ala	Thr	Tyr	Tyr	Cys	Gln	Gln	Ser	His
				85					90					95	

Glu	Asp	Pro	Phe	Thr	Phe	Gly	Gln	Gly	Thr	Lys	Leu	Glu	Ile	Lys	
		100						105						110	

&lt;210&gt; 54

&lt;211&gt; 111

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;221&gt; source

&lt;223&gt; /note="Description of Artificial Sequence: Synthetic polypeptide"

&lt;400&gt; 54

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

Glu	Arg	Ala	Thr	Ile	Ser	Cys	Lys	Ala	Ser	Gln	Ser	Val	Asp	Tyr	Asp
			20					25					30		

Gly Asp Ser Tyr Met Asn Trp Tyr Gln Gln Lys Pro Gly Gln Pro Pro  
 35 40 45

Lys Leu Leu Ile Tyr Ala Ala Ser Asp Leu Glu Ser Gly Ile Pro Ala  
 50 55 60

Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr Ile Ser  
 65 70 75 80

Ser Leu Glu Pro Glu Asp Phe Ala Thr Tyr Tyr Cys Gln Gln Ser His  
 85 90 95

Glu Asp Pro Phe Thr Phe Gly Gln Gly Thr Lys Leu Glu Ile Lys  
 100 105 110

<210> 55

<211> 111

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"

<400> 55

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

Glu Arg Ala Thr Ile Ser Cys Lys Ala Ser Gln Ser Val Asp Tyr Ser  
 20 25 30

Gly Asp Ser Tyr Met Asn Trp Tyr Gln Gln Lys Pro Gly Gln Pro Pro  
 35 40 45

Lys Leu Leu Ile Tyr Ala Ala Ser Asp Leu Glu Ser Gly Ile Pro Ala  
 50 55 60

Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr Ile Ser  
 65 70 75 80

Ser Leu Glu Pro Glu Asp Phe Ala Thr Tyr Tyr Cys Gln Gln Ser His  
 85 90 95

Glu Asp Pro Phe Thr Phe Gly Gln Gly Thr Lys Leu Glu Ile Lys  
 100 105 110

<210> 56

<211> 111

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"

<400> 56

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

Glu Arg Ala Thr Ile Ser Cys Arg Ala Ser Gln Ser Val Asp Tyr Ser  
20 25 30

Gly Asp Ser Tyr Met Asn Trp Tyr Gln Gln Lys Pro Gly Gln Pro Pro  
35 40 45

Lys Leu Leu Ile Tyr Ala Ala Ser Asp Leu Glu Ser Gly Ile Pro Ala  
50 55 60

Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr Ile Ser  
65 70 75 80

Ser Leu Glu Pro Glu Asp Phe Ala Thr Tyr Tyr Cys Gln Gln Ser His  
85 90 95

Glu Asp Pro Phe Thr Phe Gly Gln Gly Thr Lys Leu Glu Ile Lys  
100 105 110

<210> 57

<211> 111

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"

<400> 57

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

Glu Arg Ala Thr Ile Ser Cys Arg Ala Ser Gln Ser Val Asp Tyr Ser  
20 25 30

Gly Asp Ser Tyr Leu Asn Trp Tyr Gln Gln Lys Pro Gly Gln Pro Pro  
35 40 45

Lys Leu Leu Ile Tyr Ala Ala Ser Asp Leu Glu Ser Gly Ile Pro Ala  
50 55 60

Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr Ile Ser  
65 70 75 80

Ser Leu Glu Pro Glu Asp Phe Ala Thr Tyr Tyr Cys Gln Gln Ser Tyr  
85 90 95

Ser Thr Pro Phe Thr Phe Gly Gln Gly Thr Lys Leu Glu Ile Lys  
100 105 110

<210> 58



&lt;211&gt; 23

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;221&gt; source

&lt;223&gt; /note="Description of Artificial Sequence: Synthetic peptide"

&lt;400&gt; 58

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

Glu	Arg	Ala	Thr	Ile	Ser	Cys
			20			

&lt;210&gt; 59

&lt;211&gt; 15

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;221&gt; source

&lt;223&gt; /note="Description of Artificial Sequence: Synthetic peptide"

&lt;400&gt; 59

Trp	Tyr	Gln	Gln	Lys	Pro	Gly	Gln	Pro	Pro	Lys	Leu	Leu	Ile	Tyr
1				5				10						15

&lt;210&gt; 60

&lt;211&gt; 32

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;221&gt; source

&lt;223&gt; /note="Description of Artificial Sequence: Synthetic polypeptide"

&lt;400&gt; 60

Gly	Ile	Pro	Ala	Arg	Phe	Ser	Gly	Ser	Gly	Ser	Gly	Thr	Asp	Phe	Thr
1				5				10						15	

Leu	Thr	Ile	Ser	Ser	Leu	Glu	Pro	Glu	Asp	Phe	Ala	Thr	Tyr	Tyr	Cys
			20					25					30		

&lt;210&gt; 61

&lt;211&gt; 10

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;221&gt; source

&lt;223&gt; /note="Description of Artificial Sequence: Synthetic peptide"

&lt;400&gt; 61

Phe	Gly	Gln	Gly	Thr	Lys	Leu	Glu	Ile	Lys
1				5					10

&lt;210&gt; 62

&lt;211&gt; 15

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;221&gt; source

&lt;223&gt; /note="Description of Artificial Sequence: Synthetic peptide"

&lt;400&gt; 62

Lys	Ala	Ser	Gln	Ser	Val	Asp	Tyr	Ser	Gly	Asp	Ser	Tyr	Met	Asn
1				5					10					15

&lt;210&gt; 63

&lt;211&gt; 15

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;221&gt; source

&lt;223&gt; /note="Description of Artificial Sequence: Synthetic peptide"

&lt;400&gt; 63

Arg	Ala	Ser	Gln	Ser	Val	Asp	Tyr	Ser	Gly	Asp	Ser	Tyr	Met	Asn
1				5					10					15

&lt;210&gt; 64

&lt;211&gt; 15

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;221&gt; source

&lt;223&gt; /note="Description of Artificial Sequence: Synthetic peptide"

&lt;400&gt; 64

Arg	Ala	Ser	Gln	Ser	Val	Asp	Tyr	Ser	Gly	Asp	Ser	Tyr	Leu	Asn
1				5					10					15

&lt;210&gt; 65

&lt;211&gt; 9

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;221&gt; source

&lt;223&gt; /note="Description of Artificial Sequence: Synthetic peptide"

<400> 65

Gln Gln Ser Tyr Ser Thr Pro Phe Thr  
1 5

<210> 66

<211> 15

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<220>

<221> VARIANT

<222> (1)..(1)

<223> /replace="Arg"

<220>

<221> VARIANT

<222> (9)..(9)

<223> /replace="Ser"

<220>

<221> VARIANT

<222> (14)..(14)

<223> /replace="Leu"

<220>

<221> MISC\_FEATURE

<222> (1)..(15)

<223> /note="Variant residues given in the sequence have no preference with respect to those in the annotations for variant positions"

<400> 66

Lys	Ala	Ser	Gln	Ser	Val	Asp	Tyr	Asp	Gly	Asp	Ser	Tyr	Met	Asn
1				5					10					15

<210> 67

<211> 9

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<220>

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<222> (4)..(4)

<223> /replace="Tyr"

<220>

<221> VARIANT

<222> (5)..(5)

<223> /replace="Ser"

<220>

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<222> (6)..(6)

<223> /replace="Thr"

<220>

<221> MISC\_FEATURE

<222> (1)..(9)

<223> /note="Variant residues given in the sequence have no preference with respect to those in the annotations for variant positions"

<400> 67

Gln Gln Ser His Glu Asp Pro Phe Thr  
1 5

<210> 68

<211> 218

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"

<400> 68

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

Glu Arg Ala Thr Ile Ser Cys Lys Ala Ser Gln Ser Val Asp Tyr Ser  
20 25 30

Gly Asp Ser Tyr Met Asn Trp Tyr Gln Gln Lys Pro Gly Gln Pro Pro  
35 40 45

Lys Leu Leu Ile Tyr Ala Ala Ser Asp Leu Glu Ser Gly Ile Pro Ala  
50 55 60

Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr Ile Ser  
65 70 75 80

Ser Leu Glu Pro Glu Asp Phe Ala Thr Tyr Tyr Cys Gln Gln Ser His  
85 90 95

Glu Asp Pro Phe Thr Phe Gly Gln Gly Thr Lys Leu Glu Ile Lys Arg  
100 105 110

Thr Val Ala Ala Pro Ser Val Phe Ile Phe Pro Pro Ser Asp Glu Gln  
115 120 125

Leu Lys Ser Gly Thr Ala Ser Val Val Cys Leu Leu Asn Asn Phe Tyr  
130 135 140

Pro Arg Glu Ala Lys Val Gln Trp Lys Val Asp Asn Ala Leu Gln Ser  
145 150 155 160

Gly Asn Ser Gln Glu Ser Val Thr Glu Gln Asp Ser Lys Asp Ser Thr  
165 170 175

Tyr Ser Leu Ser Ser Thr Leu Thr Leu Ser Lys Ala Asp Tyr Glu Lys  
180 185 190

His Lys Val Tyr Ala Cys Glu Val Thr His Gln Gly Leu Ser Ser Pro  
195 200 205

Val Thr Lys Ser Phe Asn Arg Gly Glu Cys  
210 215

<210> 69

<211> 107

<212> PRT

<213> Homo sapiens

<400> 69

Arg Thr Val Ala Ala Pro Ser Val Phe Ile Phe Pro Pro Ser Asp Glu  
1 5 10 15

Gln Leu Lys Ser Gly Thr Ala Ser Val Val Cys Leu Leu Asn Asn Phe  
20 25 30

Tyr Pro Arg Glu Ala Lys Val Gln Trp Lys Val Asp Asn Ala Leu Gln  
35 40 45

Ser Gly Asn Ser Gln Glu Ser Val Thr Glu Gln Asp Ser Lys Asp Ser  
50 55 60

Thr Tyr Ser Leu Ser Ser Thr Leu Thr Leu Ser Lys Ala Asp Tyr Glu  
65 70 75 80

Lys His Lys Val Tyr Ala Cys Glu Val Thr His Gln Gly Leu Ser Ser  
85 90 95

Pro Val Thr Lys Ser Phe Asn Arg Gly Glu Cys  
100 105

<210> 70

<211> 104

<212> PRT

<213> Homo sapiens

<400> 70

Gln Pro Lys Ala Ala Pro Ser Val Thr Leu Phe Pro Pro Ser Ser Glu  
1 5 10 15

Glu Leu Gln Ala Asn Lys Ala Thr Leu Val Cys Leu Ile Ser Asp Phe  
                   20                  25                  30

Tyr Pro Gly Ala Val Thr Val Ala Trp Lys Ala Asp Ser Ser Pro Val  
           35                  40                  45

Lys Ala Gly Val Glu Thr Thr Pro Ser Lys Gln Ser Asn Asn Lys Tyr  
       50                  55                  60

Ala Ala Ser Ser Tyr Leu Ser Leu Thr Pro Glu Gln Trp Lys Ser His  
   65                  70                  75                  80

Arg Ser Tyr Ser Cys Gln Val Thr His Glu Gly Ser Thr Val Glu Lys  
           85                  90                  95

Thr Val Ala Pro Thr Glu Cys Ser  
           100

<210> 71

<211> 98

<212> PRT

<213> Homo sapiens

<400> 71

Ala Ser Thr Lys Gly Pro Ser Val Phe Pro Leu Ala Pro Ser Ser Lys  
   1                  5                  10                  15

Ser Thr Ser Gly Gly Thr Ala Ala Leu Gly Cys Leu Val Lys Asp Tyr  
           20                  25                  30

Phe Pro Glu Pro Val Thr Val Ser Trp Asn Ser Gly Ala Leu Thr Ser  
       35                  40                  45

Gly Val His Thr Phe Pro Ala Val Leu Gln Ser Ser Gly Leu Tyr Ser  
       50                  55                  60

Leu Ser Ser Val Val Thr Val Pro Ser Ser Ser Leu Gly Thr Gln Thr  
   65                  70                  75                  80

Tyr Ile Cys Asn Val Asn His Lys Pro Ser Asn Thr Lys Val Asp Lys  
           85                  90                  95

Arg Val

<210> 72

<211> 98

<212> PRT

<213> Homo sapiens

<400> 72

Ala Ser Thr Lys Gly Pro Ser Val Phe Pro Leu Ala Pro Cys Ser Arg  
   1                  5                  10                  15

Ser Thr Ser Glu Ser Thr Ala Ala Leu Gly Cys Leu Val Lys Asp Tyr  
       20                  25                  30

Phe Pro Glu Pro Val Thr Val Ser Trp Asn Ser Gly Ala Leu Thr Ser  
35 40 45

Gly Val His Thr Phe Pro Ala Val Leu Gln Ser Ser Gly Leu Tyr Ser  
50 55 60

Leu Ser Ser Val Val Thr Val Pro Ser Ser Asn Phe Gly Thr Gln Thr  
65 70 75 80

Tyr Thr Cys Asn Val Asp His Lys Pro Ser Asn Thr Lys Val Asp Lys  
85 90 95

Thr Val

<210> 73

<211> 98

<212> PRT

<213> Homo sapiens

<400> 73

Ala Ser Thr Lys Gly Pro Ser Val Phe Pro Leu Ala Pro Cys Ser Arg  
1 5 10 15

Ser Thr Ser Glu Ser Thr Ala Ala Leu Gly Cys Leu Val Lys Asp Tyr  
20 25 30

Phe Pro Glu Pro Val Thr Val Ser Trp Asn Ser Gly Ala Leu Thr Ser  
35 40 45

Gly Val His Thr Phe Pro Ala Val Leu Gln Ser Ser Gly Leu Tyr Ser  
50 55 60

Leu Ser Ser Val Val Thr Val Pro Ser Ser Ser Leu Gly Thr Lys Thr  
65 70 75 80

Tyr Thr Cys Asn Val Asp His Lys Pro Ser Asn Thr Lys Val Asp Lys  
85 90 95

Arg Val

<210> 74

<211> 15

<212> PRT

<213> Homo sapiens

<400> 74

Glu Pro Lys Ser Cys Asp Lys Thr His Thr Cys Pro Pro Cys Pro  
1 5 10 15

<210> 75

<211> 12

<212> PRT

<213> Homo sapiens

<400> 75

Glu Arg Lys Cys Cys Val Glu Cys Pro Pro Cys Pro  
 1 5 10

<210> 76

<211> 12

<212> PRT

<213> Homo sapiens

<400> 76

Glu Ser Lys Tyr Gly Pro Pro Cys Pro Ser Cys Pro  
 1 5 10

<210> 77

<211> 12

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 77

Glu Ser Lys Tyr Gly Pro Pro Cys Pro Pro Cys Pro  
 1 5 10

<210> 78

<211> 217

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"

<220>

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<222> (217)..(217)

<223> /replace=" "

<220>

<221> MISC\_FEATURE

<222> (1)..(217)

<223> /note="Variant residues given in the sequence have no preference with respect to those in the annotations for variant positions"

<400> 78

Ala Pro Glu Ala Ala Gly Gly Pro Ser Val Phe Leu Phe Pro Pro Lys  
 1 5 10 15

Pro Lys Asp Thr Leu Met Ile Ser Arg Thr Pro Glu Val Thr Cys Val



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Val Val Asp Val Ser His Glu Asp Pro Glu Val Lys Phe Asn Trp Tyr
    35              40              45

Val Asp Gly Val Glu Val His Asn Ala Lys Thr Lys Pro Arg Glu Glu
    50              55              60

Gln Tyr Asn Ser Thr Tyr Arg Val Val Ser Val Leu Thr Val Leu His
    65              70              75              80

Gln Asp Trp Leu Asn Gly Lys Glu Tyr Lys Cys Lys Val Ser Asn Lys
    85              90              95

Ala Leu Pro Ala Pro Ile Glu Lys Thr Ile Ser Lys Ala Lys Gly Gln
    100             105             110

Pro Arg Glu Pro Gln Val Tyr Thr Leu Pro Pro Ser Arg Glu Glu Met
    115             120             125

Thr Lys Asn Gln Val Ser Leu Thr Cys Leu Val Lys Gly Phe Tyr Pro
    130             135             140

Ser Asp Ile Ala Val Glu Trp Glu Ser Asn Gly Gln Pro Glu Asn Asn
    145             150             155             160

Tyr Lys Thr Thr Pro Pro Val Leu Asp Ser Asp Gly Ser Phe Phe Leu
    165             170             175

Tyr Ser Lys Leu Thr Val Asp Lys Ser Arg Trp Gln Gln Gly Asn Val
    180             185             190

Phe Ser Cys Ser Val Met His Glu Ala Leu His Asn His Tyr Thr Gln
    195             200             205

Lys Ser Leu Ser Leu Ser Pro Gly Lys
    210             215

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<210> 79

<211> 217

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"

<220>

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<222> (217)..(217)

<223> /replace=" "

<220>

<221> MISC\_FEATURE

<222> (1)..(217)

<223> /note="Variant residues given in the sequence have no preference with respect to those in the annotations for variant positions"

<400> 79

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Ala Pro Glu Leu Leu Gly Gly Pro Ser Val Phe Leu Phe Pro Pro Lys
1           5           10           15

Pro Lys Asp Thr Leu Met Ile Ser Arg Thr Pro Glu Val Thr Cys Val
20           25           30

Val Val Asp Val Ser His Glu Asp Pro Glu Val Lys Phe Asn Trp Tyr
35           40           45

Val Asp Gly Val Glu Val His Asn Ala Lys Thr Lys Pro Arg Glu Glu
50           55           60

Gln Tyr Asn Ser Thr Tyr Arg Val Val Ser Val Leu Thr Val Leu His
65           70           75           80

Gln Asp Trp Leu Asn Gly Lys Glu Tyr Lys Cys Lys Val Ser Asn Lys
85           90           95

Ala Leu Pro Ala Pro Ile Glu Lys Thr Ile Ser Lys Ala Lys Gly Gln
100          105          110

Pro Arg Glu Pro Gln Val Tyr Thr Leu Pro Pro Ser Arg Glu Glu Met
115          120          125

Thr Lys Asn Gln Val Ser Leu Thr Cys Leu Val Lys Gly Phe Tyr Pro
130          135          140

Ser Asp Ile Ala Val Glu Trp Glu Ser Asn Gly Gln Pro Glu Asn Asn
145          150          155          160

Tyr Lys Thr Thr Pro Pro Val Leu Asp Ser Asp Gly Ser Phe Phe Leu
165          170          175

Tyr Ser Lys Leu Thr Val Asp Lys Ser Arg Trp Gln Gln Gly Asn Val
180          185          190

Phe Ser Cys Ser Val Met His Glu Ala Leu His Asn His Tyr Thr Gln
195          200          205

Lys Ser Leu Cys Leu Ser Pro Gly Lys
210          215

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<210> 80

<211> 217

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"

&lt;220&gt;

&lt;221&gt; VARIANT

&lt;222&gt; (217)..(217)

&lt;223&gt; /replace=" "

&lt;220&gt;

&lt;221&gt; MISC\_FEATURE

&lt;222&gt; (1)..(217)

<223> /note="Variant residues given in the sequence have no preference with respect to those in the annotations for variant positions"

&lt;400&gt; 80

Ala Pro Glu Ala Ala Gly Gly Pro Ser Val Phe Leu Phe Pro Pro Lys  
1 5 10 15

Pro Lys Asp Thr Leu Met Ile Ser Arg Thr Pro Glu Val Thr Cys Val  
20 25 30

Val Val Asp Val Ser His Glu Asp Pro Glu Val Lys Phe Asn Trp Tyr  
35 40 45

Val Asp Gly Val Glu Val His Asn Ala Lys Thr Lys Pro Arg Glu Glu  
50 55 60

Gln Tyr Asn Ser Thr Tyr Arg Val Val Ser Val Leu Thr Val Leu His  
65 70 75 80

Gln Asp Trp Leu Asn Gly Lys Glu Tyr Lys Cys Lys Val Ser Asn Lys  
85 90 95

Ala Leu Pro Ala Pro Ile Glu Lys Thr Ile Ser Lys Ala Lys Gly Gln  
100 105 110

Pro Arg Glu Pro Gln Val Tyr Thr Leu Pro Pro Ser Arg Glu Glu Met  
115 120 125

Thr Lys Asn Gln Val Ser Leu Thr Cys Leu Val Lys Gly Phe Tyr Pro  
130 135 140

Ser Asp Ile Ala Val Glu Trp Glu Ser Asn Gly Gln Pro Glu Asn Asn  
145 150 155 160

Tyr Lys Thr Thr Pro Pro Val Leu Asp Ser Asp Gly Ser Phe Phe Leu  
165 170 175

Tyr Ser Lys Leu Thr Val Asp Lys Ser Arg Trp Gln Gln Gly Asn Val  
180 185 190

Phe Ser Cys Ser Val Met His Glu Ala Leu His Asn His Tyr Thr Gln  
195 200 205

Lys Ser Leu Cys Leu Ser Pro Gly Lys  
210 215

&lt;210&gt; 81

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<220>

<221> MISC\_FEATURE

<222> (1)..(6)

<223> /note="Variant residues given in the sequence have no preference with respect to those in the annotations for variant positions"

<400> 81

Gly Ser Arg Asp Tyr Phe

1 5

<210> 82

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 82

Asp Gly Glu Gly Val Met

1 5

<210> 83

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 83

Phe His Ser Gly Leu Leu

1 5

<210> 84

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 84

Phe Asn Ser Ala Thr Leu  
1 5

<210> 85

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 85

Phe Asn Ser Gly Thr Leu  
1 5

<210> 86

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 86

Phe Asn Ser Ser Thr Leu  
1 5

<210> 87

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 87

Gly Lys Ser Lys Trp Leu  
1 5

<210> 88

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 88

Gly Met Gly Gly Thr Leu  
1 5

<210> 89

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 89

His Ala Lys Gly Gly Met  
1 5

<210> 90

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 90

Ile Gly Glu Ala Val Leu  
1 5

<210> 91

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 91

Ile Gly Lys Gly Val Phe  
1 5

<210> 92

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 92

Ile Gly Lys Gly Val Leu  
1 5

<210> 93

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 93

Lys His Asp Ser Val Leu  
1 5

<210> 94

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 94

Leu Asn Thr Ala Val Met  
1 5

<210> 95

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 95

Asn Gly Glu Gly Thr Leu  
1 5

<210> 96

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 96

Asn Gly Lys Asn Thr Leu  
1 5

<210> 97

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 97

Asn Ser Ala Gly Ile Leu  
1 5

<210> 98

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 98

Pro Lys Glu Gly Trp Met  
1 5

<210> 99

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 99

Pro Lys Phe Gly Trp Lys  
1 5

<210> 100

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source



<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 100

Pro Lys Met Gly Trp Val  
1 5

<210> 101

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 101

Pro Arg Leu Gly His Leu  
1 5

<210> 102

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 102

Pro Ser Phe Gly Trp Ala  
1 5

<210> 103

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 103

Gln Ala Lys Gly Thr Met  
1 5

<210> 104

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 104

Arg Gly Met Gly Val Met  
1 5

<210> 105

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 105

Arg Lys Glu Gly Trp Met  
1 5

<210> 106

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 106

Thr Gly Lys Gly Val Leu  
1 5

<210> 107

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 107

Thr Gly Met Gly Thr Leu  
1 5

<210> 108

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 108

Thr Gly Asn Gly Val Met  
1 5

<210> 109

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 109

Trp Asn Ala Gly Thr Phe  
1 5

<210> 110

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 110

Tyr His His Thr Pro Leu  
1 5

<210> 111

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 111

Tyr Gln Ser Ala Thr Leu  
1 5

<210> 112

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 112

Asp Gly Lys Ala Val Leu  
1 5

<210> 113

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 113

Phe Asn Lys Ala Val Leu  
1 5

<210> 114

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 114

Phe Asn Ser Gly Thr Trp  
1 5

<210> 115

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 115

Phe Asn Thr Gly Val Phe  
1 5

<210> 116

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 116

Gly Lys Ser Arg Phe His  
1 5

<210> 117

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 117

Ile Gly Lys Asn Val Tyr  
1 5

<210> 118

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 118

Met Gly Lys Gly Val Met  
1 5

<210> 119

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 119

Asn Gly Glu Ser Val Phe  
1 5

<210> 120

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 120

Pro Asp Phe Gly Trp Met

1

5

&lt;210&gt; 121

&lt;211&gt; 6

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;221&gt; source

&lt;223&gt; /note="Description of Artificial Sequence: Synthetic peptide"

&lt;400&gt; 121

Pro	Gly	Ser	Gly	Val	Met
1				5	

&lt;210&gt; 122

&lt;211&gt; 6

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;221&gt; source

&lt;223&gt; /note="Description of Artificial Sequence: Synthetic peptide"

&lt;400&gt; 122

Pro	Lys	Asp	Ala	Trp	Leu
1				5	

&lt;210&gt; 123

&lt;211&gt; 6

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;221&gt; source

&lt;223&gt; /note="Description of Artificial Sequence: Synthetic peptide"

&lt;400&gt; 123

Pro	Lys	Phe	Gly	Trp	Leu
1				5	

&lt;210&gt; 124

&lt;211&gt; 6

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;221&gt; source

&lt;223&gt; /note="Description of Artificial Sequence: Synthetic peptide"

&lt;400&gt; 124

Pro	Lys	Ile	Gly	Trp	His
1				5	

<210> 125

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 125

Pro Lys Met Gly Trp Ala  
1 5

<210> 126

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 126

Pro Lys Met Gly Trp Met  
1 5

<210> 127

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 127

Pro Gln Met Gly Trp Leu  
1 5

<210> 128

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 128

Pro Arg Phe Gly Trp Leu  
1 5

<210> 129

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 129

Pro	Arg	Met	Gly	Phe	Leu
1				5	

<210> 130

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 130

Pro	Arg	Met	Gly	Phe	Met
1				5	

<210> 131

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 131

Pro	Ser	Phe	Gly	Trp	Met
1				5	

<210> 132

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 132

Arg	Arg	Glu	Gly	Trp	Met
1				5	



<210> 133

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 133

Ser Gly Glu Gly Val Leu  
1 5

<210> 134

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 134

Ser Gly Asn Gly Val Met  
1 5

<210> 135

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 135

Val Gly Lys Ala Val Leu  
1 5

<210> 136

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 136

Asp Ser Asn Ala Val Leu  
1 5

<210> 137

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 137

Phe His Ser Gly Thr Leu  
1 5

<210> 138

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 138

Gly Gly Ser Gly Val Leu  
1 5

<210> 139

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 139

Pro Arg Gln Gly Phe Leu  
1 5

<210> 140

<211> 6

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 140

Tyr Asn Ser Gly Thr Leu  
1 5

&lt;210&gt; 141

&lt;211&gt; 453

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;221&gt; source

&lt;223&gt; /note="Description of Artificial Sequence: Synthetic polypeptide"

&lt;220&gt;

&lt;221&gt; VARIANT

&lt;222&gt; (453)..(453)

&lt;223&gt; /replace=" "

&lt;220&gt;

&lt;221&gt; MISC\_FEATURE

&lt;222&gt; (1)..(453)

&lt;223&gt; /note="Variant residues given in the sequence have no preference with respect to those in the annotations for variant positions"

&lt;400&gt; 141

Glu	Val	Gln	Leu	Val	Glu	Ser	Gly	Gly	Gly	Leu	Val	Lys	Pro	Gly	Gly
1				5					10					15	

Ser	Leu	Arg	Leu	Ser	Cys	Ala	Ala	Ser	Gly	Phe	Thr	Phe	Ser	Ser	Tyr
			20					25					30		

Trp	Met	His	Trp	Val	Arg	Gln	Ala	Pro	Gly	Lys	Gly	Leu	Glu	Trp	Val
		35					40					45			

Gly	Glu	Ile	Ile	Pro	Ile	Phe	Gly	His	Thr	Asn	Tyr	Asn	Glu	Lys	Phe
	50					55					60				

Lys	Ser	Arg	Phe	Thr	Ile	Ser	Leu	Asp	Asn	Ser	Lys	Asn	Thr	Leu	Tyr
65					70				75						80

Leu	Gln	Met	Gly	Ser	Leu	Arg	Ala	Glu	Asp	Thr	Ala	Val	Tyr	Tyr	Cys
				85					90					95	

Ala	Arg	Gly	Gly	Tyr	Tyr	Tyr	Tyr	Pro	Arg	Gln	Gly	Phe	Leu	Asp	Tyr
			100					105					110		

Trp	Gly	Gln	Gly	Thr	Thr	Val	Thr	Val	Ser	Ser	Ala	Ser	Thr	Lys	Gly
		115					120					125			

Pro	Ser	Val	Phe	Pro	Leu	Ala	Pro	Ser	Ser	Lys	Ser	Thr	Ser	Gly	Gly
		130				135					140				

Thr	Ala	Ala	Leu	Gly	Cys	Leu	Val	Lys	Asp	Tyr	Phe	Pro	Glu	Pro	Val
145					150					155					160

Thr	Val	Ser	Trp	Asn	Ser	Gly	Ala	Leu	Thr	Ser	Gly	Val	His	Thr	Phe
				165					170					175	

Pro Ala Val Leu Gln Ser Ser Gly Leu Tyr Ser Leu Ser Ser Val Val  
 180 185 190  
 Thr Val Pro Ser Ser Ser Leu Gly Thr Gln Thr Tyr Ile Cys Asn Val  
 195 200 205  
 Asn His Lys Pro Ser Asn Thr Lys Val Asp Lys Arg Val Glu Pro Lys  
 210 215 220  
 Ser Cys Asp Lys Thr His Thr Cys Pro Pro Cys Pro Ala Pro Glu Ala  
 225 230 235 240  
 Ala Gly Gly Pro Ser Val Phe Leu Phe Pro Pro Lys Pro Lys Asp Thr  
 245 250 255  
 Leu Met Ile Ser Arg Thr Pro Glu Val Thr Cys Val Val Val Asp Val  
 260 265 270  
 Ser His Glu Asp Pro Glu Val Lys Phe Asn Trp Tyr Val Asp Gly Val  
 275 280 285  
 Glu Val His Asn Ala Lys Thr Lys Pro Arg Glu Glu Gln Tyr Asn Ser  
 290 295 300  
 Thr Tyr Arg Val Val Ser Val Leu Thr Val Leu His Gln Asp Trp Leu  
 305 310 315 320  
 Asn Gly Lys Glu Tyr Lys Cys Lys Val Ser Asn Lys Ala Leu Pro Ala  
 325 330 335  
 Pro Ile Glu Lys Thr Ile Ser Lys Ala Lys Gly Gln Pro Arg Glu Pro  
 340 345 350  
 Gln Val Tyr Thr Leu Pro Pro Ser Arg Glu Glu Met Thr Lys Asn Gln  
 355 360 365  
 Val Ser Leu Thr Cys Leu Val Lys Gly Phe Tyr Pro Ser Asp Ile Ala  
 370 375 380  
 Val Glu Trp Glu Ser Asn Gly Gln Pro Glu Asn Asn Tyr Lys Thr Thr  
 385 390 395 400  
 Pro Pro Val Leu Asp Ser Asp Gly Ser Phe Phe Leu Tyr Ser Lys Leu  
 405 410 415  
 Thr Val Asp Lys Ser Arg Trp Gln Gln Gly Asn Val Phe Ser Cys Ser  
 420 425 430  
 Val Met His Glu Ala Leu His Asn His Tyr Thr Gln Lys Ser Leu Ser  
 435 440 445  
 Leu Ser Pro Gly Lys  
 450

&lt;210&gt; 142

&lt;211&gt; 453

&lt;212&gt; PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"

<220>

<221> VARIANT

<222> (453)..(453)

<223> /replace=" "

<220>

<221> MISC\_FEATURE

<222> (1)..(453)

<223> /note="Variant residues given in the sequence have no preference with respect to those in the annotations for variant positions"

<400> 142

Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Lys Pro Gly Gly  
1 5 10 15

Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe Ser Ser Tyr  
20 25 30

Trp Met His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val  
35 40 45

Gly Glu Ile Ile Pro Ile Phe Gly His Thr Asn Tyr Asn Glu Lys Phe  
50 55 60

Lys Ser Arg Phe Thr Ile Ser Leu Asp Asn Ser Lys Asn Thr Leu Tyr  
65 70 75 80

Leu Gln Met Gly Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys  
85 90 95

Ala Arg Gly Gly Tyr Tyr Tyr Tyr Pro Arg Gln Gly Phe Leu Asp Tyr  
100 105 110

Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser Ala Ser Thr Lys Gly  
115 120 125

Pro Ser Val Phe Pro Leu Ala Pro Ser Ser Lys Ser Thr Ser Gly Gly  
130 135 140

Thr Ala Ala Leu Gly Cys Leu Val Lys Asp Tyr Phe Pro Glu Pro Val  
145 150 155 160

Thr Val Ser Trp Asn Ser Gly Ala Leu Thr Ser Gly Val His Thr Phe  
165 170 175

Pro Ala Val Leu Gln Ser Ser Gly Leu Tyr Ser Leu Ser Ser Val Val  
180 185 190

Thr Val Pro Ser Ser Ser Leu Gly Thr Gln Thr Tyr Ile Cys Asn Val  
195 200 205

Asn His Lys Pro Ser Asn Thr Lys Val Asp Lys Arg Val Glu Pro Lys  
210 215 220

Ser Cys Asp Lys Thr His Thr Cys Pro Pro Cys Pro Ala Pro Glu Leu  
225 230 235 240

Leu Gly Gly Pro Ser Val Phe Leu Phe Pro Pro Lys Pro Lys Asp Thr  
245 250 255

Leu Met Ile Ser Arg Thr Pro Glu Val Thr Cys Val Val Val Asp Val  
260 265 270

Ser His Glu Asp Pro Glu Val Lys Phe Asn Trp Tyr Val Asp Gly Val  
275 280 285

Glu Val His Asn Ala Lys Thr Lys Pro Arg Glu Glu Gln Tyr Asn Ser  
290 295 300

Thr Tyr Arg Val Val Ser Val Leu Thr Val Leu His Gln Asp Trp Leu  
305 310 315 320

Asn Gly Lys Glu Tyr Lys Cys Lys Val Ser Asn Lys Ala Leu Pro Ala  
325 330 335

Pro Ile Glu Lys Thr Ile Ser Lys Ala Lys Gly Gln Pro Arg Glu Pro  
340 345 350

Gln Val Tyr Thr Leu Pro Pro Ser Arg Glu Glu Met Thr Lys Asn Gln  
355 360 365

Val Ser Leu Thr Cys Leu Val Lys Gly Phe Tyr Pro Ser Asp Ile Ala  
370 375 380

Val Glu Trp Glu Ser Asn Gly Gln Pro Glu Asn Asn Tyr Lys Thr Thr  
385 390 395 400

Pro Pro Val Leu Asp Ser Asp Gly Ser Phe Phe Leu Tyr Ser Lys Leu  
405 410 415

Thr Val Asp Lys Ser Arg Trp Gln Gln Gly Asn Val Phe Ser Cys Ser  
420 425 430

Val Met His Glu Ala Leu His Asn His Tyr Thr Gln Lys Ser Leu Cys  
435 440 445

Leu Ser Pro Gly Lys  
450

<210> 143

<211> 453

<212> PRT

<213> Artificial Sequence

&lt;220&gt;

&lt;221&gt; source

&lt;223&gt; /note="Description of Artificial Sequence: Synthetic polypeptide"

&lt;220&gt;

&lt;221&gt; VARIANT

&lt;222&gt; (453)..(453)

&lt;223&gt; /replace=" "

&lt;220&gt;

&lt;221&gt; MISC\_FEATURE

&lt;222&gt; (1)..(453)

&lt;223&gt; /note="Variant residues given in the sequence have no preference with respect to those in the annotations for variant positions"

&lt;400&gt; 143

Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Lys Pro Gly Gly  
 1 5 10 15

Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe Ser Ser Tyr  
 20 25 30

Trp Met His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val  
 35 40 45

Gly Glu Ile Ile Pro Ile Phe Gly His Thr Asn Tyr Asn Glu Lys Phe  
 50 55 60

Lys Ser Arg Phe Thr Ile Ser Leu Asp Asn Ser Lys Asn Thr Leu Tyr  
 65 70 75 80

Leu Gln Met Gly Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys  
 85 90 95

Ala Arg Gly Gly Tyr Tyr Tyr Tyr Pro Arg Gln Gly Phe Leu Asp Tyr  
 100 105 110

Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser Ala Ser Thr Lys Gly  
 115 120 125

Pro Ser Val Phe Pro Leu Ala Pro Ser Ser Lys Ser Thr Ser Gly Gly  
 130 135 140

Thr Ala Ala Leu Gly Cys Leu Val Lys Asp Tyr Phe Pro Glu Pro Val  
 145 150 155 160

Thr Val Ser Trp Asn Ser Gly Ala Leu Thr Ser Gly Val His Thr Phe  
 165 170 175

Pro Ala Val Leu Gln Ser Ser Gly Leu Tyr Ser Leu Ser Ser Val Val  
 180 185 190

Thr Val Pro Ser Ser Ser Leu Gly Thr Gln Thr Tyr Ile Cys Asn Val  
 195 200 205

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Asn His Lys Pro Ser Asn Thr Lys Val Asp Lys Arg Val Glu Pro Lys  
 210 215 220

Ser Cys Asp Lys Thr His Thr Cys Pro Pro Cys Pro Ala Pro Glu Ala  
 225 230 235 240

Ala Gly Gly Pro Ser Val Phe Leu Phe Pro Pro Lys Pro Lys Asp Thr  
 245 250 255

Leu Met Ile Ser Arg Thr Pro Glu Val Thr Cys Val Val Val Asp Val  
 260 265 270

Ser His Glu Asp Pro Glu Val Lys Phe Asn Trp Tyr Val Asp Gly Val  
 275 280 285

Glu Val His Asn Ala Lys Thr Lys Pro Arg Glu Glu Gln Tyr Asn Ser  
 290 295 300

Thr Tyr Arg Val Val Ser Val Leu Thr Val Leu His Gln Asp Trp Leu  
 305 310 315 320

Asn Gly Lys Glu Tyr Lys Cys Lys Val Ser Asn Lys Ala Leu Pro Ala  
 325 330 335

Pro Ile Glu Lys Thr Ile Ser Lys Ala Lys Gly Gln Pro Arg Glu Pro  
 340 345 350

Gln Val Tyr Thr Leu Pro Pro Ser Arg Glu Glu Met Thr Lys Asn Gln  
 355 360 365

Val Ser Leu Thr Cys Leu Val Lys Gly Phe Tyr Pro Ser Asp Ile Ala  
 370 375 380

Val Glu Trp Glu Ser Asn Gly Gln Pro Glu Asn Asn Tyr Lys Thr Thr  
 385 390 395 400

Pro Pro Val Leu Asp Ser Asp Gly Ser Phe Phe Leu Tyr Ser Lys Leu  
 405 410 415

Thr Val Asp Lys Ser Arg Trp Gln Gln Gly Asn Val Phe Ser Cys Ser  
 420 425 430

Val Met His Glu Ala Leu His Asn His Tyr Thr Gln Lys Ser Leu Cys  
 435 440 445

Leu Ser Pro Gly Lys  
 450

<210> 144

<211> 4

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"



<400> 144

Ala Leu Ala Leu

1

<210> 145

<211> 4

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<220>

<221> MOD\_RES

<222> (1)..(1)

<223> Beta-Ala

<400> 145

Ala Leu Ala Leu

1

<210> 146

<211> 4

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic peptide"

<400> 146

Gly Phe Leu Gly

1

<210> 147

<211> 217

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"

<220>

<221> VARIANT

<222> (217)..(217)

<223> /replace=" "

&lt;220&gt;

&lt;221&gt; MISC\_FEATURE

&lt;222&gt; (1)..(217)

<223> /note="Variant residues given in the sequence have no preference with respect to those in the annotations for variant positions"

&lt;400&gt; 147

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Ala Pro Glu Leu Leu Gly Gly Pro Ser Val Phe Leu Phe Pro Pro Lys
1           5           10           15

Pro Lys Asp Thr Leu Tyr Ile Thr Arg Glu Pro Glu Val Thr Cys Val
20           25           30

Val Val Asp Val Ser His Glu Asp Pro Glu Val Lys Phe Asn Trp Tyr
35           40           45

Val Asp Gly Val Glu Val His Asn Ala Lys Thr Lys Pro Arg Glu Glu
50           55           60

Gln Tyr Asn Ser Thr Tyr Arg Val Val Ser Val Leu Thr Val Leu His
65           70           75           80

Gln Asp Trp Leu Asn Gly Lys Glu Tyr Lys Cys Lys Val Ser Asn Lys
85           90           95

Ala Leu Pro Ala Pro Ile Glu Lys Thr Ile Ser Lys Ala Lys Gly Gln
100           105           110

Pro Arg Glu Pro Gln Val Tyr Thr Leu Pro Pro Ser Arg Glu Glu Met
115           120           125

Thr Lys Asn Gln Val Ser Leu Thr Cys Leu Val Lys Gly Phe Tyr Pro
130           135           140

Ser Asp Ile Ala Val Glu Trp Glu Ser Asn Gly Gln Pro Glu Asn Asn
145           150           155           160

Tyr Lys Thr Thr Pro Val Leu Asp Ser Asp Gly Ser Phe Phe Leu
165           170           175

Tyr Ser Lys Leu Thr Val Asp Lys Ser Arg Trp Gln Gln Gly Asn Val
180           185           190

Phe Ser Cys Ser Val Met His Glu Ala Leu His Asn His Tyr Thr Gln
195           200           205

Lys Ser Leu Ser Leu Ser Pro Gly Lys
210           215

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&lt;210&gt; 148

&lt;211&gt; 217

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;221&gt; source

&lt;223&gt; /note="Description of Artificial Sequence: Synthetic polypeptide"

&lt;220&gt;

&lt;221&gt; VARIANT

&lt;222&gt; (217)..(217)

&lt;223&gt; /replace=" "

&lt;220&gt;

&lt;221&gt; MISC\_FEATURE

&lt;222&gt; (1)..(217)

&lt;223&gt; /note="Variant residues given in the sequence have no preference with respect to those in the annotations for variant positions"

&lt;400&gt; 148

Ala	Pro	Glu	Leu	Leu	Gly	Gly	Pro	Ser	Val	Phe	Leu	Phe	Pro	Pro	Lys
1				5					10					15	

Pro	Lys	Asp	Thr	Leu	Tyr	Ile	Thr	Arg	Glu	Pro	Glu	Val	Thr	Cys	Val
			20					25					30		

Val	Val	Asp	Val	Ser	His	Glu	Asp	Pro	Glu	Val	Lys	Phe	Asn	Trp	Tyr
		35					40					45			

Val	Asp	Gly	Val	Glu	Val	His	Asn	Ala	Lys	Thr	Lys	Pro	Arg	Glu	Glu
	50					55					60				

Gln	Tyr	Asn	Ser	Thr	Tyr	Arg	Val	Val	Ser	Val	Leu	Thr	Val	Leu	His
65					70					75					80

Gln	Asp	Trp	Leu	Asn	Gly	Lys	Glu	Tyr	Lys	Cys	Lys	Val	Ser	Asn	Lys
			85						90					95	

Ala	Leu	Pro	Ala	Pro	Ile	Glu	Lys	Thr	Ile	Ser	Lys	Ala	Lys	Gly	Gln
			100					105					110		

Pro	Arg	Glu	Pro	Gln	Val	Tyr	Thr	Leu	Pro	Pro	Ser	Arg	Glu	Glu	Met
		115					120					125			

Thr	Lys	Asn	Gln	Val	Ser	Leu	Thr	Cys	Leu	Val	Lys	Gly	Phe	Tyr	Pro
	130					135					140				

Ser	Asp	Ile	Ala	Val	Glu	Trp	Glu	Ser	Asn	Gly	Gln	Pro	Glu	Asn	Asn
145					150					155					160

Tyr	Lys	Thr	Thr	Pro	Pro	Val	Leu	Asp	Ser	Asp	Gly	Ser	Phe	Phe	Leu
				165					170					175	

Tyr	Ser	Lys	Leu	Thr	Val	Asp	Lys	Ser	Arg	Trp	Gln	Gln	Gly	Asn	Val
			180					185					190		

Phe	Ser	Cys	Ser	Val	Met	His	Glu	Ala	Leu	His	Asn	His	Tyr	Thr	Gln
		195					200					205			

Lys Ser Leu Cys Leu Ser Pro Gly Lys  
210 215

<210> 149

<211> 217

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"

<220>

<221> VARIANT

<222> (217)..(217)

<223> /replace=" "

<220>

<221> MISC\_FEATURE

<222> (1)..(217)

<223> /note="Variant residues given in the sequence have no preference with respect to those in the annotations for variant positions"

<400> 149

Ala Pro Glu Ala Ala Gly Gly Pro Ser Val Phe Leu Phe Pro Pro Lys  
1 5 10 15

Pro Lys Asp Thr Leu Tyr Ile Thr Arg Glu Pro Glu Val Thr Cys Val  
20 25 30

Val Val Asp Val Ser His Glu Asp Pro Glu Val Lys Phe Asn Trp Tyr  
35 40 45

Val Asp Gly Val Glu Val His Asn Ala Lys Thr Lys Pro Arg Glu Glu  
50 55 60

Gln Tyr Asn Ser Thr Tyr Arg Val Val Ser Val Leu Thr Val Leu His  
65 70 75 80

Gln Asp Trp Leu Asn Gly Lys Glu Tyr Lys Cys Lys Val Ser Asn Lys  
85 90 95

Ala Leu Pro Ala Pro Ile Glu Lys Thr Ile Ser Lys Ala Lys Gly Gln  
100 105 110

Pro Arg Glu Pro Gln Val Tyr Thr Leu Pro Pro Ser Arg Glu Glu Met  
115 120 125

Thr Lys Asn Gln Val Ser Leu Thr Cys Leu Val Lys Gly Phe Tyr Pro  
130 135 140

Ser Asp Ile Ala Val Glu Trp Glu Ser Asn Gly Gln Pro Glu Asn Asn  
145 150 155 160

Tyr Lys Thr Thr Pro Pro Val Leu Asp Ser Asp Gly Ser Phe Phe Leu  
165 170 175

Tyr Ser Lys Leu Thr Val Asp Lys Ser Arg Trp Gln Gln Gly Asn Val  
180 185 190

Phe Ser Cys Ser Val Met His Glu Ala Leu His Asn His Tyr Thr Gln  
195 200 205

Lys Ser Leu Ser Leu Ser Pro Gly Lys  
210 215

$\langle 210 \rangle$  150

<211> 217

<212> PRT

### <213> Artificial Sequence

**<220>**

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"

<220>

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<222> (217)..(217)

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<223> /replace=" "
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$\langle 220 \rangle$

<221> MISC\_FEATURE

<222> (1)..(217)

<223> /note="Variant residues given in the sequence have no preference with respect to those in the annotations for variant positions"

<400> 150

Ala Pro Glu Ala Ala Gly Gly Pro Ser Val Phe Leu Phe Pro Pro Lys  
1 5 10 15

Pro Lys Asp Thr Leu Tyr Ile Thr Arg Glu Pro Glu Val Thr Cys Val  
20 25 30

Val	Val	Asp	Val	Ser	His	Glu	Asp	Pro	Glu	Val	Lys	Phe	Asn	Trp	Tyr
		35					40					45			

Val Asp Gly Val Glu Val His Asn Ala Lys Thr Lys Pro Arg Glu Glu  
50 55 60

Gln Tyr Asn Ser Thr Tyr Arg Val Val Ser Val Leu Thr Val Leu His  
65 70 75 80

Gln Asp Trp Leu Asn Gly Lys Glu Tyr Lys Cys Lys Val Ser Asn Lys  
85 90 95

Ala Leu Pro Ala Pro Ile Glu Lys Thr Ile Ser Lys Ala Lys Gly Gln  
100 105 110

Pro Arg Glu Pro Gln Val Tyr Thr Leu Pro Pro Ser Arg Glu Glu Met  
 115 120 125

Thr Lys Asn Gln Val Ser Leu Thr Cys Leu Val Lys Gly Phe Tyr Pro  
 130 135 140

Ser Asp Ile Ala Val Glu Trp Glu Ser Asn Gly Gln Pro Glu Asn Asn  
 145 150 155 160

Tyr Lys Thr Thr Pro Pro Val Leu Asp Ser Asp Gly Ser Phe Phe Leu  
 165 170 175

Tyr Ser Lys Leu Thr Val Asp Lys Ser Arg Trp Gln Gln Gly Asn Val  
 180 185 190

Phe Ser Cys Ser Val Met His Glu Ala Leu His Asn His Tyr Thr Gln  
 195 200 205

Lys Ser Leu Cys Leu Ser Pro Gly Lys  
 210 215

<210> 151

<211> 453

<212> PRT

<213> Artificial Sequence

<220>

<221> source

<223> /note="Description of Artificial Sequence: Synthetic polypeptide"

<220>

<221> VARIANT

<222> (453)..(453)

<223> /replace=" "

<220>

<221> MISC\_FEATURE

<222> (1)..(453)

<223> /note="Variant residues given in the sequence have no preference with respect to those in the annotations for variant positions"

<400> 151

Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Lys Pro Gly Gly  
 1 5 10 15

Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe Ser Ser Tyr  
 20 25 30

Trp Met His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val  
 35 40 45

Gly Glu Ile Ile Pro Ile Phe Gly His Thr Asn Tyr Asn Glu Lys Phe  
 50 55 60

Lys Ser Arg Phe Thr Ile Ser Leu Asp Asn Ser Lys Asn Thr Leu Tyr  
 65 70 75 80  
 Leu Gln Met Gly Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys  
 85 90 95  
 Ala Arg Gly Gly Tyr Tyr Tyr Tyr Pro Arg Gln Gly Phe Leu Asp Tyr  
 100 105 110  
 Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser Ala Ser Thr Lys Gly  
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 Asn His Lys Pro Ser Asn Thr Lys Val Asp Lys Arg Val Glu Pro Lys  
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 Ser Cys Asp Lys Thr His Thr Cys Pro Pro Cys Pro Ala Pro Glu Leu  
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370      375      380
Val Glu Trp Glu Ser Asn Gly Gln Pro Glu Asn Asn Tyr Lys Thr Thr
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Pro Pro Val Leu Asp Ser Asp Gly Ser Phe Phe Leu Tyr Ser Lys Leu
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Thr Val Asp Lys Ser Arg Trp Gln Gln Gly Asn Val Phe Ser Cys Ser
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Leu Ser Pro Gly Lys
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 Gly Glu Ile Ile Pro Ile Phe Gly His Thr Asn Tyr Asn Glu Lys Phe  
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Asn His Lys Pro Ser Asn Thr Lys Val Asp Lys Arg Val Glu Pro Lys
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Ser Cys Asp Lys Thr His Thr Cys Pro Pro Cys Pro Ala Pro Glu Leu
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      245                      250                      255

Leu Tyr Ile Thr Arg Glu Pro Glu Val Thr Cys Val Val Val Asp Val
      260                      265                      270

Ser His Glu Asp Pro Glu Val Lys Phe Asn Trp Tyr Val Asp Gly Val
      275                      280                      285

Glu Val His Asn Ala Lys Thr Lys Pro Arg Glu Glu Gln Tyr Asn Ser
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Thr Tyr Arg Val Val Ser Val Leu Thr Val Leu His Gln Asp Trp Leu
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Asn Gly Lys Glu Tyr Lys Cys Lys Val Ser Asn Lys Ala Leu Pro Ala
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Pro Ile Glu Lys Thr Ile Ser Lys Ala Lys Gly Gln Pro Arg Glu Pro
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Gln Val Tyr Thr Leu Pro Pro Ser Arg Glu Glu Met Thr Lys Asn Gln
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Val Ser Leu Thr Cys Leu Val Lys Gly Phe Tyr Pro Ser Asp Ile Ala
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Val Glu Trp Glu Ser Asn Gly Gln Pro Glu Asn Asn Tyr Lys Thr Thr

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Pro Pro Val Leu Asp Ser Asp Gly Ser Phe Phe Leu Tyr Ser Lys Leu
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Thr Val Asp Lys Ser Arg Trp Gln Gln Gly Asn Val Phe Ser Cys Ser
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Leu Ser Pro Gly Lys
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Gly Glu Ile Ile Pro Ile Phe Gly His Thr Asn Tyr Asn Glu Lys Phe
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Lys Ser Arg Phe Thr Ile Ser Leu Asp Asn Ser Lys Asn Thr Leu Tyr
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Ala Arg Gly Gly Tyr Tyr Tyr Tyr Pro Arg Gln Gly Phe Leu Asp Tyr

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Thr Val Asp Lys Ser Arg Trp Gln Gln Gly Asn Val Phe Ser Cys Ser  
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Leu Ser Pro Gly Lys  
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Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Lys Pro Gly Gly  
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Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe Ser Ser Tyr  
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Trp Met His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val  
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Gly Glu Ile Ile Pro Ile Phe Gly His Thr Asn Tyr Asn Glu Lys Phe  
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Lys Ser Arg Phe Thr Ile Ser Leu Asp Asn Ser Lys Asn Thr Leu Tyr  
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Leu Gln Met Gly Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys  
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Ala Arg Gly Gly Tyr Tyr Tyr Tyr Pro Arg Gln Gly Phe Leu Asp Tyr  
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Pro Ala Val Leu Gln Ser Ser Gly Leu Tyr Ser Leu Ser Ser Val Val
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195                      200                      205

Asn His Lys Pro Ser Asn Thr Lys Val Asp Lys Arg Val Glu Pro Lys
210                      215                      220

Ser Cys Asp Lys Thr His Thr Cys Pro Pro Cys Pro Ala Pro Glu Ala
225                      230                      235                      240

Ala Gly Gly Pro Ser Val Phe Leu Phe Pro Pro Lys Pro Lys Asp Thr
245                      250                      255

Leu Tyr Ile Thr Arg Glu Pro Glu Val Thr Cys Val Val Val Asp Val
260                      265                      270

Ser His Glu Asp Pro Glu Val Lys Phe Asn Trp Tyr Val Asp Gly Val
275                      280                      285

Glu Val His Asn Ala Lys Thr Lys Pro Arg Glu Glu Gln Tyr Asn Ser
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Thr Tyr Arg Val Val Ser Val Leu Thr Val Leu His Gln Asp Trp Leu
305                      310                      315                      320

Asn Gly Lys Glu Tyr Lys Cys Lys Val Ser Asn Lys Ala Leu Pro Ala
325                      330                      335

Pro Ile Glu Lys Thr Ile Ser Lys Ala Lys Gly Gln Pro Arg Glu Pro
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Gln Val Tyr Thr Leu Pro Pro Ser Arg Glu Glu Met Thr Lys Asn Gln
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Val Ser Leu Thr Cys Leu Val Lys Gly Phe Tyr Pro Ser Asp Ile Ala
370                      375                      380

Val Glu Trp Glu Ser Asn Gly Gln Pro Glu Asn Asn Tyr Lys Thr Thr
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405                      410                      415

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420                      425                      430

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420

425

430

Val Met His Glu Ala Leu His Asn His Tyr Thr Gln Lys Ser Leu Cys  
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IMMUNKONJUGATER MED ADAM9 SOM MÅL OG FREMGANGSMÅDER TIL ANVENDELSE  
DERAF

PATENTKRAV

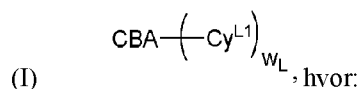
1. Immunkonjugat, der omfatter et humaniseret anti-ADAM9-antistof eller ADAM9-bindende  
5 fragment deraf, som specifikt binder til humant ADAM9 og cyno-ADAM9:
  - (I) hvor det humaniserede anti-ADAM9-antistof eller ADAM9-bindende fragment deraf er konjugeret til et farmakologisk middel; og
  - (II) hvor det humaniserede anti-ADAM9-antistof eller ADAM9-bindende fragment deraf omfatter et variabelt letkæde-(VL)-domæne og et variabelt tungkæde-(VH)-domæne, hvor det variable  
10 tungkædedomæne omfatter et CDR<sub>H1</sub>-domæne, et CDR<sub>H2</sub>-domæne og et CDR<sub>H3</sub>-domæne, og det variable letkædedomæne omfatter et CDR<sub>L1</sub>-domæne, et CDR<sub>L2</sub>-domæne og et CDR<sub>L3</sub>-domæne, hvor:
    - (A) CDR<sub>H1</sub>-domænet omfatter aminosyresekvensen ifølge SEQ ID NO:8 eller SEQ ID NO:34;  
og
    - (B) CDR<sub>H2</sub>-domænet omfatter aminosyresekvensen ifølge SEQ ID NO: 9, SEQ ID NO:35 eller  
15 SEQ ID NO:36; og
    - (C) CDR<sub>H3</sub>-domænet omfatter aminosyresekvensen ifølge en hvilken som helst af SEQ ID NO:37, SEQ ID NO:38, SEQ ID NO:39, SEQ ID NO:40, SEQ ID NO:41, SEQ ID NO:42, SEQ ID NO:43, SEQ ID NO:44, SEQ ID NO:45 eller SEQ ID NO:46; og
 hvor:
    - 20 (A) CDR<sub>L1</sub>-domænet har aminosyresekvensen ifølge SEQ ID NO:12, SEQ ID NO:62, SEQ ID NO:63 eller SEQ ID NO:64; og
    - (B) CDR<sub>L2</sub>-domænet har aminosyresekvensen ifølge SEQ ID NO:13; og
    - (C) CDR<sub>L3</sub>-domænet har aminosyresekvensen ifølge SEQ ID NO:14 eller SEQ ID NO:65.
2. Immunkonjugat ifølge krav 1, hvor det humaniserede anti-ADAM9-antistof eller ADAM9-bindende  
25 fragment deraf omfatter et CDR<sub>H1</sub>-domæne, et CDR<sub>H2</sub>-domæne og et CDR<sub>H3</sub>-domæne samt et CDR<sub>L1</sub>-domæne, et CDR<sub>L2</sub>-domæne og et CDR<sub>L3</sub>-domæne med sekvenserne valgt fra gruppen bestående af:
  - (a) henholdsvis SEQ ID NO: 8, 35 og 45 og SEQ ID NO: 62, 13, 14;
  - (b) henholdsvis SEQ ID NO: 8, 35 og 38 og SEQ ID NO: 62, 13, 14;
  - (c) henholdsvis SEQ ID NO: 8, 35 og 39 og SEQ ID NO: 62, 13, 14;
  - 30 (d) henholdsvis SEQ ID NO: 8, 35 og 40 og SEQ ID NO: 62, 13, 14;
  - (e) henholdsvis SEQ ID NO: 8, 35 og 41 og SEQ ID NO: 62, 13, 14;
  - (f) henholdsvis SEQ ID NO: 8, 35 og 42 og SEQ ID NO: 62, 13, 14;
  - (g) henholdsvis SEQ ID NO: 8, 35 og 43 og SEQ ID NO: 62, 13, 14;
  - (h) henholdsvis SEQ ID NO: 8, 35 og 44 og SEQ ID NO: 62, 13, 14;
  - 35 (i) henholdsvis SEQ ID NO: 8, 35 og 37 og SEQ ID NO: 62, 13, 14; og
  - (j) henholdsvis SEQ ID NO: 8, 35 og 46 og SEQ ID NO: 62, 13, 14.
3. Immunkonjugat ifølge krav 1 eller 2, hvor:

- 2 -

- (A) VH-domænet omfatter SEQ ID NO:20, SEQ ID NO:21, SEQ ID NO:22, SEQ ID NO:23, SEQ ID NO:24, SEQ ID NO:25, SEQ ID NO:26, SEQ ID NO:27, SEQ ID NO:28 eller SEQ ID NO:29; og
- (B) VL-domænet omfatter SEQ ID NO:54, SEQ ID NO:55, SEQ ID NO:56 eller SEQ ID NO:57.
- 5 4. Immunkonjugat ifølge krav 1, hvor CDR<sub>H1</sub>-domænet omfatter aminosyresekvensen SYWMH (SEQ ID NO:8), CDR<sub>H2</sub>-domænet omfatter aminosyresekvensen EIPIFGHTNYNEKFKS (SEQ ID NO:35), CDR<sub>H3</sub>-domænet omfatter aminosyresekvensen GGYYYYPRQGFLDY (SEQ ID NO:45), CDR<sub>L1</sub>-domænet omfatter aminosyresekvensen KASQSVDYSGDSYMN (SEQ ID NO:62), CDR<sub>L2</sub>-domænet omfatter aminosyresekvensen AASDLES (SEQ ID NO:13), og CDR<sub>L3</sub>-domænet omfatter aminosyresekvensen
- 10 QQSHEDPFT (SEQ ID NO:14).
5. Immunkonjugat ifølge krav 4, hvor immunkonjugatet omfatter:
- (A) det variable tungkæde-(VH)-domæne af hMAB-A (2I,2) (SEQ ID NO:28); og/eller
- (B) det variable letkæde-(VL)-domæne af hMAB-A (2I,2) (SEQ ID NO:55); og/eller
- (C) det variable tungkæde-(VH)-domæne af hMAB-A (2I,2) (SEQ ID NO:28) og det variable
- 15 letkæde-(VL)-domæne af hMAB-A (2I,2) (SEQ ID NO:55).
6. Immunkonjugat ifølge et hvilket som helst af kravene 1-5, hvor immunkonjugatet omfatter en Fc-region, eventuelt hvor Fc-regionen er en variant-Fc-region, der omfatter:
- (a) én eller flere aminosyremodifikationer, der reducerer variant-Fc-regionens affinitet for en FcγR; og/eller
- 20 (b) én eller flere aminosyremodifikationer, der indfører en cysteinrest; og/eller
- (c) én eller flere aminosyremodifikationer, der forlænger serumhalveringstiden.
7. Immunkonjugat ifølge krav 6, hvor
- (I) den ene eller flere aminosyremodifikationer, der reducerer variant-Fc-regionens affinitet for en FcγR, omfatter:
- 25 (A) L234A;
- (B) L235A; eller
- (C) L234A og L235A; og
- (II) den ene eller flere aminosyremodifikationer, der indfører en cysteinrest, omfatter S442C;
- og
- 30 (III) den ene eller flere aminosyremodifikationer, der forlænger serumhalveringstiden, omfatter:
- (A) M252Y;
- (B) M252Y og S254T;
- (C) M252Y og T256E;
- (D) M252Y, S254T og T256E; eller
- 35 (E) K288D og H435K; og
- hvor nummereringen er ifølge EU-indekset som i Kabat.
8. Immunkonjugat ifølge et hvilket som helst af kravene 1-7, hvor det humaniserede anti-ADAM9-antistof omfatter en tungkæde og en letkæde med sekvenserne valgt fra gruppen bestående af:

- 3 -

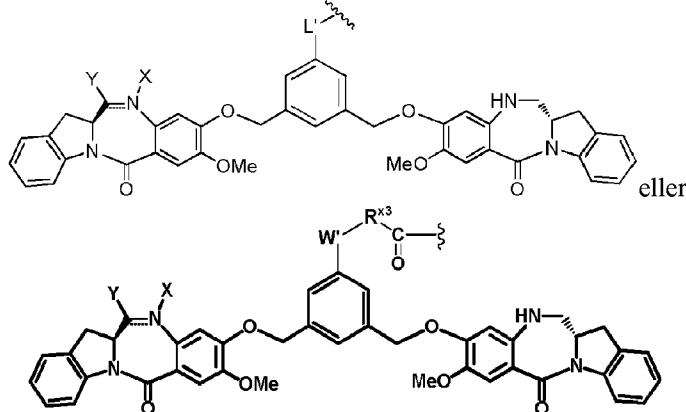
- (a) henholdsvis SEQ ID NO:152 og SEQ ID NO:68;  
 (b) henholdsvis SEQ ID NO:141 og SEQ ID NO:68;  
 (c) henholdsvis SEQ ID NO:142 og SEQ ID NO:68;  
 (d) henholdsvis SEQ ID NO:143 og SEQ ID NO:68;  
 5 (e) henholdsvis SEQ ID NO:151 og SEQ ID NO:68;  
 (f) henholdsvis SEQ ID NO:52 og SEQ ID NO:68;  
 (g) henholdsvis SEQ ID NO:153 og SEQ ID NO:68; og  
 (h) henholdsvis SEQ ID NO:154 og SEQ ID NO:68.
9. Immunkonjugat ifølge krav 8, hvor X i SEQ ID NO:141, SEQ ID NO:142, SEQ ID NO:143, SEQ  
 10 ID NO:151, SEQ ID NO:152, SEQ ID NO:153 eller SEQ ID NO:154 er fraværende.
10. Immunkonjugat ifølge et hvilket som helst af kravene 1-9, hvor det humaniserede anti-ADAM9-  
 antistof omfatter en tungkæde og en letkæde med sekvenserne ifølge henholdsvis SEQ ID NO:152 og SEQ  
 ID NO:68.
11. Immunkonjugat ifølge krav 1, hvor det humaniserede anti-ADAM9-antistof eller ADAM9-bindende  
 15 fragment deraf omfatter et variabelt tungkæde-(VH)-domæne og et variabelt letkæde-(VL)-domæne med  
 sekvenserne ifølge henholdsvis SEQ ID NO:28 og SEQ ID NO:55.
12. Immunkonjugat ifølge et hvilket som helst af kravene 1-11, hvor det farmakologiske middel er en  
 maytansinoidforbindelse, en pyrrolbenzodiazepinforbindelse eller en indolinbenzodiazepinforbindelse.
13. Immunkonjugat ifølge krav 12, hvor det farmakologiske middel er en maytansinoidforbindelse.
- 20 14. Immunkonjugat ifølge et hvilket som helst af kravene 1-13, hvor immunkonjugatet er angivet ved  
 en formel, der er valgt fra gruppen bestående af:



CBA er det humaniserede anti-ADAM9-antistof eller ADAM9-bindende fragment deraf, som ved  
 hjælp af en lysinrest er kovalent bundet til  $Cy^{L1}$ ;

25  $W_L$  er et heltal fra 1 til 20; og

$Cy^{L1}$  er angivet med følgende formel:



30 eller et farmaceutisk acceptabelt salt deraf, hvor:

- 4 -

dobbeltlinjen  $\equiv$  mellem N og C angiver en enkeltbinding eller en dobbeltbinding, forudsat at X, når det er en dobbeltbinding, er fraværende, og Y er -H eller et (C<sub>1</sub>-C<sub>4</sub>)alkyl; og X, når det er en enkeltbinding, er -H eller en aminbeskyttelsesgruppe, og Y er -OH eller -SO<sub>3</sub>H eller et farmaceutisk acceptabelt salt deraf;

W' er -NR<sup>e</sup>,

5 R<sup>e</sup> er -(CH<sub>2</sub>-CH<sub>2</sub>-O)<sub>n</sub>-R<sup>k</sup>;

n er et heltal fra 2 til 6;

R<sup>k</sup> er -H eller -Me;

R<sup>x3</sup> er en (C<sub>1</sub>-C<sub>6</sub>)alkyl;

L' er angivet med følgende formel:

10 -NR<sub>5</sub>-P-C(=O)-(CR<sub>a</sub>R<sub>b</sub>)<sub>m</sub>-C(=O)- (B1'); eller

-NR<sub>5</sub>-P-C(=O)-(CR<sub>a</sub>R<sub>b</sub>)<sub>m</sub>-S-Z<sup>s1</sup>- (B2');

R<sub>5</sub> er -H eller en (C<sub>1</sub>-C<sub>3</sub>)alkyl;

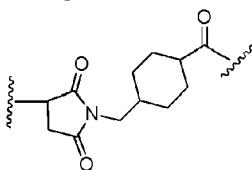
P er en aminosyrerest eller et peptid, der indeholder mellem 2 og 20 aminosyrerester;

R<sub>a</sub> og R<sub>b</sub>, for hver forekomst, hver især uafhængigt af hinanden er -H, (C<sub>1</sub>-C<sub>3</sub>)alkyl eller en ladet

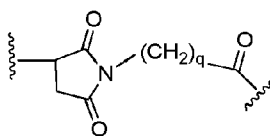
15 substituent eller en ioniserbar gruppe Q;

m er et heltal fra 1 til 6; og

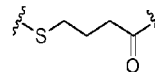
Z<sup>s1</sup> er valgt blandt en hvilken som helst af følgende formler:



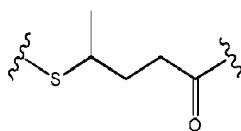
(b1);



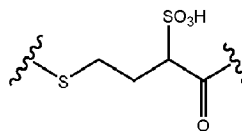
(b2);



(b3);

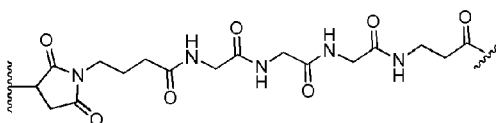


(b4);

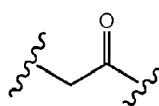


(b5);

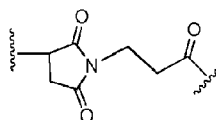
20



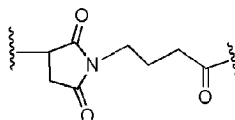
(b6);



(b7);

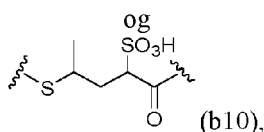


(b8);



(b9);

25

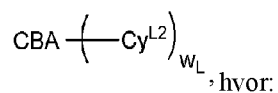


(b10);

hvor q er et heltal fra 1 til 5, og eventuelt hvor det farmaceutisk acceptable salt er et natrium- eller et kaliumsalt;

- 5 -

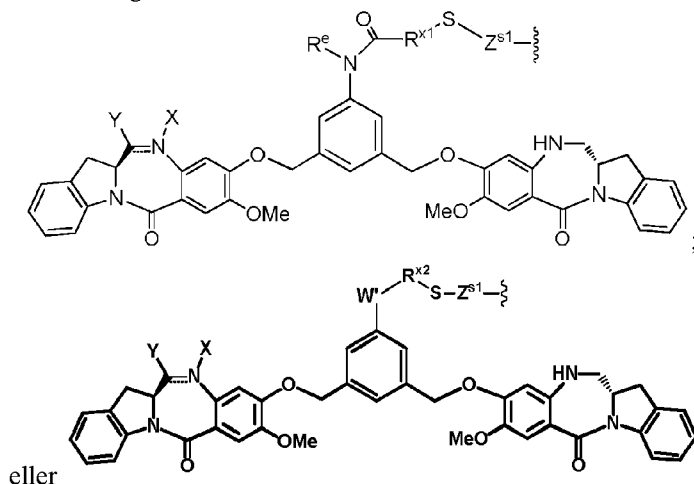
(II)



CBA er det humaniserede anti-ADAM9-antistof eller ADAM9-bindende fragment deraf, som ved hjælp af en lysinrest er kovalent bundet til  $\text{Cy}^{\text{L2}}$ ;

$\text{W}_\text{L}$  er et heltal fra 1 til 20; og

5  $\text{Cy}^{\text{L2}}$  er angivet med følgende formel:



eller et farmaceutisk acceptabelt salt deraf, hvor:

10 dobbeltlinjen  $\equiv$  mellem N og C angiver en enkeltbinding eller en dobbeltbinding, forudsat at X, når det er en dobbeltbinding, er fraværende, og Y er -H eller en  $(\text{C}_1\text{-C}_4)$ alkyl; og X, når det er en enkeltbinding, er -H eller en aminbeskyttelsesgruppe, og Y er -OH eller  $-\text{SO}_3\text{H}$ ;

$\text{R}^{\text{x1}}$  og  $\text{R}^{\text{x2}}$  uafhængigt af hinanden er  $(\text{C}_1\text{-C}_6)$ alkyl;

$\text{R}^{\text{e}}$  er -H eller en  $(\text{C}_1\text{-C}_6)$ alkyl;

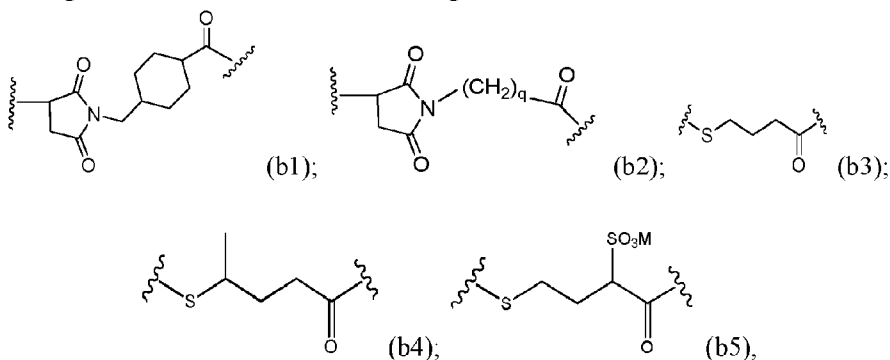
$\text{W}'$  er  $-\text{NR}^{\text{e}}$ ,

15  $\text{R}^{\text{e}}$  er  $-(\text{CH}_2\text{-CH}_2\text{-O})_n\text{-R}^{\text{k}}$ ;

n er et heltal fra 2 til 6;

$\text{R}^{\text{k}}$  er -H eller -Me;

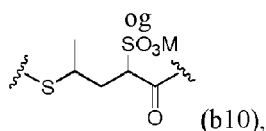
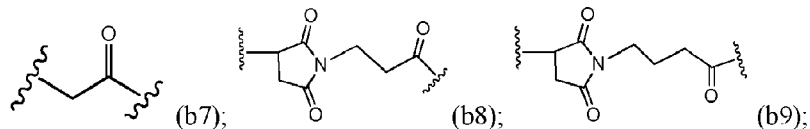
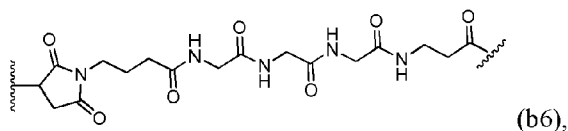
$\text{Z}^{\text{s1}}$  er valgt blandt en hvilken som helst af følgende formler:



20



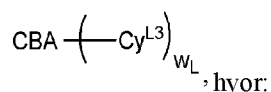
- 6 -



5

hvor q er et heltal fra 1 til 5, og eventuelt hvor det farmaceutisk acceptabelt salt er et natrium- eller et kaliumsalt;

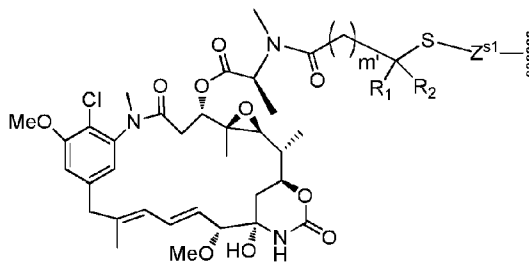
(III)



CBA er det humaniserede anti-ADAM9-antistof eller ADAM9-bindende fragment deraf, som ved hjælp af en lysinrest er kovalent bundet til  $\text{Cy}^{\text{L3}}$ ;

$\text{W}_\text{L}$  er et heltal fra 1 til 20;

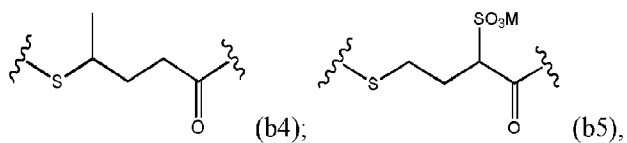
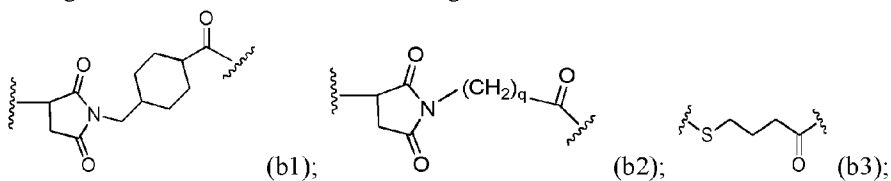
$\text{Cy}^{\text{L3}}$  er angivet med følgende formel:



$m'$  er 1 eller 2;

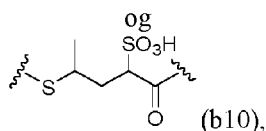
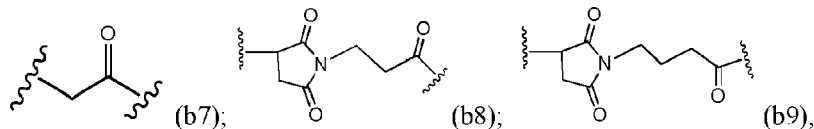
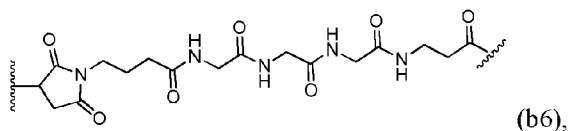
$\text{R}_1$  og  $\text{R}_2$  hver især uafhængigt af hinanden er H eller en  $(\text{C}_1\text{--C}_3)$ alkyl; og

$\text{Z}^{\text{s1}}$  er valgt blandt en hvilken som helst af følgende formler:



20

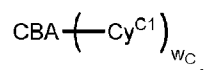
- 7 -



5

hvor q er et heltal fra 1 til 5, og eventuelt hvor det farmaceutisk acceptabelt salt er et natrium- eller et kaliumsalt;

(IV)

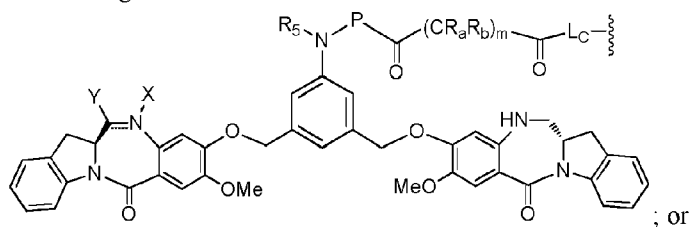


hvor:

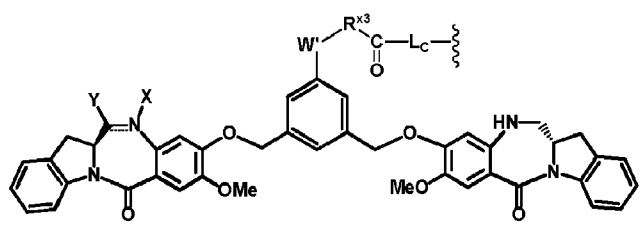
10 CBA er det humaniserede anti-ADAM9-antistof eller ADAM9-bindende fragment deraf, som ved hjælp af en cysteinrest er kovalent bundet til  $\text{Cy}^{\text{C1}}$ ;

$\text{W}_\text{C}$  er 1 eller 2;

$\text{Cy}^{\text{C1}}$  er angivet med følgende formel:



15



eller et farmaceutisk acceptabelt salt deraf, hvor:

20 dobbeltlinjen .. mellem N og C angiver en enkeltbinding eller en dobbeltbinding, forudsat at X, når det er en dobbeltbinding, er fraværende, og Y er -H eller en  $(\text{C}_1\text{-C}_4)$ alkyl; og X, når det er en enkeltbinding, er -H eller en aminbeskyttelsesgruppe, Y er -OH eller - $\text{SO}_3\text{H}$  eller et farmaceutisk acceptabelt salt deraf;

$\text{R}_5$  er -H eller en  $(\text{C}_1\text{-C}_3)$ alkyl;

P er en aminosyrerest eller et peptid, som indeholder 2 til 20 aminosyrerester;

$\text{R}_\text{a}$  og  $\text{R}_\text{b}$ , for hver forekomst, uafhængigt af hinanden er -H,  $(\text{C}_1\text{-C}_3)$ alkyl eller en ladet substituent eller en ioniserbar gruppe Q;

- 8 -

W' er -NR<sup>e</sup>,

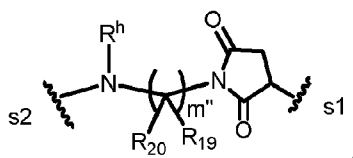
R<sup>e</sup> er -(CH<sub>2</sub>-CH<sub>2</sub>-O)<sub>n</sub>-R<sup>k</sup>;

n er et heltal fra 2 til 6;

R<sup>k</sup> er -H eller -Me;

5 R<sup>x3</sup> er en (C<sub>1</sub>-C<sub>6</sub>)alkyl; og

L<sub>C</sub> er angivet ved



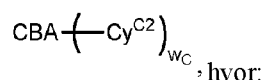
s1 er det sted, der er kovalent bundet til CBA, og s2 er det sted, der er kovalent bundet til -C(=O)-gruppen på Cy<sup>C1</sup>; hvor:

10 R<sub>19</sub> og R<sub>20</sub>, for hver forekomst, uafhængigt af hinanden er -H eller en (C<sub>1</sub>-C<sub>3</sub>)alkyl;

m'' er et heltal mellem 1 og 10; og

R<sup>h</sup> er -H eller en (C<sub>1</sub>-C<sub>3</sub>)alkyl, og eventuelt hvor det farmaceutisk acceptable salt er et natrium- eller et kaliumsalt;

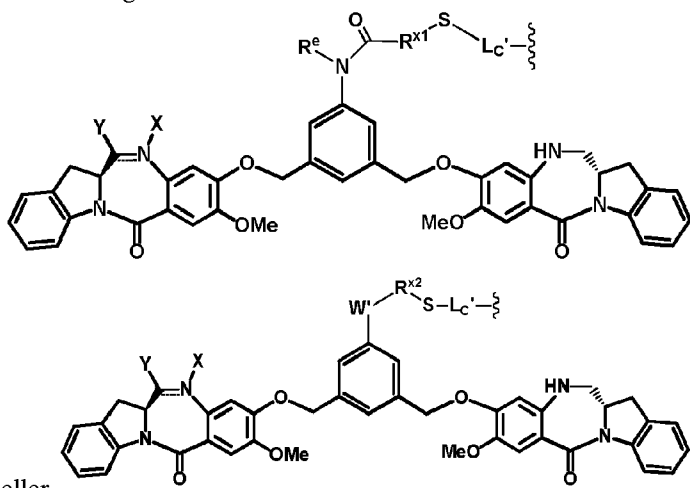
(V)



15 CBA er det humaniserede anti-ADAM9-antistof eller ADAM9-bindende fragment deraf, som ved hjælp af en cysteinrest er kovalent bundet til Cy<sup>C2</sup>;

W<sub>C</sub> er 1 eller 2;

Cy<sup>C2</sup> er angivet med følgende formel:



20

eller et farmaceutisk acceptabelt salt deraf, hvor:

dobbeltlinjen == mellem N og C angiver en enkeltbinding eller en dobbeltbinding, forudsat at X, når det er en dobbeltbinding, er fraværende, og Y er -H eller en (C<sub>1</sub>-C<sub>4</sub>)alkyl; og X, når det er en enkeltbinding, er -H eller en aminbeskyttelsesgruppe, Y er -OH eller -SO<sub>3</sub>H eller et farmaceutisk acceptabelt salt deraf;

25 R<sup>x1</sup> er en (C<sub>1</sub>-C<sub>6</sub>)alkyl;

- 9 -

$R^e$  er -H eller en  $(C_1-C_6)$ alkyl;

$W'$  er  $-NR^{e'}$ ;

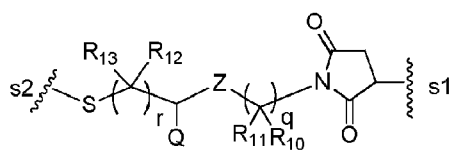
$R^{e'}$  er  $-(CH_2-CH_2-O)_n-R^k$ ;

$n$  er et heltal fra 2 til 6;

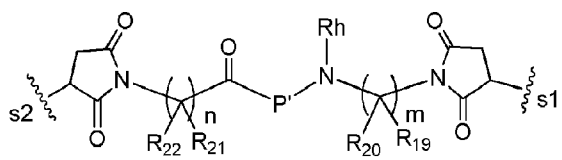
5  $R^k$  er -H eller -Me;

$R^{x2}$  er en  $(C_1-C_6)$ alkyl;

$L_c'$  er angivet med følgende formel:



10



hvor:

$s1$  er det sted, der er kovalent bundet til CBA'et, og  $s2$  er det sted, der er kovalent bundet til -S-gruppen på  $Cy^{C2}$ ;

15  $Z$  er  $-C(=O)-NR_9-$  eller  $-NR_9-C(=O)-$ ;

$Q$  er -H, en ladet substituent eller en ioniserbar gruppe;

$R_9$ ,  $R_{10}$ ,  $R_{11}$ ,  $R_{12}$ ,  $R_{13}$ ,  $R_{19}$ ,  $R_{20}$ ,  $R_{21}$  og  $R_{22}$ , for hver forekomst, uafhængigt af hinanden er -H eller en  $(C_1-C_3)$ alkyl;

$q$  og  $r$ , for hver forekomst, uafhængigt af hinanden er et heltal mellem 0 og 10;

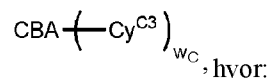
20  $m$  og  $n$  hver især uafhængigt af hinanden er et heltal mellem 0 og 10;

$R^h$  er -H eller en  $(C_1-C_3)$ alkyl; og

$P'$  er en aminosyrerest eller et peptid, der indeholder 2 til 20 aminosyrerester, og eventuelt hvor det farmaceutisk acceptabelt salt er et natrium- eller et kaliumsalt;

(VI)

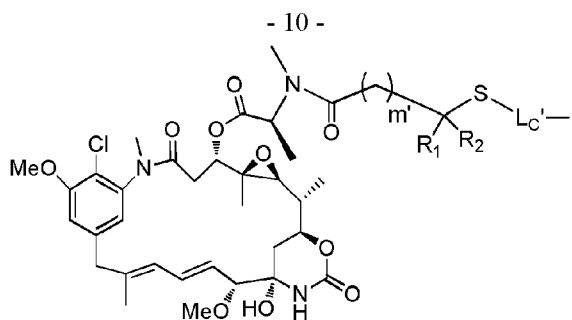
og



25  $CBA$  er det humaniserede anti-ADAM9-antistof eller ADAM9-bindende fragment deraf, som ved hjælp af en cysteinrest er kovalent bundet til  $Cy^{C3}$ ;

$w_C$  er 1 eller 2;

$Cy^{C3}$  er angivet med følgende formel:

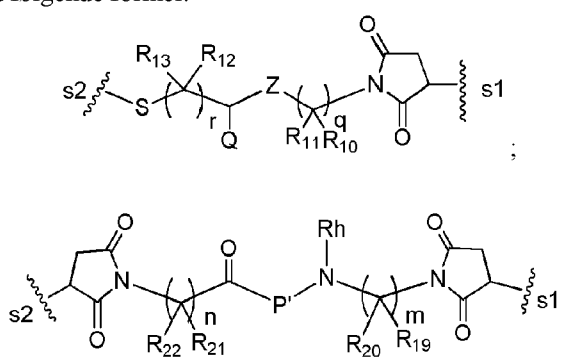


hvor:

$m'$  er 1 eller 2;

$R_1$  og  $R_2$  hver især uafhængigt af hinanden er -H eller en  $(C_1-C_3)$ alkyl;

5  $Lc'$  er angivet med følgende formel:



hvor:

10  $s1$  er det sted, der er kovalent bundet til CBA'et, og  $s2$  er det sted, der er kovalent bundet til -S-gruppen på  $Cy^{C3}$ ;

$Z$  er  $-C(=O)-NR_9-$  eller  $-NR_9-C(=O)-$ ;

$Q$  er H, en ladet substituent eller en ioniserbar gruppe;

15  $R_9, R_{10}, R_{11}, R_{12}, R_{13}, R_{19}, R_{20}, R_{21}$  og  $R_{22}$ , for hver forekomst, uafhængigt af hinanden er -H eller en  $(C_1-C_3)$ alkyl;

$q$  og  $r$ , for hver forekomst, uafhængigt af hinanden er et heltal mellem 0 og 10;

$m$  og  $n$  hver især uafhængigt af hinanden er et heltal mellem 0 og 10;

$R^h$  er -H eller en  $(C_1-C_3)$ alkyl;

20  $P'$  er en aminosyrerest eller et peptid, der indeholder 2 til 20 aminosyrerester, og eventuelt hvor det farmaceutisk acceptabelt salt er et natrium- eller et kaliumsalt.

15. Farmaceutisk sammensætning, der omfatter en effektiv mængde af immunkonjugatet ifølge et hvilket som helst af kravene 1-14 og en farmaceutisk acceptabel bærer, excipients eller diluent.

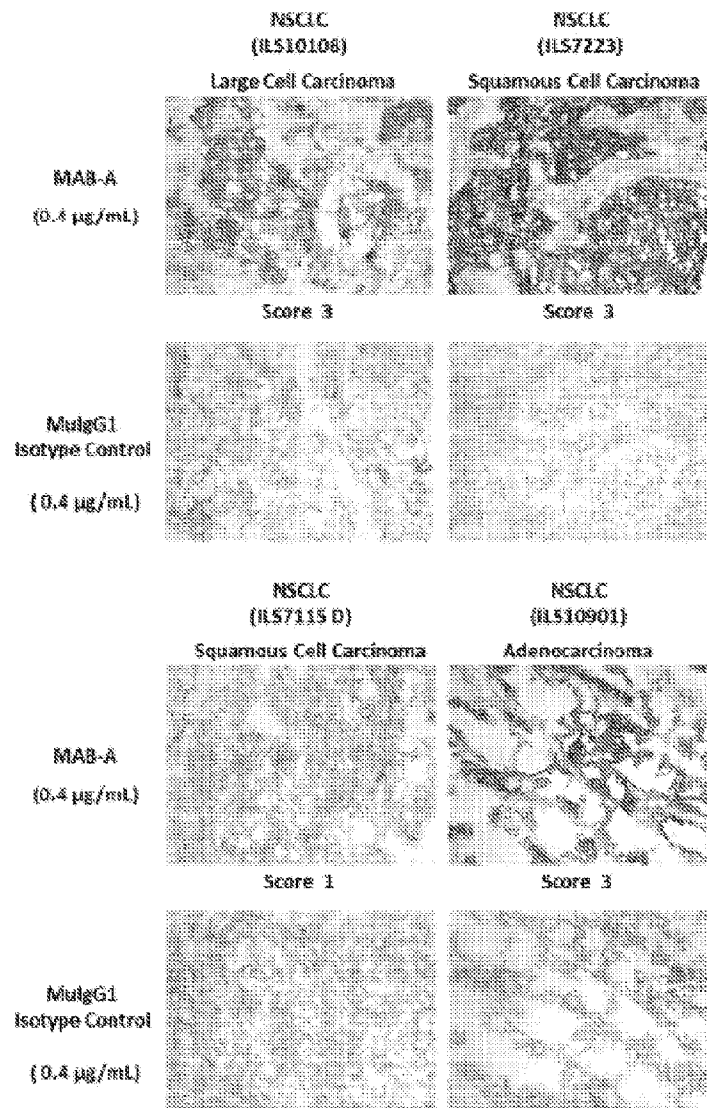
16. Immunkonjugat ifølge et hvilket som helst af kravene 1-14 eller farmaceutisk sammensætning ifølge krav 15 til anvendelse ved behandling af en sygdom eller tilstand, der er associeret med eller kendetegnet ved 25 ekspression af ADAM9.

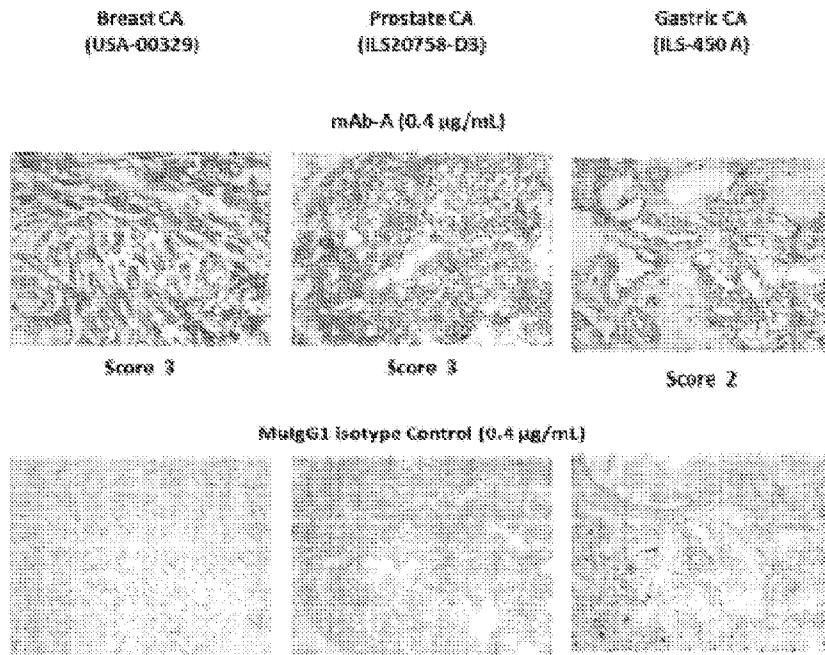
17. Immunkonjugat eller farmaceutisk sammensætning til anvendelse ifølge krav 16, hvor sygdommen eller tilstanden, der er associeret med eller kendetegnet ved ekspression af ADAM9, er cancer, eventuelt hvor canceren er valgt fra gruppen bestående af ikke-småcellet lungecancer, kolorektal cancer, blærecancer,

- 11 -

mavecancer, pankreascancer, nyrecellekarcinom, prostatacancer, øsofaguscancer, brystcancer, hoved- og halscancer, uterus cancer, ovariecancer, levercancer, cervixcancer, thyroideacancer, testikelcancer, myeloid cancer, melanom og lymfoid cancer.

# DRAWINGS

**FIG. 1A**



**FIG. 1B**



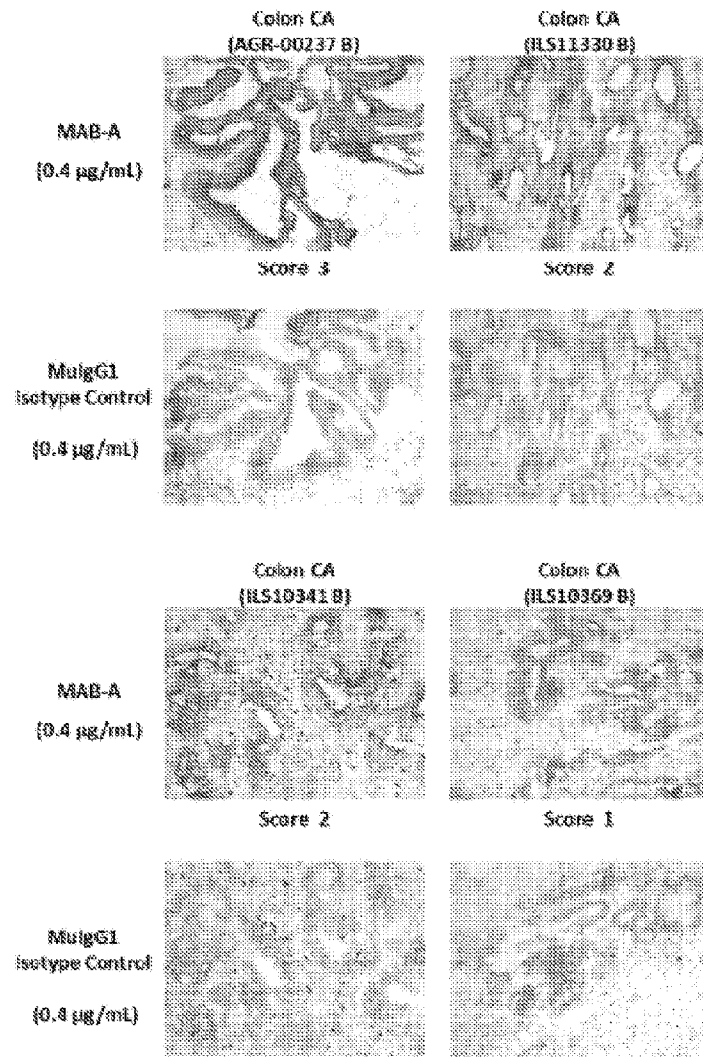


FIG. 1C

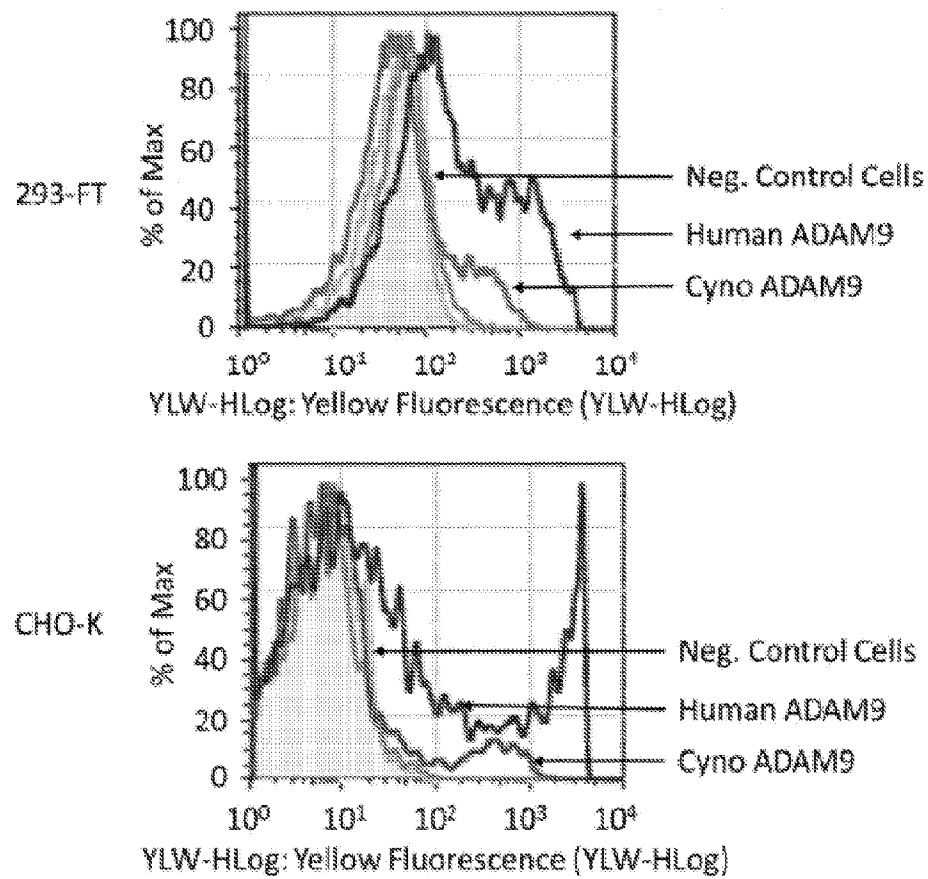


FIG. 2

		FR1	CDR1
Maeline MAE-A VH	SEQ ID NO:7	QVQLQQPGAEIVKPGASVKLSCHASGYSFT SYMMH	
MMAB-A VH(1)	SEQ ID NO:16	E...VES.GG....G.LR...A...F..S .....	
MMAB-A VH(2)	SEQ ID NO:17	E...VES.GG....G.LR...A...F..S .....	
MMAB-A VH(3)	SEQ ID NO:18	E...VES.GG....G.LR...A...F..S .....	
MMAB-A VH(4)	SEQ ID NO:19	E...VES.GG....G.LR...A...F..S ....I.	
MMAB-A VH(20)	SEQ ID NO:21	E...VES.GG....G.LR...A...F..S .....	
MMAB-A VH(20)	SEQ ID NO:22	E...VES.GG....G.LR...A...F..S .....	
MMAB-A VH(20)	SEQ ID NO:23	E...VES.GG....G.LR...A...F..S .....	
MMAB-A VH(21)	SEQ ID NO:28	E...VES.GG....G.LR...A...F..S .....	

FR2	CDR2	FR3
WYKQRFQGGLEWIG	ELIIPINGHTNYNEKFKS	KATLTIDKSSSTAYMQLSLASEDSAVYYCAR
..R.A..K...V.	.....	RF.IS..N.KN.L.L.MG..RA..T.....
..R.A..K...V.	.....F.....	RF.IS..N.KN.L.L.MG..RA..T.....
..R.A..K...V.	.....F.....R.QG	RF.IS..N.KN.L.L.MG..RA..T.....
..R.A..K...V.	.....F.....R.QG	RF.IS..N.KN.L.L.MG..RA..T.....
..R.A..K...V.	.....F.....	RF.IS..N.KN.L.L.MG..RA..T.....
..R.A..K...V.	.....F.....	RF.IS..N.KN.L.L.MG..RA..T.....
..R.A..K...V.	.....F.....	RF.IS..N.KN.L.L.MG..RA..T.....
..R.A..K...V.	.....F.....	RF.IS..N.KN.L.L.MG..RA..T.....

CDR3	FR4
GQYFFYGSRDYFDY	WGQGFIITVSS
.....V....	
.....V....	
.....V....	
.....V....	
.....FGKGV..	.....V....
.....PFGWL..	.....V....
.....FGKGV..	.....V....
.....PFGWL..	.....V....

FIG. 3A

		FR1	CDR1
Murine MAB-A VL	SEQ ID NO:11	DIYLTQSPASIAVSISGQRATIS	KASQSVVDYDQDSYNN
hMAB-A VL(1)	SEQ ID NO:54	...M...D...E...	.....
hMAB-A VL(2)	SEQ ID NO:55	...M...D...E...	.....S.....
hMAB-A VL(3)	SEQ ID NO:56	...M...D...E...	R.....S.....
hMAB-A VL(4)	SEQ ID NO:57	...M...D...E...	R.....S...L...

FR2	CDR2	FR3	CDR3	FR4
WYQQIPIPGQPPEILTY	AASULER	GIIPATSGSGSGSTDTIMINPVEEEDAAITYC	QGSHERPFT	PGGTEKLEIS
...K.....	.....	...T.SSL.P..F.....	.....	.....
...K.....	.....	...T.SSL.P..F.....	.....	.....
...K.....	.....	...T.SSL.P..F.....	.....	.....
...K.....	.....	...T.SSL.P..F.....	...YST...	.....

FIG. 3B

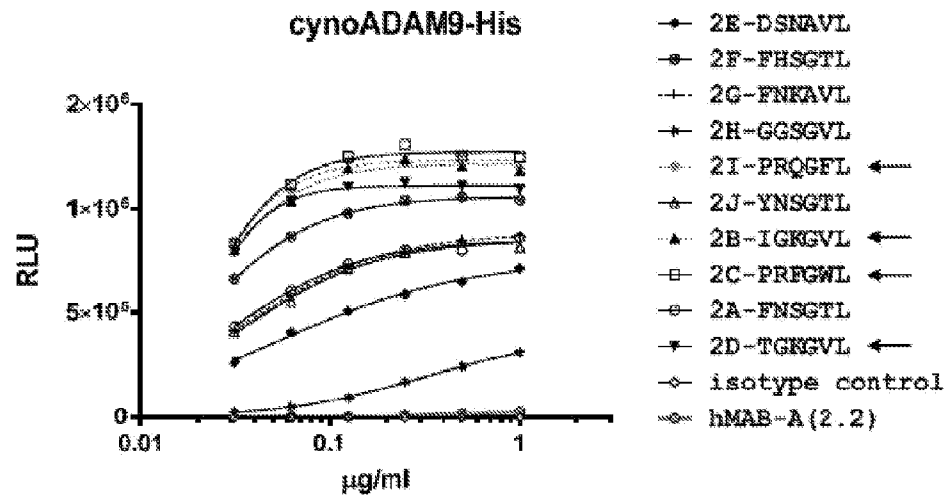


FIG. 4A

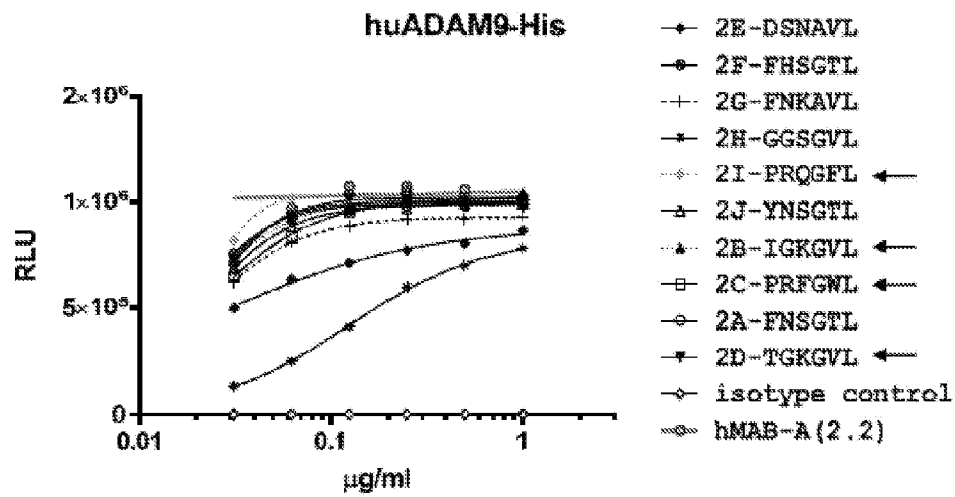


FIG. 4B

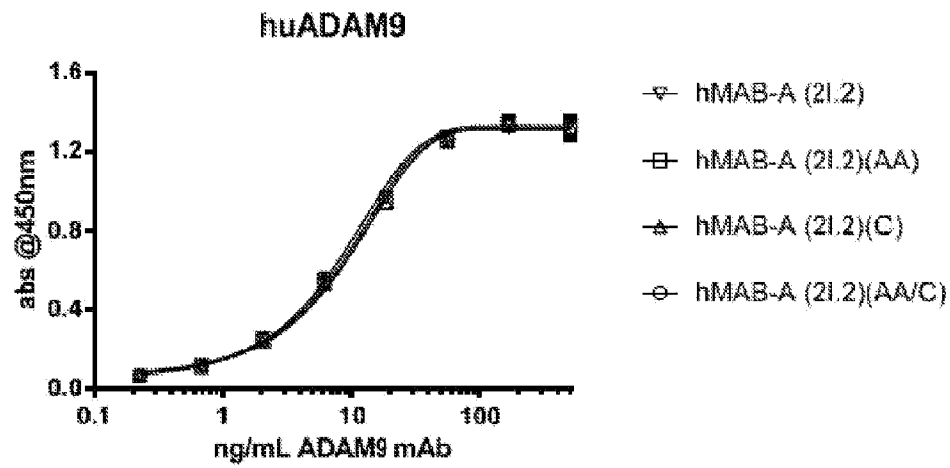


FIG. 5A

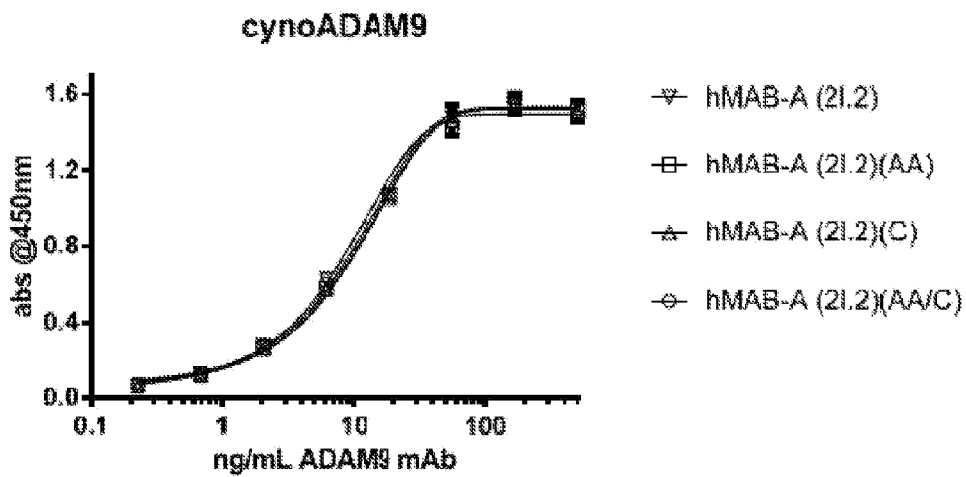


FIG. 5B

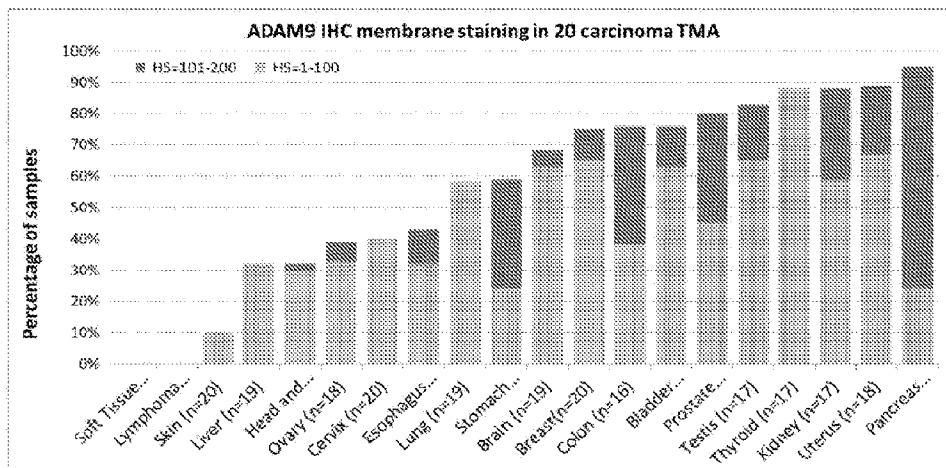


FIG. 6A

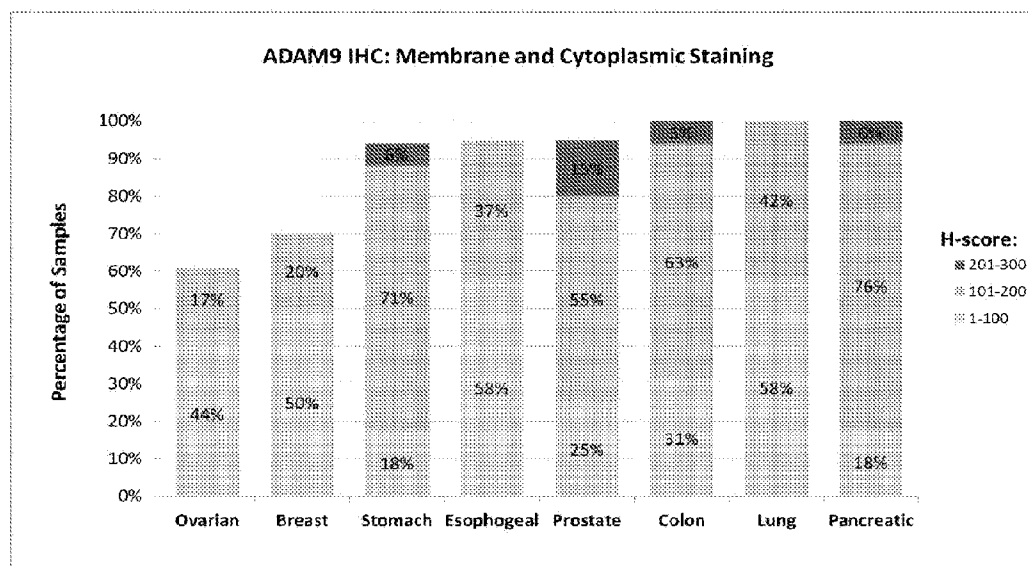


FIG. 6B

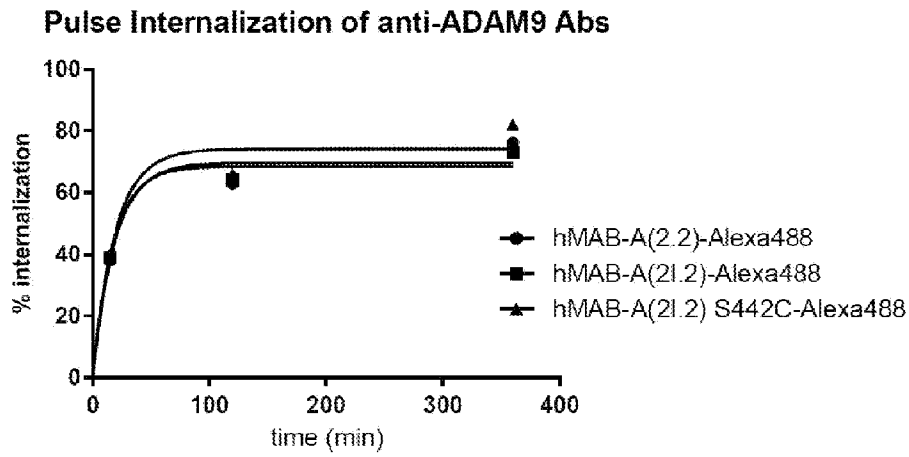


FIG. 7A

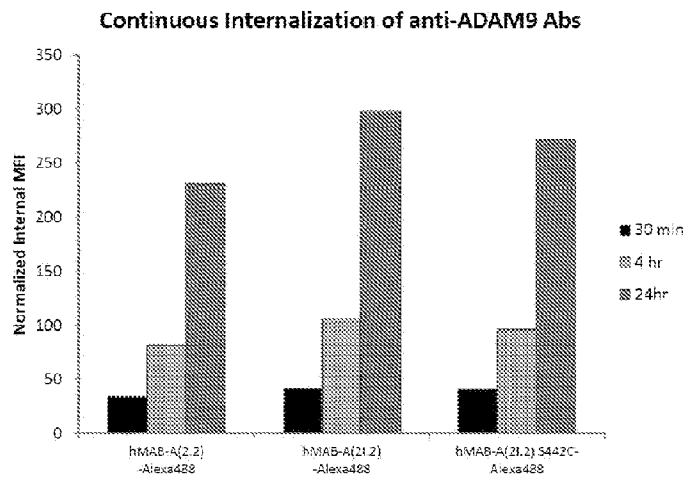


FIG. 7B



FIG. 8A

FACS: 300-19:human ADAM9

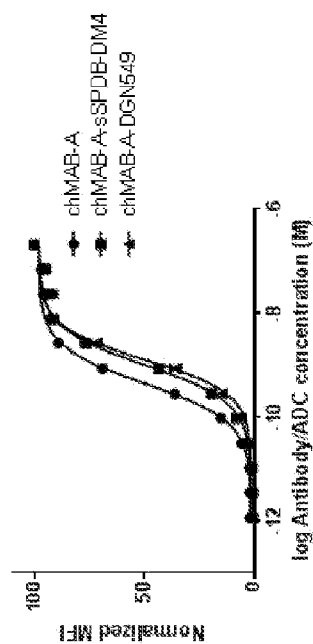


FIG. 8B

FACS: 300-19:human ADAM9

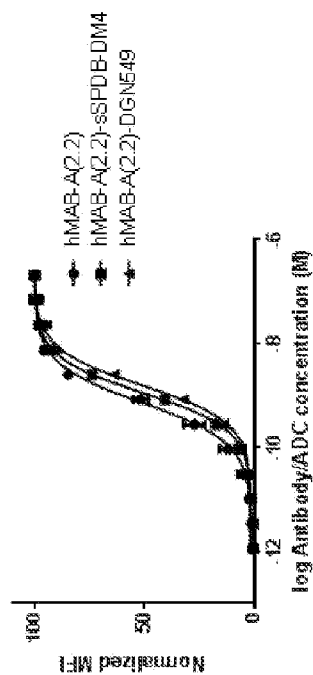


FIG. 8C

FACS: 300-19:human ADAM9

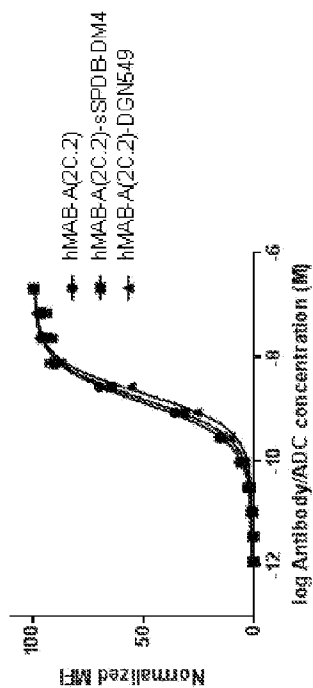


FIG. 8D

FACS: 300-19:human ADAM9

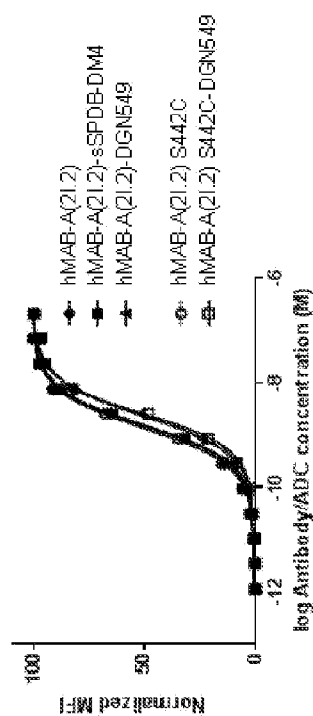


FIG. 9A

A498 (Kidney Carcinoma)

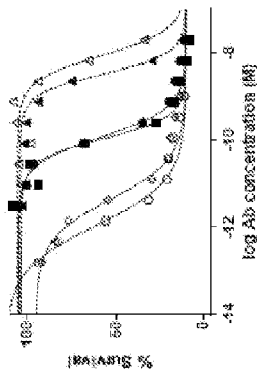


FIG. 9B

DLD-1 (Colorectal Adenocarcinoma)

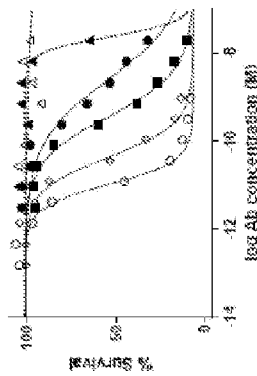


FIG. 9C

DU145 (Prostate Carcinoma)

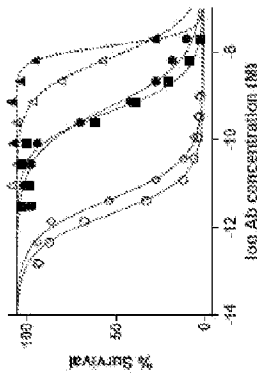


FIG. 9D

HPAF2 (Pancreatic Adenocarcinoma)

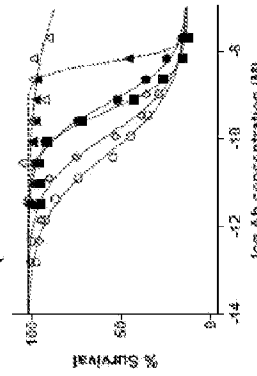


FIG. 9E

Hs578T (Breast Carcinoma)

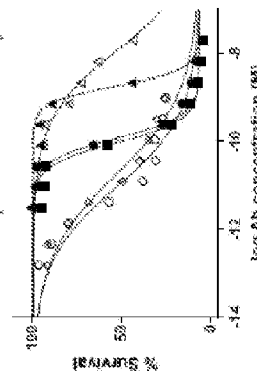


FIG. 9F

IGROV1 (Ovarian Adenocarcinoma)

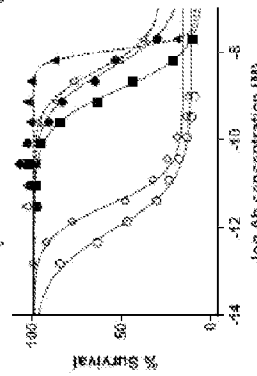


FIG. 9G

KATO III (Gastric Carcinoma)

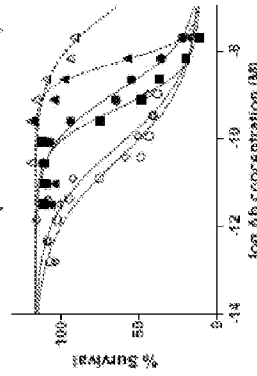
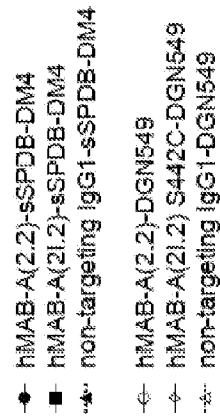
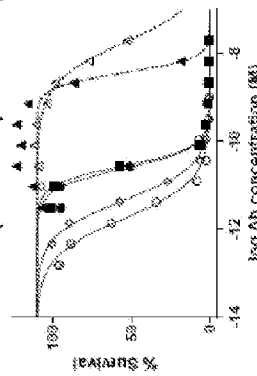
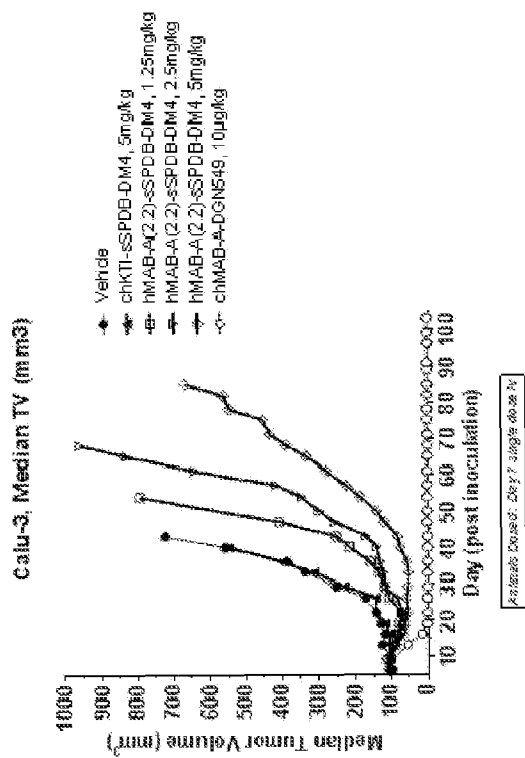


FIG. 9H

NCI-H1703 (NSCLS - Squamous Cell)





Group	Agent	Route	Dosage per injection (mg/kg)	Dose schedule	Tx day	Total dose (mg/kg)	Time to reach 1000mm <sup>3</sup> (days)	T/C (%)	T-C (days)	LCK	Regressions Day	Results
A	Vehicle	iv	-	qdx1	7	-	43	-	-	-	Partial	-
B	chK1T1-sPDB-DM4	iv	5	qdx1	7	5	50	98%	7	0.2	0/8	Inactive
C	hMAB-A(2:2)-sPDB-DM4	iv	1.25	qdx1	7	1.25	60	39%	17	0.5	3/8	Active
D	hMAB-A(2:2)-sPDB-DM4	iv	2.5	qdx1	7	2.5	65	25%	22	0.7	3/8	Active
E	hMAB-A(2:2)-sPDB-DM4	iv	5	qdx1	7	5	79	14%	36	1.1	4/8	Active
F	chMAB-A-DGNS49	iv	10ug/kg	qdx1	7	10ug/kg	CBD	0%	CBD	CBD	8/8	Highly Active
Tumor doubling time (T <sub>d</sub> ) =		9.774	(nonlinear exponential curve fit; R <sup>2</sup> = 0.982)									

FIG. 10

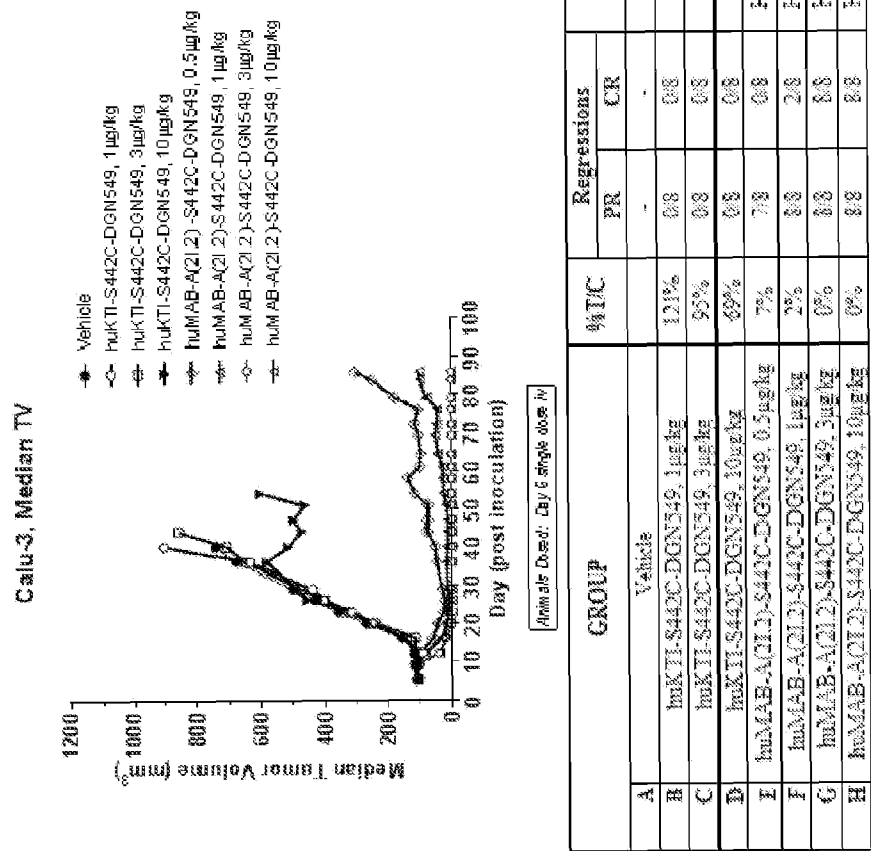
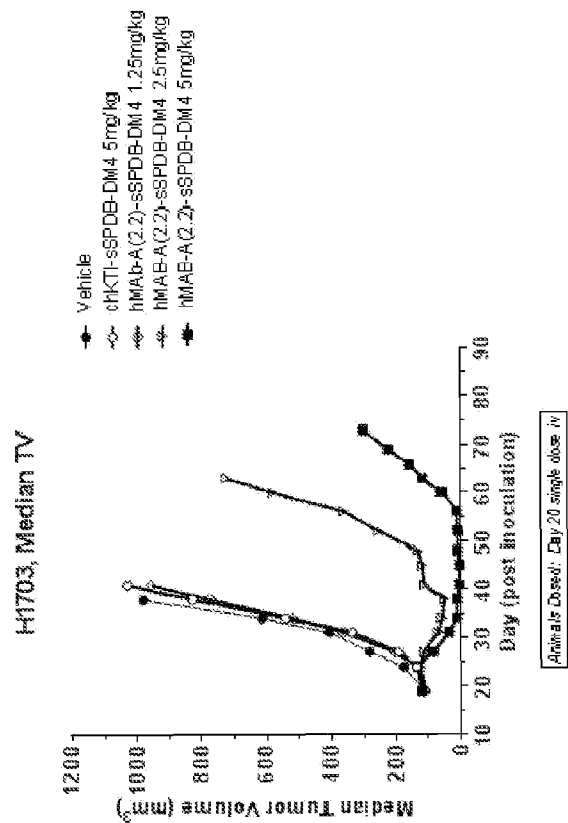
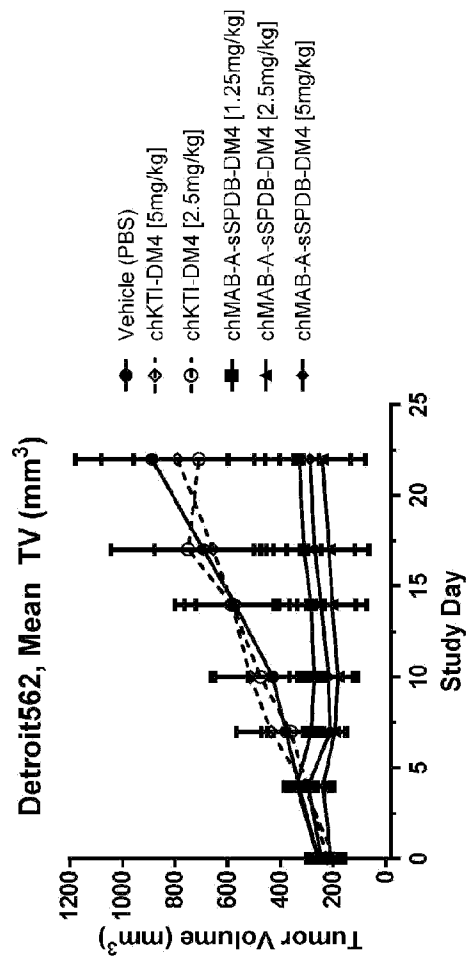


FIG. 11



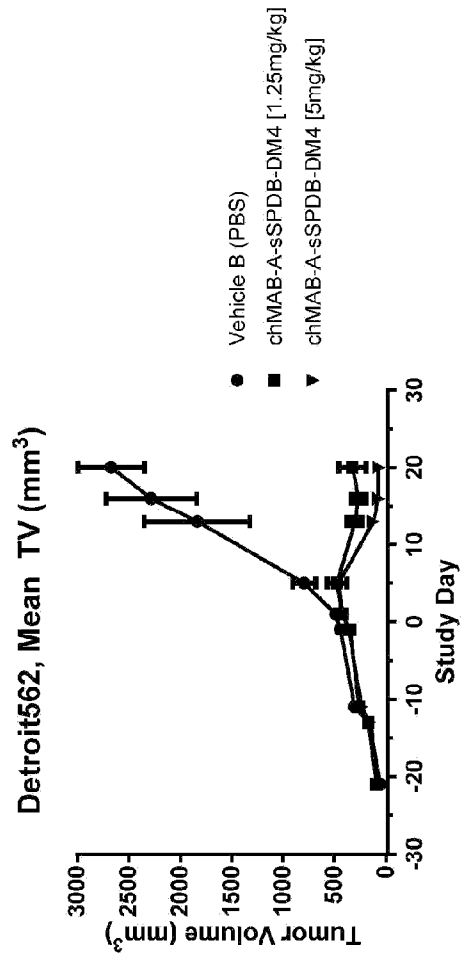
Group	Agent	Route	Dosage per injection (mg/kg)	Dose schedule	Tx day	Total dose (mg/kg)	Time to reach 100mm <sup>3</sup> (days)	T/C (%)	T-C (days)	LCK		Regressions Day		Results
												Partial	Complete	
A	Vehicle	iv	-	qdx1	20	-	38	-	-	-	-	-	-	-
B	chK1T-sSPDB-DM4	iv	5	qdx1	20	5	40	84%	2	0.1	0/6	0/6	0/6	Inactive
C	hMAB-A(2.2)-sSPDB-DM4	iv	1.25	qdx1	20	1.25	42	79%	4	0.2	1/6	0/6	0/6	Inactive
D	hMAB-A(2.2)-sSPDB-DM4	iv	2.5	qdx1	20	2.5	66	6%	28	1.4	3/6	0/6	0/6	Highly Active
E	hMAB-A(2.2)-sSPDB-DM4	iv	5	qdx1	20	5	NA	1%	NA	NA	6/6	3/6	3/6	Highly Active
Tumor doubling time (T <sub>d</sub> ) = 5.94 (nonlinear exponential curve fit; R <sup>2</sup> = 0.9943)														

FIG. 12



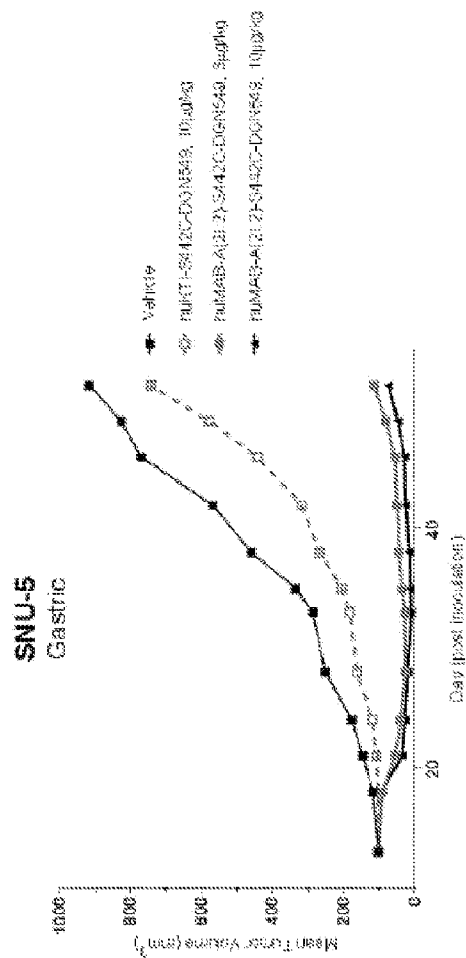
Group	Agent	Route	Dosage per injection (mg/kg)	Dose Schedule	Tx day	Total dose (mg/kg)	T/C (%)	Regressions Day	
								Partial	Complete
1	Vehicle	ip	-	qdx1	0	-	-	-	-
2	chKTI-sSPDB-DM4	ip	5	qdx1	0	5	89	3/7	0/7
3	chKTI-sSPDB-DM4	ip	2.5	qdx1	0	2.5	80	3/7	1/7
4	chMAB-A-sSPDB-DM4	ip	5	qdx1	0	5	32	6/7	1/7
5	chMAB-A-sSPDB-DM4	ip	2.5	qdx1	0	2.5	27	6/7	2/7
6	chMAB-A-sSPDB-DM4	ip	1.25	qdx1	0	1.25	37	5/7	0/7

FIG. 13



Group	Agent	Route	Dosage per injection (mg/kg)	Dose Schedule	Tx day	Total dose (mg/kg)	T/C (%)	Regressions Day	
1	Vehicle	ip	-	qdx1	1	-	-	Partial	Complete
2	chMAB-A-sSPDB-DM4	ip	5	qdx1	1	5	3	6/6	1/7
3	chMAB-A-sSPDB-DM4	ip	1.25	qdx1	1	1.25	14	6/6	0/7

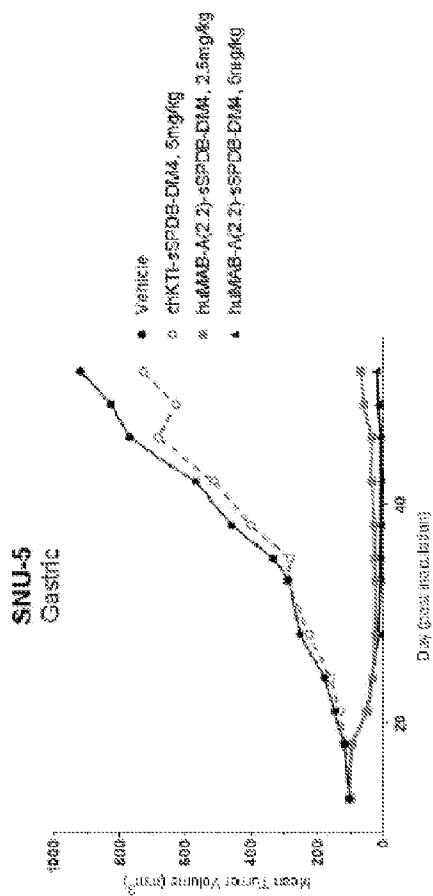
FIG. 14



Treatment	%T/C (Day 46)	Regressions		Results
		PR	CR	
huKT1-S442C-DGN549, 10µg/kg	58%	0/8	0/8	Inactive
huMAB-A(2L2)-S442C-DGN549, 5µg/kg	7%	8/8	4/8	Highly Active
huMAB-A(2L2)-S442C-DGN549, 10µg/kg	4%	8/8	5/8	Highly Active

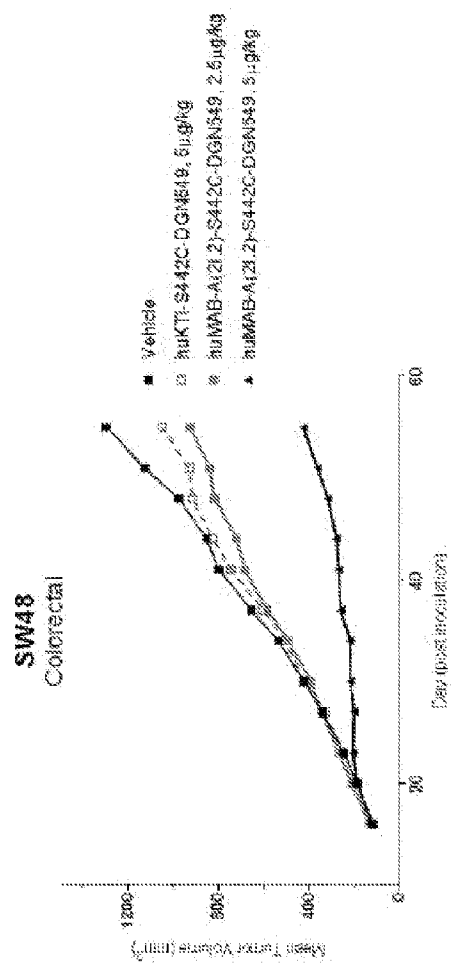
FIG. 15





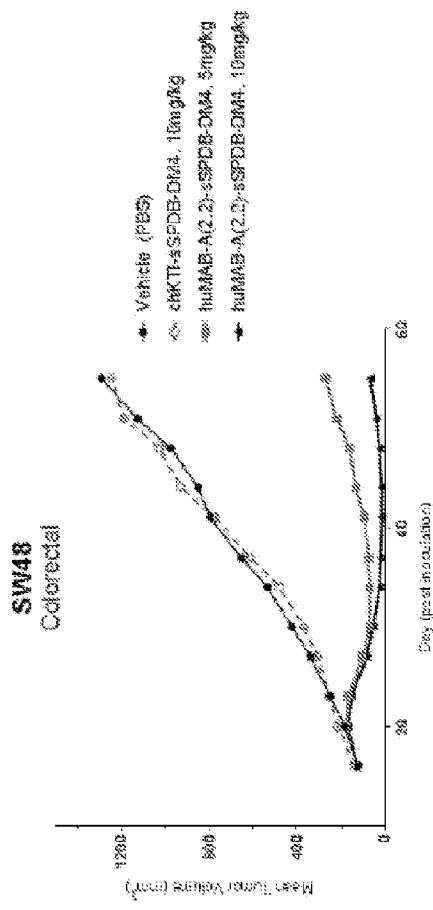
Treatment	%T/C (Day 46)	Regressions		Results
		PR	CR	
chKT1-sSPDB-DM4, 5mg/kg	89%	0/8	0/8	Inactive
huMAB-A(2.2)-sSPDB-DM4, 2.5mg/kg	5%	8/8	2/8	Highly Active
huMAB-A(2.2)-sSPDB-DM4, 5mg/kg	1%	8/8	6/8	Highly Active

FIG. 16



Treatment	%T/C (Day 34)	Regressions		Results
		PR	CR	
huKT1-S442C-DGN549, 5µg/kg	94%	0/6	0/6	Inactive
huMAB-A(2L2)-S442C-DGN549, 2.5µg/kg	92%	0/6	0/6	Inactive
huMAB-A(2L2)-S442C-DGN549, 5µg/kg	41%	2/6	0/6	Active

FIG. 17



Treatment	%T/C (Day 34)	Regressions		Results
		PR	CR	
chKTI-sSPDB-DM4, 10mg/kg	90%	0/6	0/6	Inactive
HuMAB-A(2.2)-sSPDB-DM4, 5mg/kg	13%	0/6	0/6	Active
HuMAB-A(2.2)-sSPDB-DM4, 10mg/kg	5%	6/6	0/6	Highly Active

FIG. 18

FIG. 19A

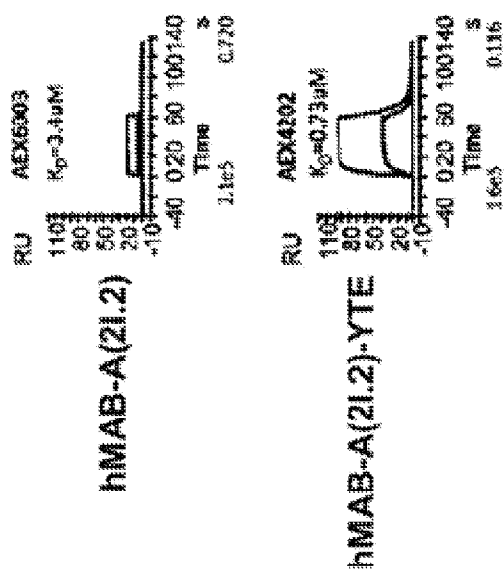
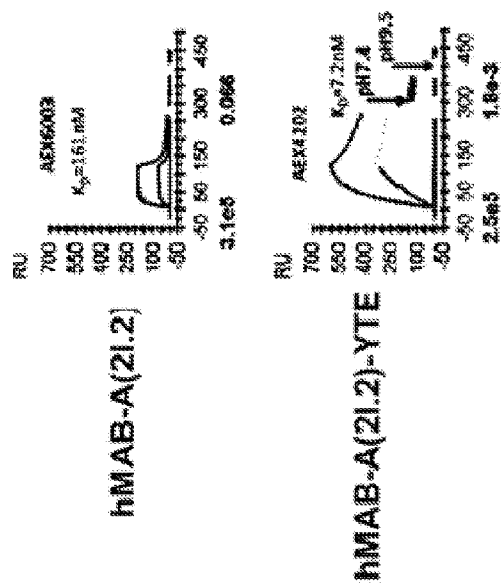


FIG. 19B



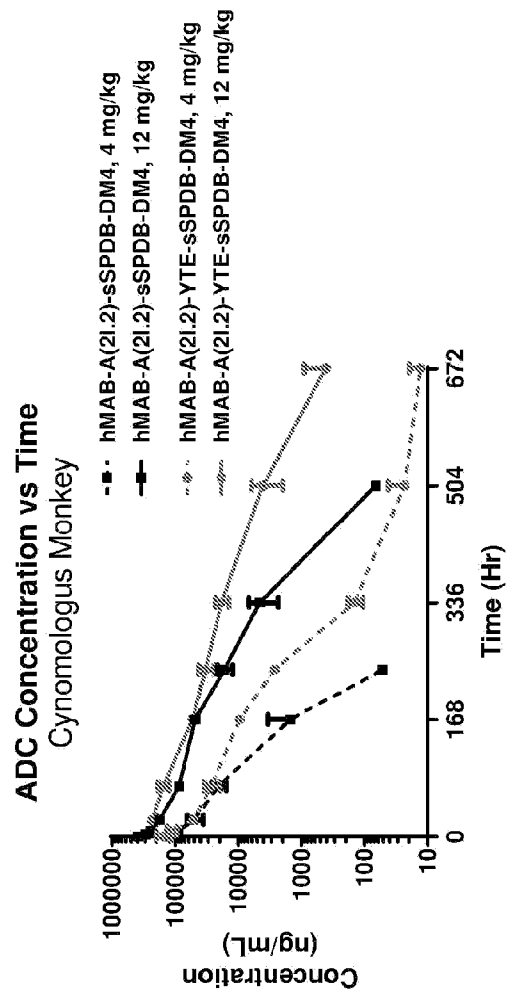


FIG. 20