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(54) **ANTIBODIES TO MADCAM**  
(71) Applicants: **Amgen Fremont Inc.**, Thousand Oaks, CA (US); **Pfizer Inc.**, New York, NY (US)  
(72) Inventors: **Nicholas Pullen**, Cambridge, MA (US); **Elizabeth Molloy**, Sandwich (GB); **Sirid-Aimee Kellermann**, Menlo Park, CA (US); **Larry L. Green**, San Francisco, CA (US); **Mary Haak-Frendscho**, Newark, CA (US)  
(73) Assignees: **Pfizer Inc.**, New York, NY (US); **Amgen Fremont Inc.**, Thousand Oaks, CA (US)

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*Primary Examiner* — Shri Ponnaluri

(74) *Attorney, Agent, or Firm* — Ropes & Gray LLP; Z. Ying Li; Brian M. Gummow

(57) **ABSTRACT**

The present invention relates to antibodies including human antibodies and antigen-binding portions thereof that specifically bind to MAdCAM, preferably human MAdCAM and that function to inhibit MAdCAM. The invention also relates to human anti-MAdCAM antibodies and antigen-binding portions thereof. The invention also relates to antibodies that are chimeric, bispecific, derivatized, single chain antibodies or portions of fusion proteins. The invention also relates to isolated heavy and light chain immunoglobulins derived from human anti-MAdCAM antibodies and nucleic acid molecules encoding such immunoglobulins. The present invention also relates to methods of making human anti-MAdCAM antibodies, compositions comprising these antibodies and methods of using the antibodies and compositions for diagnosis and treatment. The invention also provides gene therapy methods using nucleic acid molecules encoding the heavy and/or light immunoglobulin molecules that comprise the human anti-MAdCAM antibodies. The invention also relates to transgenic animals or plants comprising nucleic acid molecules of the invention.

**4 Claims, 9 Drawing Sheets**



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Figure 1

|                    |  |      |      |
|--------------------|--|------|------|
| Figure 1A          | CDR1   | CDR2 | CDR3 |
| VH3-13 Product     | EVQLVESGGGLVQPGGSLRLSCAASGFTTVAASGKSTGQDIYKASVNGRTISRDGSNRYLIQVNSLKTEDTAVYCTT...VA-DYWGQFLAVTVSSA  |      |      |
| L-7.2 Heavy chain  | EVQLVESGGGLVQPGGSLRLSCAASGFTTVAASGKSTGQDIYKASVNGRTISRDGSNRYLIQVNSLKTEDTAVYCTT...VA-DYWGQFLAVTVSSA  |      |      |
| L-8.2 Heavy chain  | EVQLVESGGGLVQPGGSLRLSCAASGFTTVAASGKSTGQDIYKASVNGRTISRDGSNRYLIQVNSLKTEDTAVYCTT...VA-DYWGQFLAVTVSSA  |      |      |
| Figure 1B          |  |      |      |
| VH3-13 Product     | EVQLLESGGSLVQPGGSLRLSCAASGFTTVAASGKSTGQDIYKASVNGRTISRDGSNRYLIQVNSLKTEDTAVYCTT...VA-DYWGQFLAVTVSSA  |      |      |
| L-14.1 Heavy chain | EVQLLESGGSLVQPGGSLRLSCAASGFTTVAASGKSTGQDIYKASVNGRTISRDGSNRYLIQVNSLKTEDTAVYCTT...VA-DYWGQFLAVTVSSA  |      |      |
| Figure 1C          |  |      |      |
| VH3-15 Product     | QVQLVYSSGSGVVDGKRSLSLSCAASGFTTVAASGKSTGQDIYKASVNGRTISRDGSNRYLIQVNSLKTEDTAVYCTT...VA-DYWGQFLAVTVSSA |      |      |
| L-22.1 Heavy chain | QVQLVYSSGSGVVDGKRSLSLSCAASGFTTVAASGKSTGQDIYKASVNGRTISRDGSNRYLIQVNSLKTEDTAVYCTT...VA-DYWGQFLAVTVSSA |      |      |
| Figure 1D          |  |      |      |
| VH3-20 Product     | QVQLVYSSGSGVVDGKRSLSLSCAASGFTTVAASGKSTGQDIYKASVNGRTISRDGSNRYLIQVNSLKTEDTAVYCTT...VA-DYWGQFLAVTVSSA |      |      |
| L-34.1 Heavy chain | QVQLVYSSGSGVVDGKRSLSLSCAASGFTTVAASGKSTGQDIYKASVNGRTISRDGSNRYLIQVNSLKTEDTAVYCTT...VA-DYWGQFLAVTVSSA |      |      |
| Figure 1E          |  |      |      |
| VH4-4 Product      | QVQLVYSSGSGVVDGKRSLSLSCAASGFTTVAASGKSTGQDIYKASVNGRTISRDGSNRYLIQVNSLKTEDTAVYCTT...VA-DYWGQFLAVTVSSA |      |      |
| L-67.1 Heavy chain | QVQLVYSSGSGVVDGKRSLSLSCAASGFTTVAASGKSTGQDIYKASVNGRTISRDGSNRYLIQVNSLKTEDTAVYCTT...VA-DYWGQFLAVTVSSA |      |      |
| Figure 1F          |  |      |      |
| VH3-23 Product     | EVQLLESGGSLVQPGGSLRLSCAASGFTTVAASGKSTGQDIYKASVNGRTISRDGSNRYLIQVNSLKTEDTAVYCTT...VA-DYWGQFLAVTVSSA  |      |      |
| L-73.2 Heavy chain | EVQLLESGGSLVQPGGSLRLSCAASGFTTVAASGKSTGQDIYKASVNGRTISRDGSNRYLIQVNSLKTEDTAVYCTT...VA-DYWGQFLAVTVSSA  |      |      |
| Figure 1G          |  |      |      |
| VH3-21 Product     | EVQLVDSGGSLVQPGGSLRLSCAASGFTTVAASGKSTGQDIYKASVNGRTISRDGSNRYLIQVNSLKTEDTAVYCTT...VA-DYWGQFLAVTVSSA  |      |      |
| L-77.1 Heavy chain | EVQLVDSGGSLVQPGGSLRLSCAASGFTTVAASGKSTGQDIYKASVNGRTISRDGSNRYLIQVNSLKTEDTAVYCTT...VA-DYWGQFLAVTVSSA  |      |      |
| Figure 1H          |  |      |      |
| VH1-18 Product     | QVQLVDSGGSLVQPGGSLRLSCAASGFTTVAASGKSTGQDIYKASVNGRTISRDGSNRYLIQVNSLKTEDTAVYCTT...VA-DYWGQFLAVTVSSA  |      |      |
| L-18.6 Heavy chain | QVQLVDSGGSLVQPGGSLRLSCAASGFTTVAASGKSTGQDIYKASVNGRTISRDGSNRYLIQVNSLKTEDTAVYCTT...VA-DYWGQFLAVTVSSA  |      |      |
| L-26.8 Heavy chain | QVQLVDSGGSLVQPGGSLRLSCAASGFTTVAASGKSTGQDIYKASVNGRTISRDGSNRYLIQVNSLKTEDTAVYCTT...VA-DYWGQFLAVTVSSA  |      |      |
| Figure 1I          |  |      |      |
| VH4-6 Product      | QVQLVDSGGSLVQPGGSLRLSCAASGFTTVAASGKSTGQDIYKASVNGRTISRDGSNRYLIQVNSLKTEDTAVYCTT...VA-DYWGQFLAVTVSSA  |      |      |
| L-29.5 Heavy chain | QVQLVDSGGSLVQPGGSLRLSCAASGFTTVAASGKSTGQDIYKASVNGRTISRDGSNRYLIQVNSLKTEDTAVYCTT...VA-DYWGQFLAVTVSSA  |      |      |
| Figure 1J          |  |      |      |
| VH3-23 Product     | EVQLVDSGGSLVQPGGSLRLSCAASGFTTVAASGKSTGQDIYKASVNGRTISRDGSNRYLIQVNSLKTEDTAVYCTT...VA-DYWGQFLAVTVSSA  |      |      |
| L-8.2 Heavy chain  | EVQLVDSGGSLVQPGGSLRLSCAASGFTTVAASGKSTGQDIYKASVNGRTISRDGSNRYLIQVNSLKTEDTAVYCTT...VA-DYWGQFLAVTVSSA  |      |      |



Figure 1, cont.

|                    |   |      |      |
|--------------------|---|------|------|
|                    | CDR1  | CDR2 | CDR3 |
| Figure 1k          |   |      |      |
| A3 Product         | DIVVTQSPPLSLPVTPGQPASISCKASISCSLSLQSNINWYILOWYKPKQSPQLLIYLSNTRASQVDFRFSSESSTDFTLKISRVEADQVAVYVYCHQRLQIITFGQSTRLEIKR |      |      |
| 1.7.2 Kappa chain  | DIVVTQSPPLSLPVTPGQPASISCKASISCSLSLQSNINWYILOWYKPKQSPQLLIYLSNTRASQVDFRFSSESSTDFTLKISRVEADQVAVYVYCHQRLQIITFGQSTRLEIKR |      |      |
| 1.8.2 Kappa chain  | DIVVTQSPPLSLPVTPGQPASISCKASISCSLSLQSNINWYILOWYKPKQSPQLLIYLSNTRASQVDFRFSSESSTDFTLKISRVEADQVAVYVYCHQRLQIITFGQSTRLEIKR |      |      |
| Figure 1l          |   |      |      |
| 012 Product        | DIQNTQSPSSLSASVGDRTVITCRASQSISSYLHWYQCPKPKAFKVLIFFAASSLQSGVPSRFSSESSTDFTLKISRVEADQVAVYVYCHQRLQIITFGQSTRLEIKR        |      |      |
| 6.14.2 Kappa chain | DIQNTQSPSSLSASVGDRTVITCRASQSISSYLHWYQCPKPKAFKVLIFFAASSLQSGVPSRFSSESSTDFTLKISRVEADQVAVYVYCHQRLQIITFGQSTRLEIKR        |      |      |
| Figure 1m          |   |      |      |
| A25 Product        | EIVLTQSPDFQSVTRKPKYVITCRASQSISSYLHWYQCPKPKAFKVLIFFAASSLQSGVPSRFSSESSTDFTLKISRVEADQVAVYVYCHQRLQIITFGQSTRLEIKR        |      |      |
| 6.22.2 Kappa chain | EIVLTQSPDFQSVTRKPKYVITCRASQSISSYLHWYQCPKPKAFKVLIFFAASSLQSGVPSRFSSESSTDFTLKISRVEADQVAVYVYCHQRLQIITFGQSTRLEIKR        |      |      |
| Figure 1n          |   |      |      |
| 012 Product        | DIQNTQSPSSLSASVGDRTVITCRASQSISSYLHWYQCPKPKAFKVLIFFAASSLQSGVPSRFSSESSTDFTLKISRVEADQVAVYVYCHQRLQIITFGQSTRLEIKR        |      |      |
| 6.16.2 Kappa chain | DIQNTQSPSSLSASVGDRTVITCRASQSISSYLHWYQCPKPKAFKVLIFFAASSLQSGVPSRFSSESSTDFTLKISRVEADQVAVYVYCHQRLQIITFGQSTRLEIKR        |      |      |
| Figure 1o          |   |      |      |
| B3 Product         | DIVVTQSPPLSLAVSLGSRPAVITCRASQSISSYLHWYQCPKPKAFKVLIFFAASSLQSGVPSRFSSESSTDFTLKISRVEADQVAVYVYCHQRLQIITFGQSTRLEIKR      |      |      |
| 6.67.1 Kappa chain | DIVVTQSPPLSLAVSLGSRPAVITCRASQSISSYLHWYQCPKPKAFKVLIFFAASSLQSGVPSRFSSESSTDFTLKISRVEADQVAVYVYCHQRLQIITFGQSTRLEIKR      |      |      |
| Figure 1p          |   |      |      |
| 012 Product        | DIQNTQSPSSLSASVGDRTVITCRASQSISSYLHWYQCPKPKAFKVLIFFAASSLQSGVPSRFSSESSTDFTLKISRVEADQVAVYVYCHQRLQIITFGQSTRLEIKR        |      |      |
| 6.71.2 Kappa chain | DIQNTQSPSSLSASVGDRTVITCRASQSISSYLHWYQCPKPKAFKVLIFFAASSLQSGVPSRFSSESSTDFTLKISRVEADQVAVYVYCHQRLQIITFGQSTRLEIKR        |      |      |
| Figure 1q          |   |      |      |
| A2 Product         | DIVVTQSPPLSLAVTPGQPASISCKASISCSLSLQSNINWYILOWYKPKQSPQLLIYLSNTRASQVDFRFSSESSTDFTLKISRVEADQVAVYVYCHQRLQIITFGQSTRLEIKR |      |      |
| 6.77.2 Kappa chain | DIVVTQSPPLSLAVTPGQPASISCKASISCSLSLQSNINWYILOWYKPKQSPQLLIYLSNTRASQVDFRFSSESSTDFTLKISRVEADQVAVYVYCHQRLQIITFGQSTRLEIKR |      |      |
| Figure 1r          |   |      |      |
| A2 product         | DIVVTQSPPLSLAVTPGQPASISCKASISCSLSLQSNINWYILOWYKPKQSPQLLIYLSNTRASQVDFRFSSESSTDFTLKISRVEADQVAVYVYCHQRLQIITFGQSTRLEIKR |      |      |
| 7.16.6 Kappa chain | DIVVTQSPPLSLAVTPGQPASISCKASISCSLSLQSNINWYILOWYKPKQSPQLLIYLSNTRASQVDFRFSSESSTDFTLKISRVEADQVAVYVYCHQRLQIITFGQSTRLEIKR |      |      |
| 7.26.4 Kappa chain | DIVVTQSPPLSLAVTPGQPASISCKASISCSLSLQSNINWYILOWYKPKQSPQLLIYLSNTRASQVDFRFSSESSTDFTLKISRVEADQVAVYVYCHQRLQIITFGQSTRLEIKR |      |      |
| Figure 1s          |   |      |      |
| A3 Product         | DIVVTQSPPLSLPVTPGQPASISCKASISCSLSLQSNINWYILOWYKPKQSPQLLIYLSNTRASQVDFRFSSESSTDFTLKISRVEADQVAVYVYCHQRLQIITFGQSTRLEIKR |      |      |
| 7.26.5 Kappa chain | DIVVTQSPPLSLPVTPGQPASISCKASISCSLSLQSNINWYILOWYKPKQSPQLLIYLSNTRASQVDFRFSSESSTDFTLKISRVEADQVAVYVYCHQRLQIITFGQSTRLEIKR |      |      |
| Figure 1t          |   |      |      |
| 018 Product        | DIQNTQSPSSLSASVGDRTVITCRASQSISSYLHWYQCPKPKAFKVLIFFAASSLQSGVPSRFSSESSTDFTLKISRVEADQVAVYVYCHQRLQIITFGQSTRLEIKR        |      |      |
| 9.8.2 Kappa chain  | DIQNTQSPSSLSASVGDRTVITCRASQSISSYLHWYQCPKPKAFKVLIFFAASSLQSGVPSRFSSESSTDFTLKISRVEADQVAVYVYCHQRLQIITFGQSTRLEIKR        |      |      |



Figure 2  
Figure 2A

```

1.7.2 --MRLPAQLLGLLMLWVS--GSSGDI VMTQSPLELSEVTPGEPASISCRSSQSLIQS-NGY
1.8.2 --MRLPAQLLGLLMLWVS--GSSGDI VMTQSPLELSEVTPGEPASISCRSSQSLIQS-NGY
7.20.5 --MRLPAQLLGLLMLWVS--GSSGDI VMTQSPLELSEVTPGEPASISCRSSQSLIQS-NGY
7.16.6 --MRLPAQLLGLLMLWIP--GSSADI VMTQSPLELSEVTPGEPASISCRSSQSLIQS-DGT
7.26.4 --MRLPAQLLGLLMLWIP--GSSADI VMTQSPLELSEVTPGEPASISCRSSQSLIQS-DGT
6.77.1 --MRLPAQLLGLLMLWIP--GSSADI VMTQSPLELSEVTPGEPASISCRSSQSLIQS-DGT
6.67.1 --MRLPAQLLGLLMLWIP--GSSADI VMTQSPLELSEVTPGEPASISCRSSQSLIQS-DGT
6.34.2 MEMRVPAQLLGLLMLWLR--GARCDI QMTQSPLELSEVTPGEPASISCRSSQSLIQS-NGY
6.73.2 MEMRVPAQLLGLLMLWLR--GARCDI QMTQSPLELSEVTPGEPASISCRSSQSLIQS-NGY
6.14.2 MEMRVPAQLLGLLMLWLR--GARCDI QMTQSPLELSEVTPGEPASISCRSSQSLIQS-NGY
9.8.2 MEMRVPAQLLGLLMLWLR--GARCDI QMTQSPLELSEVTPGEPASISCRSSQSLIQS-NGY
6.22.2 --MLPQQLLGLLMLWVP--ASRDEI VLTQSPDFQSVTPKRVVITTCRASQRIQSS-NGY

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1.7.2 NYLDWYLQKPGQSPQQLIYLQSNRASGVVDRFSGSGSGTDFTLKISRVEAEDVGVYYCMQ
1.8.2 NYLDWYLQKPGQSPQQLIYLQSNRASGVVDRFSGSGSGTDFTLKISRVEAEDVGVYYCMQ
7.20.5 NYLDWYLQKPGQSPQQLIYLQSNRASGVVDRFSGSGSGTDFTLKISRVEAEDVGVYYCMQ
7.16.6 TYLWYLQKPGQSPQQLIYLQSNRASGVVDRFSGSGSGTDFTLKISRVEAEDVGVYYCMQ
7.26.4 TYLWYLQKPGQSPQQLIYLQSNRASGVVDRFSGSGSGTDFTLKISRVEAEDVGVYYCMQ
6.77.1 TYLWYLQKPGQSPQQLIYLQSNRASGVVDRFSGSGSGTDFTLKISRVEAEDVGVYYCMQ
6.67.1 TYLWYLQKPGQSPQQLIYLQSNRASGVVDRFSGSGSGTDFTLKISRVEAEDVGVYYCMQ
6.34.2 --LHWYQKPGKAPKLLIYAASGLRQGVVDRFSGSGSGTDFTLITRSLQPEDFATYTCQQ
6.73.2 --LHWYQKPGKAPKLLIYAASGLRQGVVDRFSGSGSGTDFTLITRSLQPEDFATYTCQQ
6.14.2 --LHWYQKPGKAPKLLIYAASGLRQGVVDRFSGSGSGTDFTLITRSLQPEDFATYTCQQ
9.8.2 --LHWYQKPGKAPKLLIYAASGLRQGVVDRFSGSGSGTDFTLITRSLQPEDFATYTCQQ
6.22.2 --LHWYQKPGQSPKLLIYASQSPGVVDRFSGSGSGTDFTLITRSLQPEDFATYTCQQ

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1.7.2 ALQT---ITFGQGTTRLEIKR
1.8.2 ALQT---ITFGQGTTRLEIKR
7.20.5 ALQT---LTFGQGTTRLEIKR
7.16.6 SIQLP--WTFGQGTTRLEIKR
7.26.4 SIQLP--WTFGQGTTRLEIKR
6.77.1 SIQLM--CSFGQGTTRLEIKR
6.67.1 YYSIFP-LTFGQGTTRLEIKR
6.34.2 SYSIFP-LTFGQGTTRLEIKR
6.73.2 SYSNPFBCGFTTRLEIKR
6.14.2 NYIIFP--ITFGQGTTRLEIKR
9.8.2 SENLSE--ITFGQGTTRLEIKR
6.22.2 SRRLP--LTFGQGTTRLEIKR

```

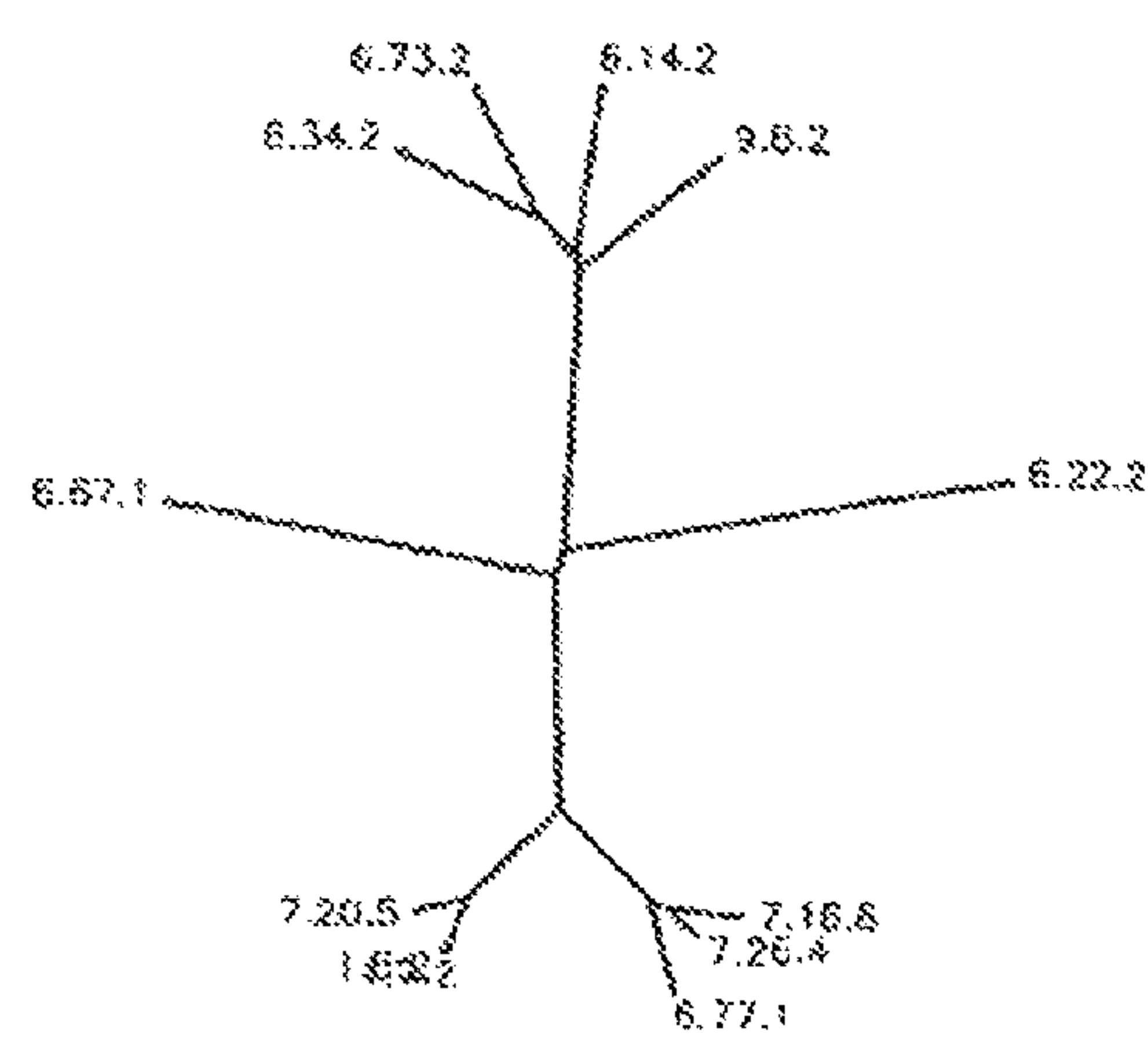




Figure 2B

7.16.6 QVQLVQSGAEVKKFGASVKVSCKASGYTFTSYGINWVRQAPGQGLEWMGWIS--VYSGNT  
7.26.4 QVQLVQSGAEVKKFGASVKVSCKASGYTFTSYGIDWVRQAPGQGLEWMGWIS--VYSGNT  
1.7.2 EVQLVESGGGLVQPGGSLRLSCVASGFTFTNAWMIWVRQAPGKGLEWVGRIGKKTGGTT  
1.8.2 EVQLVESGGGLVQPGGSLRLSCVVSQFTFTNAWMIWVRQAPGKGLEWVGRIGKKTGGTT  
6.14.2 EVQLLESQGGGLVQPGGSLRLSCAASGLTFNNSAMTWVRQAPGKGLEWVSTTS--GSGGTT  
6.73.2 EVQLLESQGGGLVQPGGSLRLSCAASGFTFRSYAMWVRQAPGKGLEWVSVIS--GSGGTT  
6.77.1 EVQLVESGGGLVQPGGSLRLSCAASGFTFSSYSWVRQAPGKGLEWVSSIS--SSSYI  
6.22.2 QVQLVESGGGVVQPGRSRLSCLASGHTFSSDGMWVRQAPGKGLEWVAITW--YDGSNK  
6.34.2 QVQLVESGGGVVQPGRSRLSCLASGFTFSSYGMWVRQAPGKGLEWVAVIS--NKGNNK  
9.8.2 QVQLVESGGGVVQPGRSRLSCLASGFTFSSYGMWVRQAPGKGLEWVAIIV--YDGSNK  
7.20.5 QVQLQESGGPGLVQPSSETLSLTCTVSGSRISSYKMNWVRQAPGKGLEWIGRIY---TGGST  
6.67.1 QVQLQESGGPGLVQPSSETLSLTCTVSGDSTSSNYSWVRQAPGKGLEWIGRIY---TGGST  
:\*\*\* :\*\* : ( \* . : ) \* . \*\* : ) . \* : \*\* . \* : \*\*\*) ; . . .

7.16.6 NYAQKVGGRVIMTADTSTSTAYNDLRSLRSDDTAVYYCAREG-SS--SSGDYYFGMDVWG  
7.26.4 NYAQKLGGRVIMTADTSTSTAFFLLRSLRSDDTAVYYCAREG-SS--SSGDYYFGMDVWG  
1.7.2 DYAAPVKGKRFITSRDSSKNTLYLQMNLSLRAEDTAVYYCTDGG-----VADY-----WG  
1.8.2 DYAAPVKGKRFITSRDSSKNTLYLQMNLSLRAEDTAVYYCTDGG-----VADY-----WG  
6.14.2 YYADSVKGRFITSRDSSKNTLYLQMNLSLRAEDTAVYYCAARG-YSYGTTPEY-----WG  
6.73.2 YYADSVKGRFITSRDSSKNTLYLQMNLSLRAEDTAVYYCAKIA-VAGEGLTYYG-MDVWG  
6.77.1 YYADSVKGRFITSRDSSKNTLYLQMNLSLRAEDTAVYYCARDG-YSSGHSYTYFGMDVWG  
6.22.2 YYADSVKGRFITSRDSSKNTLYLQMNLSLRAEDTAVYYCARD-----FGYYG-MDVWG  
6.34.2 YYADSVKGRFITSRDSSKNTLYLQMNLSLRAEDTAVYYCARDS-TA--ITYYTYG-MDVWG  
9.8.2 YYADSVKGRFITSRDSSKNTLYLQMNLSLRAEDTAVYYCARG-----AYH-FAYWG  
7.20.5 NYNPSLKSRTVMSLDTSEKQPSLKLSSVTAADTAVYYCAREGVRYYYAGSSYYGLDVG  
6.67.1 NSNPSLQKVTILADTSEKQPSLKLSSVTAADTAVYYCARD--RITILNGLIPSPDYWG  
: : . \* . \* : \* . . . : ) \* : ( \* : \*\*\*) ; \*\*

7.16.6 QGTVTVVSSA  
7.26.4 QGTVTVVSSA  
1.7.2 QGTLVTVSSA  
1.8.2 QGTLVTVSSA  
6.14.2 QGTLVTVSSA  
6.73.2 QGTVTVVSSA  
6.77.1 QGTVTVVSSA  
6.22.2 QGTVTVVSSA  
6.34.2 QGTVTVVSSA  
9.8.2 QGTLVTVSSA  
7.20.5 QGTVTVVSSA  
6.67.1 QGTLVTVSSA  
\*\*\* \*\*\*\*\*

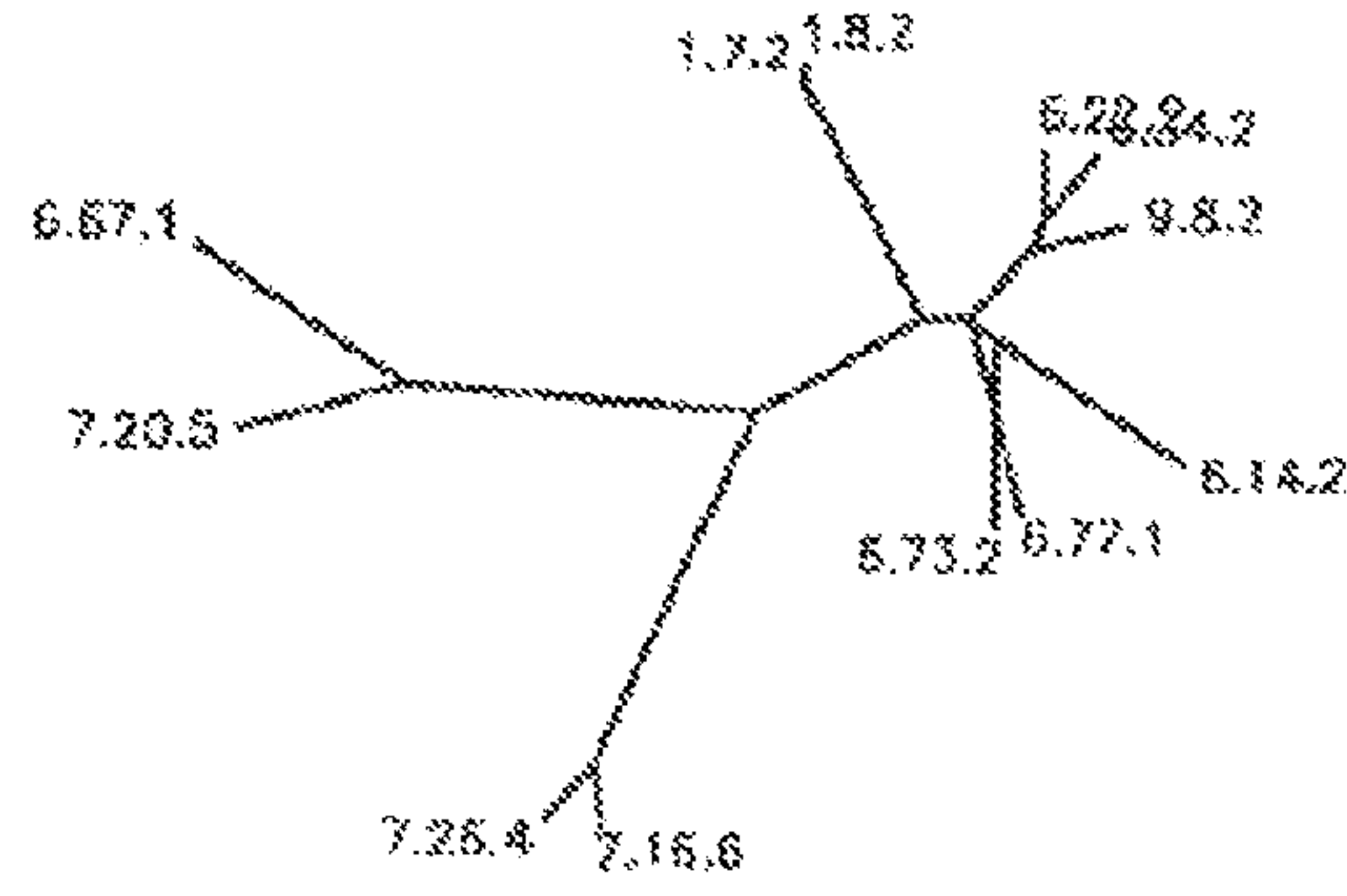




Figure 3

Domain 1

```

cyno MAdCAM
human MAdCAM
** *****

cyno MAdCAM
human MAdCAM
** *****

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Domain 2

```

cyno MAdCAM
human MAdCAM
** , *****

cyno MAdCAM
human MAdCAM
** *****

```



Figure 4

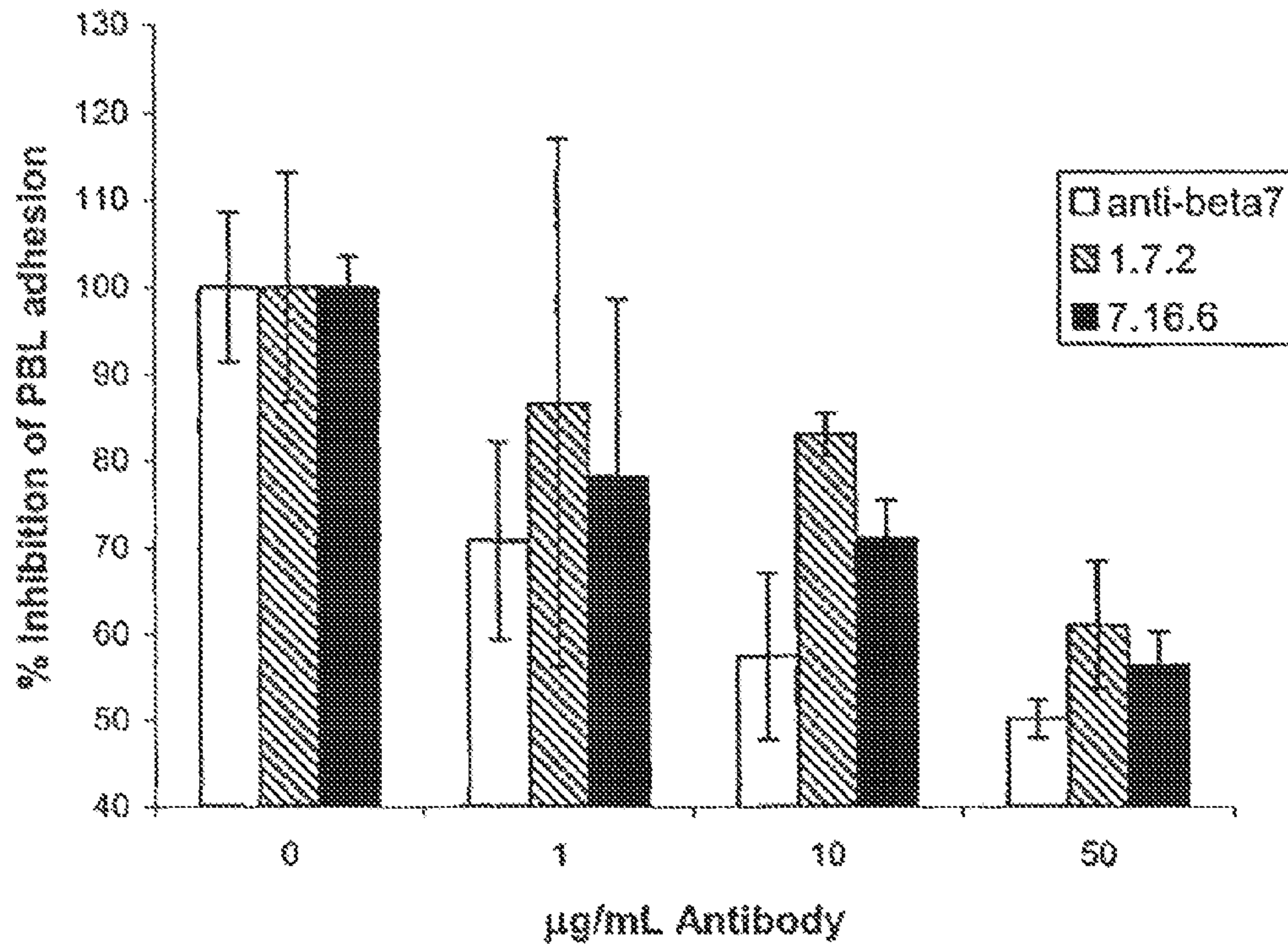




Figure 5

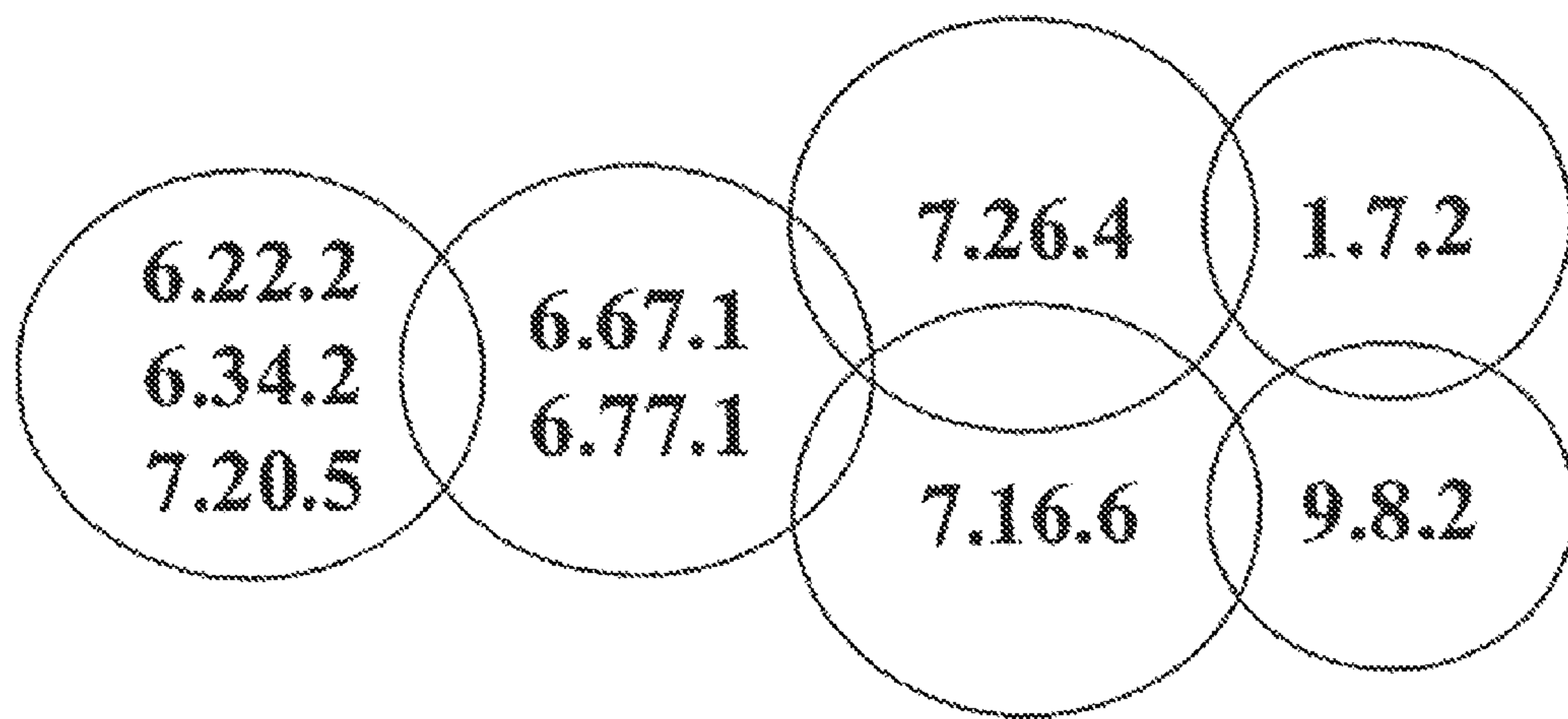




Figure 6

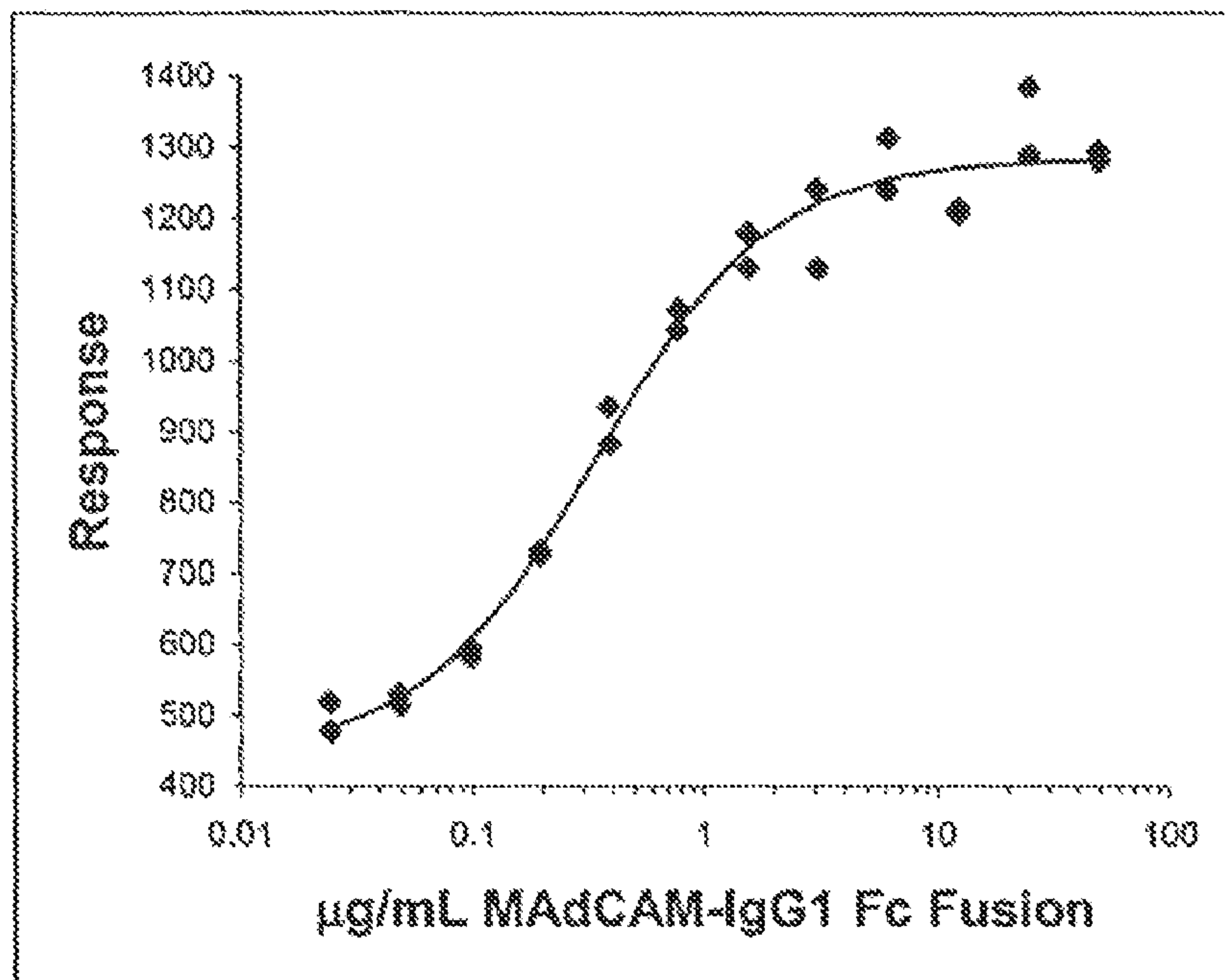
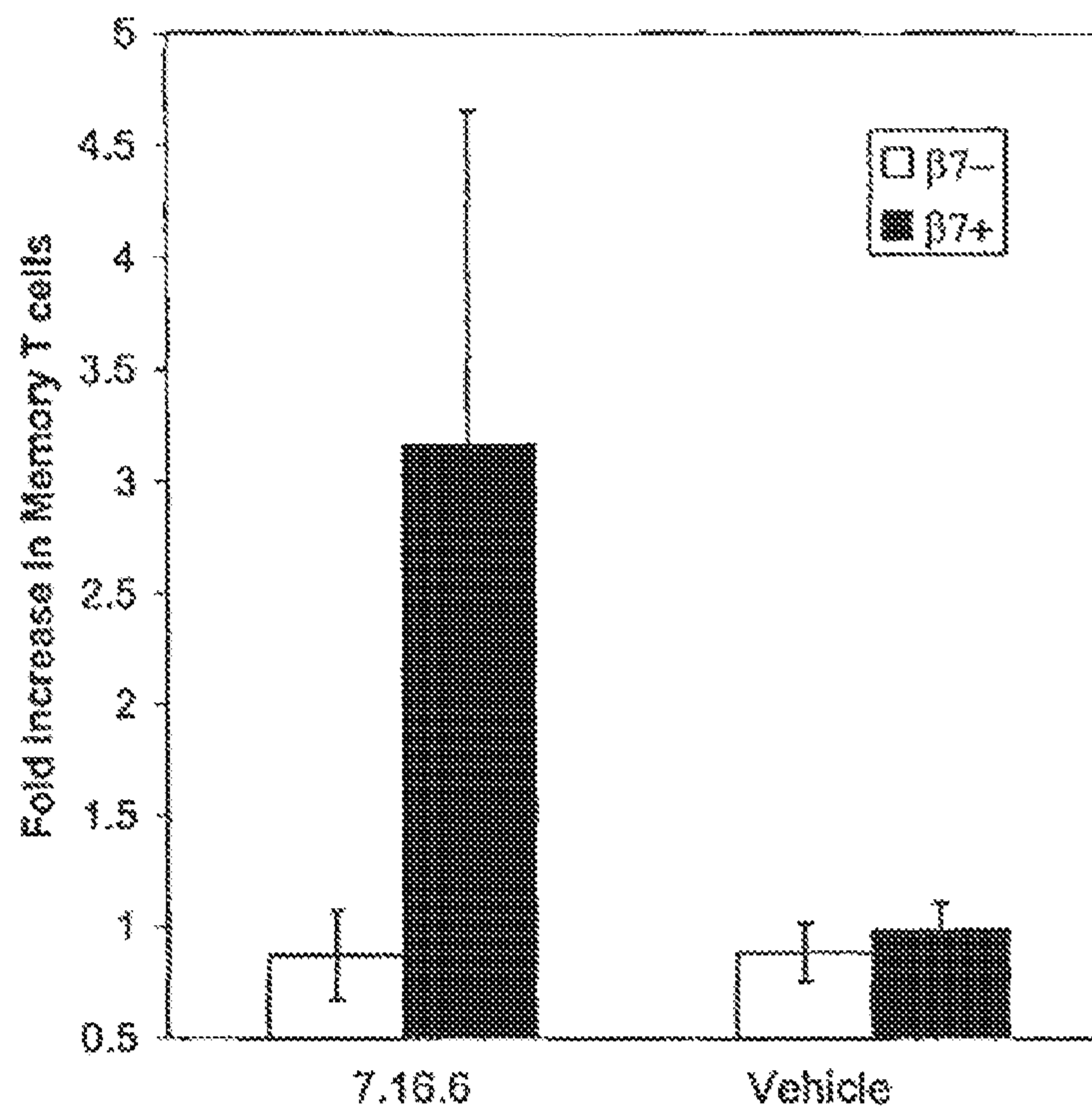




Figure 7





## ANTIBODIES TO MADCAM

**Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue; a claim printed with strikethrough indicates that the claim was canceled, disclaimed, or held invalid by a prior post-patent action or proceeding.**

This application is *an application for reissue of U.S. Pat. No. 7,932,372, and is a continuation application of U.S. application Ser. No. 13/871,913, filed Apr. 26, 2013, now abandoned, which is an application for reissue of U.S. Pat. No. 7,932,372, which issued from U.S. application Ser. No. 11/484,247, filed Jul. 10, 2006, which is a continuation under 35 U.S.C. §120 of International Application PCT/US2005/000370, filed Jan. 7, 2005, which claims priority under 35 U.S.C. §119(e) from U.S. Provisional Application No. 60/535,490, filed Jan. 9, 2004, now expired. More than one reissue application has been filed for the reissue of U.S. Pat. No. 7,932,372. The reissue applications are application Ser. No. 14/219,900 (the present application) and Ser. No. 13/871,913, all of which are continuation reissues of U.S. Pat. No. 7,932,372.*

The Sequence Listing associated with this application is provided in text format in lieu of a paper copy, and is hereby incorporated by reference into the specification. The name of the text file containing the Sequence Listing is Sequence\_listing.txt. The text file is [188,900] 188,950 bytes in size, was created on [Sep. 17, 2010] Mar. 19, 2014, and is submitted electronically via EFS-Web.

## BACKGROUND OF THE INVENTION

Mucosal addressin cell adhesion molecule (MAdCAM) is a member of the immunoglobulin superfamily of cell adhesion receptors. The selectivity of lymphocyte homing to specialized lymphoid tissue and mucosal sites of the gastrointestinal tract is determined by the endothelial expression of MAdCAM (Berlin, C. et al., Cell, 80:413-422(1994); Berlin, C., et al., Cell, 74:185-195 (1993); and Erle, D. J., et al., J. Immunol., 153: 517-528 (1994)). MAdCAM is uniquely expressed on the cell surface of high endothelial venules of organized intestinal lymphoid tissue, such as Peyer's patches and mesenteric lymph nodes (Streeter et al., Nature, 331:41-6 (1988); Nakache et al., Nature, 337:179-81 (1989); Briskin et al., Am. J. Pathol. 151-97-110 (1997)), but also in other lymphoid organs, such as pancreas, gall bladder and splenic venules and marginal sinus of the splenic white pulp (Briskin et al(1997), supra; Kraal et al., Am. J. Path., 147: 763-771 (1995)).

While MAdCAM plays a physiological role in gut immune surveillance, it appears to facilitate excessive lymphocyte extravasation in inflammatory bowel disease under conditions of chronic gastrointestinal tract inflammation. TNF $\alpha$  and other pro-inflammatory cytokines increase endothelial MAdCAM expression and, in biopsy specimens taken from patients with Crohn's disease and ulcerative colitis, there is an approximate 2-3 fold focal increase in MAdCAM expression at sites of inflammation (Briskin et al. (1997), Souza et al., Gut, 45:856-63 (1999); Arihiro et al., Pathol Int., 52:367-74 (2002)). Similar patterns of elevated expression have been observed in experimental models of colitis (Hesterberg et al., Gastroenterology, 111: 1373-1380 (1997); Picarella et al., J. Immunol., 158: 2099-2106 (1997); Connor et al., J Leukoc

Biol., 65:349-55 (1999); Kato et al., J Pharmacol Exp Ther., 295:183-9(2000); Hokari et al., Clin Exp Immunol., 26:259-65 (2001); Shigematsu et al., Am J Physiol Gastrointest Liver Physiol., 281:G1309-15 (2001)). In other pre-clinical models for inflammatory conditions, such as insulin-dependent diabetes (Yang et al. Diabetes, 46:1542-7 (1997); Hänninen et al., J Immunol., 160:6018-25 (1998)), graft versus host disease (Fujisaki et al., Scand J Gastroenterol., 38:437-42 (2003), Murai et al., Nat Immunol., 4:154-60 (2003)), chronic liver disease (Hillan et al., Liver, 19:509-18 (1999); Grant et al., Hepatology, 33:1065-72 (2001)), inflammatory encephalopathy (Stalder et al., Am J Pathol., 153:767-83 (1998); Kanawar et al., Immunol Cell Biol., 78:641-5 (2000)), and gastritis (Barrett et al., J Leukoc Biol., 67:169-73 (2000); Hatanaka et al., Clin Exp Immunol., 130:183-9 (2002)), there is also reawakening of fetal MAdCAM expression and participation of activated  $\alpha_4\beta_7^+$  lymphocytes in disease pathogenesis. In these inflammatory models as well as hapten-mediated (e.g., TNBS, DSS, etc.) or adoptive transfer (CD4 $^+$  CD45Rb $^{high}$ ) mouse colitic models, the rat anti-mouse MAdCAM monoclonal antibody (mAb), MECA-367, which blocks the binding of  $\alpha_4\beta_7^+$  lymphocytes to MAdCAM, reduces the lymphocyte recruitment, tissue extravasation, inflammation and disease severity. Mouse monoclonal antibodies (mAbs) against human MAdCAM also have been reported (see, e.g., WO 96/24673 and WO 99/58573).

Given the role of MAdCAM in inflammatory bowel disease (IBD) and other inflammatory diseases associated with the gastrointestinal tract or other tissues, a means for inhibiting  $\alpha_4\beta_7$  binding and MAdCAM-mediated leukocyte recruitment is desirable. It further would be desirable to have such therapeutic means with advantageous properties including but not limited to the absence of unwanted interactions with other medications in patients and favorable physico-chemical properties such as pK/pD values in humans, solubility, stability, shelf-life and in vivo half-life. A therapeutic protein, such as an antibody, would advantageously be free of unwanted post-translational modifications or aggregate formation. Accordingly, there is a critical need for therapeutic anti-MAdCAM antibodies.

## SUMMARY OF THE INVENTION

The present invention provides an isolated antibody that specifically binds MAdCAM, wherein at least the CDR sequences of said antibody are human CDR sequences, or an antigen-binding portion of said antibody. In some embodiments the antibody is a human antibody, preferably an antibody that acts as a MAdCAM antagonist. Also provided are compositions comprising said antibodies or portions.

The invention also provides a composition comprising the heavy and/or light chain of said anti-MAdCAM antagonist antibody or the variable region or other antigen-binding portion thereof or nucleic acid molecules encoding any of the foregoing and a pharmaceutically acceptable carrier. Compositions of the invention may further comprise another component, such as a therapeutic agent or a diagnostic agent. Diagnostic and therapeutic methods are also provided by the invention.

The invention further provides an isolated cell line, that produces said anti-MAdCAM antibody or antigen-binding portion thereof.

The invention also provides nucleic acid molecules encoding the heavy and/or light chain of said anti-MAdCAM antibody or the variable region thereof or antigen-binding portion thereof.



The invention provides vectors and host cells comprising said nucleic acid molecules, as well as methods of recombinantly producing the polypeptides encoded by the nucleic acid molecules.

Non-human transgenic animals or plants that express the heavy and/or light chain of said anti-MAdCAM antibody, or antigen-binding portion thereof, are also provided.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an alignment of the predicted amino acid sequences of the heavy and kappa light chain variable regions of twelve human anti-MAdCAM monoclonal antibodies with the germline amino acid sequences of the corresponding human genes.

FIG. 1A shows an alignment of the predicted amino acid sequence of the heavy chain for antibodies 1.7.2 and 1.8.2 (residues 20-138 of SEQ ID NOS: 2 and 6, respectively) with the germline human VH 3-15 gene product (SEQ ID NO: 113).

FIG. 1B shows an alignment of the predicted amino acid sequence of the heavy chain for antibody 6.14.2 (residues 20-141 of SEQ ID NO: 10) with the germline human VH 3-23 gene product (SEQ ID NO: 114).

FIG. 1C shows an alignment of the predicted amino acid sequence of the heavy chain for antibody 6.22.2 (residues 20-139 of SEQ ID NO: 14) with the germline human VH 3-33 gene product (SEQ ID NO: 115).

FIG. 1D shows an alignment of the predicted amino acid sequence of the heavy chain for antibody 6.34.2 (residues 20-143 of SEQ ID NO: 18) with the germline human VH 3-30 gene product (SEQ ID NO: 116).

FIG. 1E shows an alignment of the predicted amino acid sequence of the heavy chain for antibody 6.67.1 (residues 20-144 of SEQ ID NO: 22) with the germline human VH 4-4 gene product (SEQ ID NO: 117).

FIG. 1F shows an alignment of the predicted amino acid sequence of the heavy chain for antibody 6.73.2 (residues 20-145 of SEQ ID NO: 26) with the germline human VH 3-23 gene product (SEQ ID NO: 118).

FIG. 1G shows an alignment of the predicted amino acid sequence of the heavy chain for antibody 6.77.1 (residues 20-146 of SEQ ID NO: 30) with the germline human VH 3-21 gene product (SEQ ID NO: 119).

FIG. 1H shows an alignment of the predicted amino acid sequence of the heavy chain for antibodies 7.16.6 and 7.26.4 (residues 20-144 of SEQ ID NOS: 34 and 42, respectively) with the germline human VH 1-18 gene product (SEQ ID NO: 120).

FIG. 1I shows an alignment of the predicted amino acid sequence of the heavy chain for antibody 7.20.5 (residues 20-146 of SEQ ID NO: 38) with the germline human VH 4-4 gene product (SEQ ID NO: 121).

FIG. 1J shows an alignment of the predicted amino acid sequence of the heavy chain for antibody 9.8.2 (residues 20-136 of SEQ ID NO: 46) with the germline human VH 3-33 gene product (SEQ ID NO: 122).

FIG. 1K shows an alignment of the predicted amino acid sequence of the light kappa chain for antibodies 1.7.2 and 1.8.2 (residues 21-132 of SEQ ID NOS: 4 and 8, respectively) with the germline human A3 gene product (SEQ ID NO: 123).

FIG. 1L shows an alignment of the predicted amino acid sequence of the kappa light chain for antibody 6.14.2 (residues 23-130 of SEQ ID NO: 12) with the germline human O12 gene product (SEQ ID NO: 124).

FIG. 1M shows an alignment of the predicted amino acid sequence of the kappa light chain for antibody 6.22.2 (resi-

dues 20-127 of SEQ ID NO: 16) with the germline human A26 gene product (SEQ ID NO: 125).

FIG. 1N shows an alignment of the predicted amino acid sequence of the kappa light chain for antibody 6.34.2 (residues 23-130 of SEQ ID NO: 20) with the germline human O12 gene product (SEQ ID NO: 126).

FIG. 1O shows an alignment of the predicted amino acid sequence of the kappa light chain for antibody 6.67.1 (residues 21-135 of SEQ ID NO: 24) with the germline human B3 gene product (SEQ ID NO: 127).

FIG. 1P shows an alignment of the predicted amino acid sequence of the kappa light chain for antibody 6.73.2 (residues 23-132 of SEQ ID NO: 28) with the germline human O12 gene product (SEQ ID NO: 128).

FIG. 1Q shows an alignment of the predicted amino acid sequence of the kappa light chain for antibody 6.77.1 (residues 21-133 of SEQ ID NO: 32) with the germline human A2 gene product (SEQ ID NO: 129).

FIG. 1R shows an alignment of the predicted amino acid sequence of the kappa light chain for antibodies 7.16.6 and 7.26.4 (residues 21-133 of SEQ ID NOS: 36 and 44, respectively) with the germline human A2 gene product (SEQ ID NO: 130).

FIG. 1S shows an alignment of the predicted amino acid sequence of the kappa light chain for antibody 7.20.5 (residues 21-132 of SEQ ID NO: 40) with the germline human A3 gene product (SEQ ID NO: 131).

FIG. 1T shows an alignment of the predicted amino acid sequence of the kappa light chain for antibody 9.8.2 (residues 25-132 of SEQ ID NO: 48) with the germline human O18 gene product (SEQ ID NO: 132).

FIG. 2 are CLUSTAL alignments of the predicted heavy and kappa light chain amino acid sequences of human anti-MAdCAM antibodies.

FIG. 2A is a CLUSTAL alignment (residues 1-132 of SEQ ID NOS: 4, 8, and 40, residues 1-133 of SEQ ID NOS: 36, 44, and 32, residues 1-135 of SEQ ID NO: 24, residues 1-130 of SEQ ID NO: 20, residues 1-132 of SEQ ID NO: 28, residues 1-130 of SEQ ID NO: 12, residues 1-132 of SEQ ID NO: 48, and residues 1-127 of SEQ ID NO: 16, all respectively in order of appearance) and radial tree of the predicted kappa light chain amino acid sequences, showing the degree of similarity between the anti-MAdCAM antibody kappa light chains.

FIG. 2B is a CLUSTAL alignment (residues 20-144 of SEQ ID NO: 34, SEQ ID NO: 133, residues 20-138 of SEQ ID NOS: 4 and 6, residues 20-122 of SEQ ID NO: 10, residues 20-145 of SEQ ID NO: 26, residues 20-146 of SEQ ID NO: 30, residues 20-139 of SEQ ID NO: 14, residues 20-143 of SEQ ID NO: 18, residues 20-136 of SEQ ID NO: 46, residues 20-146 of SEQ ID NO: 38, and residues 20-144 of SEQ ID NO: 22, all respectively in order of appearance) and radial tree of the predicted heavy amino acid sequences, showing the degree of similarity between the anti-MAdCAM antibody heavy chains.

FIG. 3 is on amino acid sequence CLUSTAL alignment of the 2 N-terminal domains of cynomolgus (SEQ ID NO: 50) and human (residues 1-225 of SEQ ID NO: 107) MAdCAM which form the  $\alpha_4\beta_7$  binding domain. The  $\beta$ -strands are aligned according to Tan et al., Structure (1998) 6:793-801.

FIG. 4 is a graph representing the dose effects of purified biotinylated 1.7.2 and 7.16.6 on the adhesion of human peripheral blood lymphocytes to sections of MAdCAM-expressing frozen human liver endothelium.

FIG. 5 shows a two dimensional graphical representation based on the data captured in Table 7 of the diversity of MAdCAM epitopes to which the anti-MAdCAM antibodies,



1.7.2, 6.22.2, 6.34.2, 6.67.1, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2 bind. Anti-MAdCAM antibodies within the same circle show the same reactivity pattern, belong in the same epitope bin and are likely to recognize the same epitope on MAdCAM. Anti-MAdCAM antibody clones within overlapping circles are unable to bind simultaneously and are, therefore, likely to recognize an overlapping epitope on MAdCAM. Non-integrating circles represent anti-MAdCAM antibody clones with distinct spatial epitope separation.

FIG. 6 shows sandwich ELISA data with anti-MAdCAM antibodies 1.7.2 and an Alexa 488-labelled 7.16.6, showing that two antibodies that are able to detect different epitopes on MAdCAM could be used to detect soluble MAdCAM for diagnostic purposes.

FIG. 7 shows the effect of an inhibitory anti-MAdCAM antibody (1 mg/kg) on the number of circulating peripheral  $\alpha_4\beta_7+$  lymphocytes, expressed as a fold increase over control IgG2a mAb or vehicle, using anti-MAdCAM mAb 7.16.6 in a cynomolgus monkey model.

## DETAILED DESCRIPTION OF THE INVENTION

### Definitions and General Techniques

Unless otherwise defined herein, scientific and technical terms used in connection with the present invention shall have the meanings that are commonly understood by those of ordinary skill in the art. Further, unless otherwise required by context, singular terms shall include pluralities and plural terms shall include the singular. Generally, nomenclatures used in connection with, and techniques of, cell and tissue culture, molecular biology, immunology, microbiology, genetics, protein and nucleic acid chemistry and hybridization described herein are those well known and commonly used in the art. The methods and techniques of the present invention are generally performed according to conventional methods well known in the art and as described in various general and more specific references that are cited and discussed throughout the present specification unless otherwise indicated. See, e.g., Sambrook et al., *Molecular Cloning: A Laboratory Manual*, 2nd ed., Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y. (1989) and Ausubel et al., *Current Protocols in Molecular Biology*, Greene Publishing Associates (1992), and Harlow and Lane, *Antibodies: A Laboratory Manual*, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y. (1990), which are incorporated herein by reference. Enzymatic reactions and purification techniques are performed according to manufacturer's specifications, as commonly accomplished in the art or as described herein. Standard techniques are used for chemical syntheses, chemical analyses, pharmaceutical preparation, formulation, and delivery, and treatment of patients.

The following terms, unless otherwise indicated, shall be understood to have the following meanings:

The term "polypeptide" encompasses native or artificial proteins, protein fragments and polypeptide analogs of a protein sequence. A polypeptide may be monomeric or polymeric.

The term "isolated protein" or "isolated polypeptide" is a protein or polypeptide that by virtue of its origin or source of derivation (1) is not associated with naturally associated components that accompany it in its native state, (2) is free of other proteins from the same species (3) is expressed by a cell from a different species, or (4) does not occur in nature. Thus, a polypeptide that is chemically synthesized or synthesized in a cellular system different from the cell from which it naturally originates will be "isolated" from its naturally associated

components. A protein may also be rendered substantially free of naturally associated components by isolation, using protein purification techniques well known in the art.

A protein or polypeptide is "substantially pure," "substantially homogeneous" or "substantially purified" when at least about 60 to 75% of a sample exhibits a single species of polypeptide. The polypeptide or protein may be monomeric or multimeric. A substantially pure polypeptide or protein will typically comprise about 50%, 60%, 70%, 80% or 90% W/W of a protein sample, more usually about 95%, and preferably will be over 99% pure. Protein purity or homogeneity may be indicated by a number of means well known in the art, such as polyacrylamide gel electrophoresis of a protein sample, followed by visualizing a single polypeptide band upon staining the gel with a stain well known in the art. For certain purposes, higher resolution may be provided by using HPLC or other means well known in the art for purification.

The term "polypeptide fragment" as used herein refers to a polypeptide that has an amino-terminal and/or carboxy-terminal deletion, but where the remaining amino acid sequence is identical to the corresponding positions in the naturally-occurring sequence. In some embodiments, fragments are at least 5, 6, 8 or 10 amino acids long. In other embodiments, the fragments are at least 14 amino acids long, more preferably at least 20 amino acids long, usually at least 50 amino acids long, even more preferably at least 70, 80, 90, 100, 150 or 200 amino acids long.

The term "polypeptide analog" as used herein refers to a polypeptide that comprises a segment of at least 25 amino acids that has substantial identity to a portion of an amino acid sequence and that has at least one of the following properties: (1) specific binding to MAdCAM under suitable binding conditions, (2) ability to inhibit  $\alpha_4\beta_7$  integrin and/or L-selectin binding to MAdCAM, or (3) ability to reduce MAdCAM cell surface expression in vitro or in vivo. Typically, polypeptide analogs comprise a conservative amino acid substitution (or insertion or deletion) with respect to the naturally-occurring sequence. Analog typically are at least 20 amino acids long, preferably at least 50, 60, 70, 80, 90, 100, 150 or 200 amino acids long or longer, and can often be as long as a full-length naturally-occurring polypeptide.

Preferred amino acid substitutions are those which: (1) reduce susceptibility to proteolysis, (2) reduce susceptibility to oxidation, (3) alter binding affinity for forming protein complexes, (4) alter binding affinities, or (5) confer or modify other physicochemical or functional properties of such analogs. Analog can include various muteins of a sequence other than the naturally-occurring peptide sequence. For example, single or multiple amino acid substitutions (preferably conservative amino acid substitutions) may be made in the naturally-occurring sequence (preferably in the portion of the polypeptide outside the domain(s) forming intermolecular contacts. A conservative amino acid substitution should not substantially change the structural characteristics of the parent sequence (e.g., a replacement amino acid should not tend to break a helix that occurs in the parent sequence, or disrupt other types of secondary structure that characterizes the parent sequence). Examples of art-recognized polypeptide secondary and tertiary structures are described in *Proteins, Structures and Molecular Principles* (Creighton, Ed., W.H. Freeman and Company, New York (1984)); *Introduction to Protein Structure* (C. Brandon and J. Tooze, eds., Garland Publishing, New York, N.Y. (1991)); and Thornton et al., *Nature*, 354:105 (1991), which are each incorporated herein by reference.



Non-peptide analogs are commonly used in the pharmaceutical industry as drugs with properties analogous to those of the template peptide. These types of non-peptide compound are termed "peptide mimetics" or "peptidomimetics". Fauchere, J. *Adv. Drug Res.*, 15:29(1986); Veber and Freidinger, *TINS*, p. 392(1985); and Evans et al., *J. Med. Chem.*, 30:1229(1987), which are incorporated herein by reference. Such compounds are often developed with the aid of computerized molecular modeling. Peptide mimetics that are structurally similar to therapeutically useful peptides may be used to produce an equivalent therapeutic or prophylactic effect. Generally, peptidomimetics are structurally similar to a paradigm polypeptide (i.e., a polypeptide that has a desired biochemical property or pharmacological activity), such as a human antibody, but have one or more peptide linkages optionally replaced by a linkage such as:  $-\text{CH}_2\text{NH}-$ ,  $-\text{CH}_2\text{S}-$ ,  $-\text{CH}_2-\text{CH}_2-$ ,  $-\text{CH}=\text{CH}-$  (cis and trans),  $-\text{COCH}_2-$ ,  $-\text{CH}(\text{OH})\text{CH}_2-$ , and  $-\text{CH}_2\text{SO}-$ , by methods well known in the art. Systematic substitution of one or more amino acids of a consensus sequence with a D-amino acid of the same type (e.g., D-lysine in place of L-lysine) may also be used to generate more stable peptides. In addition, constrained peptides comprising a consensus sequence or a substantially identical consensus sequence variation may be generated by methods known in the art (Rizo and Gierasch *Ann. Rev. Biochem.* 61:387 (1992), incorporated herein by reference); for example, by adding internal cysteine residues capable of forming intramolecular disulfide bridges which cyclize the peptide.

An "immunoglobulin" is a tetrameric molecule. In a naturally-occurring immunoglobulin, each tetramer is composed of two identical pairs of polypeptide chains, each pair having one "light" (about 25 kDa) and one "heavy" chain (about 50-70 kDa). The amino-terminal portion of each chain includes a variable region of about 100 to 110 or more amino acids primarily responsible for antigen recognition. The carboxy-terminal portion of each chain defines a constant region primarily responsible for effector function. Human light chains are classified as  $\kappa$  and  $\lambda$  light chains. Heavy chains are classified as  $\mu$ ,  $\delta$ ,  $\gamma$ ,  $\alpha$ , or  $\epsilon$ , and define the antibody's isotype as IgM, IgD, IgG, IgA, and IgE, respectively. Within light and heavy chains, the variable and constant regions are joined by a "J" region of about 12 or more amino acids, with the heavy chain also including a "D" region of about 10 or more amino acids. See generally, *Fundamental Immunology*, Ch. 7 (Paul, W., ed., 2nd ed. Raven Press, N.Y. (1989)) (incorporated by reference in its entirety for all purposes). The variable regions of each light/heavy chain pair form the antibody binding site such that an intact immunoglobulin has two binding sites.

Immunoglobulin chains exhibit the same general structure of relatively conserved framework regions (FR) joined by three hypervariable regions, also called complementarity determining regions or CDRs. The CDRs from the two chains of each pair are aligned by the framework regions to form an epitope-specific binding site. From N-terminus to C-terminus, both light and heavy chains comprise the domains FR1, CDR1, FR2, CDR2, FR3, CDR3 and FR4. The assignment of amino acids to each domain is in accordance with the definitions of Kabat, *Sequences of Proteins of Immunological Interest* (National Institutes of Health, Bethesda, Md. (1987 and 1991)), or Chothia & Lesk, *J. Mol. Biol.*, 196:901-917 (1987); Chothia et al., *Nature*, 342:878-883(1989), each of which is incorporated herein by reference in their entirety.

An "antibody" refers to an intact immunoglobulin or to an antigen-binding portion thereof that competes with the intact antibody for specific binding. In some embodiments, an antibody is an antigen-binding portion thereof. Antigen-binding

portions may be produced by recombinant DNA techniques or by enzymatic or chemical cleavage of intact antibodies. Antigen-binding portions include, inter alia, Fab, Fab', F(ab')<sub>2</sub>, Fv, dAb, and complementarity determining region (CDR) fragments, single-chain antibodies (scFv), chimeric antibodies, diabodies and polypeptides that contain at least a portion of an immunoglobulin that is sufficient to confer specific antigen binding to the polypeptide. A Fab fragment is a monovalent fragment consisting of the VL, VH, CL and CH1 domains; a F(ab)<sub>2</sub> fragment is a bivalent fragment comprising two Fab fragments linked by a disulfide bridge at the hinge region; a Fd fragment consists of the VH and CH1 domains; an Fv fragment consists of the VL and VH domains of a single arm of an antibody; and a dAb fragment (Ward et al., *Nature*, 341:544-546(1989)) consists of a VH domain.

As used herein, an antibody that is referred to as, e.g., 1.7.2, 1.8.2, 6.14.2, 6.34.2, 6.67.1, 6.77.2, 7.16.6, 7.20.5, 7.26.4 or 9.8.2, is a monoclonal antibody that is produced by the hybridoma of the same name. For example, antibody 1.7.2 is produced by hybridoma 1.7.2. An antibody that is referred to as 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod is a monoclonal antibody whose sequence has been modified from its corresponding parent by site-directed mutagenesis.

A single-chain antibody (scFv) is an antibody in which VL and VH regions are paired to form a monovalent molecule via a synthetic linker that enables them to be made as a single protein chain (Bird et al., *Science*, 242:423-426 (1988) and Huston et al., *Proc. Natl. Acad. Sci. USA*, 85:5879-5883 (1988)). Diabodies are bivalent, bispecific antibodies in which VH and VL domains are expressed on a single polypeptide chain, but using a linker that is too short to allow for pairing between the two domains on the same chain, thereby forcing the domains to pair with complementary domains of another chain and creating two antigen binding sites (see, e.g., Holliger, P., et al., *Proc. Natl. Acad. Sci. USA*, 90: 6444-6448 (1993) and Poljak, R. J., et al., *Structure*, 2:1121-1123 (1994)). One or more CDRs from an antibody of the invention may be incorporated into a molecule either covalently or noncovalently to make it an immunoadhesin that specifically binds to MAdCAM. An immunoadhesin may incorporate the CDR(s) as part of a larger polypeptide chain, may covalently link the CDR(s) to another polypeptide chain, or may incorporate the CDR(s) noncovalently. The CDRs permit the immunoadhesin to specifically bind to a particular antigen of interest.

An antibody may have one or more binding sites. If there is more than one binding site, the binding sites may be identical to one another or may be different. For instance, a naturally-occurring immunoglobulin has two identical binding sites, a single-chain antibody or Fab fragment has one binding site, while a "bispecific" or "bifunctional" antibody (diabody) has two different binding sites.

An "isolated antibody" is an antibody that (1) is not associated with naturally-associated components, including other naturally-associated antibodies, that accompany it in its native state, (2) is free of other proteins from the same species, (3) is expressed by a cell from a different species, or (4) does not occur in nature. Examples of isolated antibodies include an anti-MAdCAM antibody that has been affinity purified using MAdCAM, an anti-MAdCAM antibody that has been produced by a hybridoma or other cell line in vitro, and a human anti-MAdCAM antibody derived from a transgenic mammal or plant.

As used herein, the term "human antibody" means an antibody in which the variable and constant region sequences are human sequences. The term encompasses antibodies with



sequences derived from human genes, but which have been changed, e.g., to decrease possible immunogenicity, increase affinity, eliminate cysteines or glycosylation sites that might cause undesirable folding, etc. The term encompasses such antibodies produced recombinantly in non-human cells which might impart glycosylation not typical of human cells. The term also encompasses antibodies which have been raised in a transgenic mouse which comprises some or all of the human immunoglobulin heavy and light chain loci.

In one aspect, the invention provides a humanized antibody. In some embodiments, the humanized antibody is an antibody that is derived from a non-human species, in which certain amino acids in the framework and constant domains of the heavy and light chains have been mutated so as to avoid or abrogate an immune response in humans. In some embodiments, a humanized antibody may be produced by fusing the constant domains from a human antibody to the variable domains of a non-human species. Examples of how to make humanized antibodies may be found in U.S. Pat. Nos. 6,054,297, 5,886,152 and 5,877,293. In some embodiments, a humanized anti-MAdCAM antibody of the invention comprises the amino acid sequence of one or more framework regions of one or more human anti-MAdCAM antibodies of the invention.

In another aspect, the invention includes a "chimeric antibody". In some embodiments the chimeric antibody refers to an antibody that contains one or more regions from one antibody and one or more regions from one or more other antibodies. In a preferred embodiment, one or more of the CDRs are derived from a human anti-MAdCAM antibody of the invention. In a more preferred embodiment, all of the CDRs are derived from a human anti-MAdCAM antibody of the invention. In another preferred embodiment, the CDRs from more than one human anti-MAdCAM antibody of the invention are mixed and matched in a chimeric antibody. For instance, a chimeric antibody may comprise a CDR1 from the light chain of a first human anti-MAdCAM antibody may be combined with CDR2 and CDR3 from the light chain of a second human anti-MAdCAM antibody, and the CDRs from the heavy chain may be derived from a third anti-MAdCAM antibody. Further, the framework regions may be derived from one of the same anti-MAdCAM antibodies, from one or more different antibodies, such as a human antibody, or from a humanized antibody.

A "neutralizing antibody," "an inhibitory antibody" or antagonist antibody is an antibody that inhibits the binding of  $\alpha_4\beta_7$  or  $\alpha_4\beta_7$ -expressing cells, or any other cognate ligand or cognate ligand-expressing cells, to MAdCAM by at least about 20%. In a preferred embodiment, the antibody reduces inhibits the binding of  $\alpha_4\beta_7$  integrin or  $\alpha_4\beta_7$ -expressing cells to MAdCAM by at least 40%, more preferably by 60%, even more preferably by 80%, 85%, 90%, 95% or 100%. The binding reduction may be measured by any means known to one of ordinary skill in the art, for example, as measured in an in vitro competitive binding assay. An example of measuring the reduction in binding of  $\alpha_4\beta_7$ -expressing cells to MAdCAM is presented in Example 1.

Fragments or analogs of antibodies can be readily prepared by those of ordinary skill in the art following the teachings of this specification. Preferred amino- and carboxy-termini of fragments or analogs occur near boundaries of functional domains. Structural and functional domains can be identified by comparison of the nucleotide and/or amino acid sequence data to public or proprietary sequence databases. Preferably, computerized comparison methods are used to identify sequence motifs or predicted protein conformation domains that occur in other proteins of known structure and/or func-

tion. Methods to identify protein sequences that fold into a known three-dimensional structure are known (Bowie et al., Science, 253:164 (1991)).

The term "surface plasmon resonance", as used herein, refers to an optical phenomenon that allows for the analysis of real-time biospecific interactions by detection of alterations in protein concentrations within a biosensor matrix, for example using the BIAcore system (Pharmacia Biosensor AB, Uppsala, Sweden and Piscataway, N.J.). For further descriptions, see Jonsson, U., et al., Ann. Biol. Clin., 51:19-26 (1993); Jonsson, U., et al., Biotechniques, 11:620-627 (1991); Johnson, B., et al., J. Mol. Recognit., 8:125-131 (1995); and Johnson, B., et al., Anal. Biochem., 198:268-277 (1991).

The term " $k_{off}$ " refers to the off rate constant for dissociation of an antibody from the antibody/antigen complex.

The term " $K_d$ " refers to the dissociation constant of a particular antibody-antigen interaction. An antibody is said to bind an antigen when the dissociation constant is  $\leq 1 \mu\text{M}$ , preferably  $\leq 100 \text{ nM}$  and most preferably  $\leq 10 \text{ nM}$ .

The term "epitope" includes any protein determinant capable of specific binding to an immunoglobulin or T-cell receptor or otherwise interacting with a molecule. Epitopic determinants usually consist of chemically active surface groupings of molecules such as amino acids or carbohydrate side chains and usually have specific three dimensional structural characteristics, as well as specific charge characteristics. An epitope may be "linear" or "conformational." In a linear epitope, all of the points of interaction between the protein and the interacting molecule (such as an antibody) occur linearly along the primary amino acid sequence of the protein. In a conformational epitope, the points of interaction occur across amino acid residues on the protein that are separated from one another.

As used herein, the twenty conventional amino acids and their abbreviations follow conventional usage. See Immunology—A Synthesis (2nd Edition, E. S. Golub and D. R. Gren, Eds., Sinauer Associates, Sunderland, Mass. (1991)), which is incorporated herein by reference. Stereoisomers (e.g., D-amino acids) of the twenty conventional amino acids, unnatural amino acids such as  $\alpha$ -,  $\alpha$ -disubstituted amino acids, N-alkyl amino acids, lactic acid, and other unconventional amino acids may also be suitable components for polypeptides of the present invention. Examples of unconventional amino acids include: 4-hydroxyproline,  $\gamma$ -carboxyglutamate,  $\epsilon$ -N,N,N-trimethyllysine,  $\epsilon$ -N-acetyllysine, O-phosphoserine, N-acetylserine, N-formylmethionine, 3-methylhistidine, 5-hydroxylysine, s-N-methylarginine, and other similar amino acids and imino acids (e.g., 4-hydroxyproline). In the polypeptide notation used herein, the lefthand direction is the amino terminal direction and the righthand direction is the carboxy-terminal direction, in accordance with standard usage and convention.

The term "polynucleotide" as referred to herein means a polymeric form of nucleotides of at least 10 bases in length, either ribonucleotides or deoxynucleotides or a modified form of either type of nucleotide. The term includes single and double stranded forms of DNA.

The term "isolated polynucleotide" as used herein shall mean a polynucleotide of genomic, cDNA, or synthetic origin or some combination thereof, which by virtue of its origin the "isolated polynucleotide" (1) is not associated with all or a portion of a polynucleotide in which the "isolated polynucleotide" is found in nature, (2) is operably linked to a polynucleotide which it is not linked to in nature, or (3) does not occur in nature as part of a larger sequence.



The term "oligonucleotide" referred to herein includes naturally occurring, and modified nucleotides linked together by naturally occurring, and non-naturally occurring oligonucleotide linkages. Oligonucleotides are a polynucleotide subset generally comprising a length of 200 bases or fewer. Preferably oligonucleotides are 10 to 60 bases in length and most preferably 12, 13, 14, 15, 16, 17, 18, 19, or 20 to 40 bases in length. Oligonucleotides are usually single stranded, e.g., for probes; although oligonucleotides may be double stranded, e.g., for use in the construction of a gene mutant. Oligonucleotides of the invention can be either sense or anti-sense oligonucleotides.

The term "naturally occurring nucleotides" referred to herein includes deoxyribonucleotides and ribonucleotides. The term "modified nucleotides" referred to herein includes nucleotides with modified or substituted sugar groups and the like. The term "oligonucleotide linkages" referred to herein includes oligonucleotides linkages such as phosphorothioate, phosphorodithioate, phosphoroselenoate, phosphorodiselenoate, phosphoroanilothioate, phosphoraniladate, phosphoramidate, and the like. See, e.g., LaPlanche et al., *Nucl. Acids Res.* 14:9081 (1986); Stec et al., *J. Am. Chem. Soc.* 106:6077(1984); Stein et al., *Nucl. Acids Res.*, 16:3209(1988); Zon et al., *Anti-Cancer Drug Design* 6:539 (1991); Zon et al., *Oligonucleotides and Analogues: A Practical Approach*, pp. 87-108 (F. Eckstein, Ed., Oxford University Press, Oxford England(1991)); Stec et al., U.S. Pat. No. 5,151,510; Uhlmann and Peyman, *Chemical Reviews*, 90:543 (1990), the disclosures of which are hereby incorporated by reference. An oligonucleotide can include a label for detection, if desired.

"Operably linked" sequences include both expression control sequences that are contiguous with the gene of interest and expression control sequences that act in trans or at a distance to control the gene of interest. The term "expression control sequence" as used herein refers to polynucleotide sequences which are necessary to effect the expression and processing of coding sequences to which they are ligated. Expression control sequences include appropriate transcription initiation, termination, promoter and enhancer sequences; efficient RNA processing signals such as splicing and polyadenylation signals; sequences that stabilize cytoplasmic mRNA; sequences that enhance translation efficiency (i.e., Kozak consensus sequence); sequences that enhance protein stability; and when desired, sequences that enhance protein secretion. The nature of such control sequences differs depending upon the host organism; in prokaryotes, such control sequences generally include promoter, ribosomal binding site, and transcription termination sequence; in eukaryotes, generally, such control sequences include promoters and transcription termination sequence. The term "control sequences" is intended to include, at a minimum, all components whose presence is essential for expression and processing, and can also include additional components whose presence is advantageous, for example, leader sequences and fusion partner sequences.

The term "vector", as used herein, is intended to refer to a nucleic acid molecule capable of transporting another nucleic acid to which it has been linked. One type of vector is a "plasmid", which refers to a circular double stranded DNA loop into which additional DNA segments may be ligated. Another type of vector is a viral vector, wherein additional DNA segments may be ligated into the viral genome. Certain vectors are capable of autonomous replication in a host cell into which they are introduced (e.g., bacterial vectors having a bacterial origin of replication and episomal mammalian vectors). Other vectors (e.g., non-episomal mammalian vec-

tors) can be integrated into the genome of a host cell upon introduction into the host cell, and thereby are replicated along with the host genome. Moreover, certain vectors are capable of directing the expression of genes to which they are operatively linked. Such vectors are referred to herein as "recombinant expression vectors" (or simply, "expression vectors"). In general, expression vectors of utility in recombinant DNA techniques are often in the form of plasmids. In the present specification, "plasmid" and "vector" may be used interchangeably as the plasmid is the most commonly used form of vector. However, the invention is intended to include such other forms of expression vectors, such as viral vectors (e.g., replication defective retroviruses, adenoviruses and adeno-associated viruses), which serve equivalent functions.

The term "recombinant host cell" (or simply "host cell"), as used herein, is intended to refer to a cell into which a recombinant expression vector has been introduced. It should be understood that such terms are intended to refer not only to the particular subject cell but to the progeny of such a cell. Because certain modifications may occur in succeeding generations due to either mutation or environmental influences, such progeny may not, in fact, be identical to the parent cell, but are still included within the scope of the term "host cell" as used herein.

The term "selectively hybridize" referred to herein means to detectably and specifically bind. Polynucleotides, oligonucleotides and fragments thereof in accordance with the invention selectively hybridize to nucleic acid strands under hybridization and wash conditions that minimize appreciable amounts of detectable binding to nonspecific nucleic acids. "High stringency" or "highly stringent" conditions can be used to achieve selective hybridization conditions as known in the art and discussed herein. An example of "high stringency" or "highly stringent" conditions is a method of incubating a polynucleotide with another polynucleotide, wherein one polynucleotide may be affixed to a solid surface such as a membrane, in a hybridization buffer of 6xSSPE or SSC, 50% formamide, 5xDenhardt's reagent, 0.5% SDS, 100 µg/ml denatured, fragmented salmon sperm DNA at a hybridization temperature of 42° C. for 12-16 hours, followed by twice washing at 55° C. using a wash buffer of 1xSSC, 0.5% SDS. See also Sambrook et al., *supra*, pp. 9.50-9.55.

The term "percent sequence identity" in the context of nucleotide sequences refers to the residues in two sequences which are the same when aligned for maximum correspondence. The length of sequence identity comparison may be over a stretch of at least about nine nucleotides, usually at least about 18 nucleotides, more usually at least about 24 nucleotides, typically at least about 28 nucleotides, more typically at least about 32 nucleotides, and preferably at least about 36, 48 or more nucleotides. There are a number of different algorithms known in the art which can be used to measure nucleotide sequence identity. For instance, polynucleotide sequences can be compared using FASTA, Gap or Bestfit, which are programs in Wisconsin Package Version 10.3, Accelrys, San Diego, Calif. FASTA, which includes, e.g., the programs FASTA2 and FASTA3, provides alignments and percent sequence identity of the regions of the best overlap between the query and search sequences (Pearson, *Methods Enzymol.*, 183: 63-98 (1990); Pearson, *Methods Mol. Biol.*, 132: 185-219 (2000); Pearson, *Methods Enzymol.*, 266: 227-258 (1996); Pearson, *J. Mol. Biol.*, 276: 71-84 (1998); herein incorporated by reference). Unless otherwise specified, default parameters for a particular program or algorithm are used. For instance, percent sequence identity between nucleotide sequences can be determined using FASTA with its default parameters (a word size of 6 and the



NOPAM factor for the scoring matrix) or using Gap with its default parameters as provided in Wisconsin Package Version 10.3, herein incorporated by reference.

A reference to a nucleotide sequence encompasses its complement unless otherwise specified. Thus, a reference to a nucleic acid molecule having a particular sequence should be understood to encompass its complementary strand, with its complementary sequence.

In the molecular biology art, researchers use the terms “percent sequence identity”, “percent sequence similarity” and “percent sequence homology” interchangeably. In this application, these terms shall have the same meaning with respect to nucleotide sequences only.

The term “substantial similarity” or “substantial sequence similarity,” when referring to a nucleic acid or fragment thereof, indicates that, when optimally aligned with appropriate nucleotide insertions or deletions with another nucleic acid (or its complementary strand), there is nucleotide sequence identity in at least about 85%, preferably at least about 90%, and more preferably at least about 95%, 96%, 97%, 98% or 99% of the nucleotide bases, as measured by any well-known algorithm of sequence identity, such as FASTA, BLAST or Gap, as discussed above.

As applied to polypeptides, the term “substantial identity” means that two peptide sequences, when optimally aligned, such as by the programs GAP or BESTFIT using default gap weights, share at least 75% or 80% sequence identity, preferably at least 90% or 95% sequence identity, even more preferably at least 98% or 99% sequence identity. Preferably, residue positions that are not identical differ by conservative amino acid substitutions. A “conservative amino acid substitution” is one in which an amino acid residue is substituted by another amino acid residue having a side chain (R group) with similar chemical properties (e.g., charge or hydrophobicity). In general, a conservative amino acid substitution will not substantially change the functional properties of a protein. In cases where two or more amino acid sequences differ from each other by conservative substitutions, the percent sequence identity or degree of similarity may be adjusted upwards to correct for the conservative nature of the substitution. Means for making this adjustment are well-known to those of skill in the art. See, e.g., Pearson, *Methods Mol. Biol.*, 24: 307-31 (1994), herein incorporated by reference. Examples of groups of amino acids that have side chains with similar chemical properties include 1) aliphatic side chains: glycine, alanine, valine, leucine and isoleucine; 2) aliphatic-hydroxyl side chains: serine and threonine; 3) amide-containing side chains: asparagine and glutamine; 4) aromatic side chains: phenylalanine, tyrosine, and tryptophan; 5) basic side chains: lysine, arginine, and histidine; and 6) sulfur-containing side chains are cysteine and methionine. Preferred conservative amino acids substitution groups are: valine-leucine-isoleucine, phenylalanine-tyrosine, lysine-arginine, alanine-valine, glutamate-aspartate, and asparagine-glutamine.

Alternatively, a conservative replacement is any change having a positive value in the PAM250 log-likelihood matrix disclosed in Gonnet et al., *Science*, 256: 1443-45 (1992), herein incorporated by reference. A “moderately conservative” replacement is any change having a nonnegative value in the PAM250 log-likelihood matrix.

Sequence similarity for polypeptides is typically measured using sequence analysis software. Protein analysis software matches similar sequences using measures of similarity assigned to various substitutions, deletions and other modifications, including conservative amino acid substitutions. For instance, GCG contains programs such as “Gap” and “Best-fit” which can be used with default parameters to determine

sequence homology or sequence identity between closely related polypeptides, such as homologous polypeptides from different species of organisms or between a wild type protein and a mutein thereof. See, e.g., Wisconsin package Version 10.3. Polypeptide sequences also can be compared using FASTA using default or recommended parameters, a program in Wisconsin package Version 10.3. FASTA (e.g., FASTA2 and FASTA3) provides alignments and percent sequence identity of the regions of the best overlap between the query and search sequences (Pearson (1990); Pearson (2000)). Another preferred algorithm when comparing a sequence of the invention to a database containing a large number of sequences from different organisms is the computer program BLAST, especially blastp or tblastn, using default parameters. See, e.g., Altschul et al., *J. Mol. Biol.* 215: 403-410 (1990); Altschul et al., *Nucleic Acids Res.* 25:3389-402 (1997); herein incorporated by reference.

The length of polypeptide sequences compared for homology will generally be at least about 16 amino acid residues, usually at least about 20 residues, more usually at least about 24 residues, typically at least about 28 residues, and preferably more than about 35 residues. When searching a database containing sequences from a large number of different organisms, it is preferable to compare amino acid sequences.

As used herein, the terms “label” or “labeled” refers to incorporation of another molecule in the antibody. In one embodiment, the label is a detectable marker, e.g., incorporation of a radiolabeled amino acid or attachment to a polypeptide of biotinyl moieties that can be detected by marked avidin (e.g., streptavidin containing a fluorescent marker or enzymatic activity that can be detected by optical or colorimetric methods). In another embodiment, the label or marker can be therapeutic, e.g., a drug conjugate or toxin. Various methods of labeling polypeptides and glycoproteins are known in the art and may be used. Examples of labels for polypeptides include, but are not limited to, the following: radioisotopes or radionuclides (e.g., <sup>3</sup>H, <sup>14</sup>C, <sup>15</sup>N, <sup>35</sup>S, <sup>90</sup>Y, <sup>99</sup>Tc, <sup>111</sup>In, <sup>125</sup>I, <sup>131</sup>I), fluorescent labels (e.g., FITC, rhodamine, lanthanide phosphors), enzymatic labels (e.g., horseradish peroxidase, β-galactosidase, luciferase, alkaline phosphatase), chemiluminescent markers, biotinyl groups, predetermined polypeptide epitopes recognized by a secondary reporter (e.g., leucine zipper pair sequences, binding sites for secondary antibodies, metal binding domains, epitope tags), magnetic agents, such as gadolinium chelates, toxins such as pertussis toxin, taxol, cytochalasin B, gramicidin D, ethidium bromide, emetine, mitomycin, etoposide, tenoposide, vincristine, vinblastine, colchicin, doxorubicin, daunorubicin, dihydroxy anthracin dione, mitoxantrone, mithramycin, actinomycin D, 1-dehydrotestosterone, glucocorticoids, procaine, tetracaine, lidocaine, propranolol, and puromycin and analogs or homologs thereof. In some embodiments, labels are attached by spacer arms of various lengths to reduce potential steric hindrance.

The term “agent” is used herein to denote a chemical compound, a mixture of chemical compounds, a biological macromolecule, or an extract made from biological materials. The term “pharmaceutical agent or drug” as used herein refers to a chemical compound or composition capable of inducing a desired therapeutic effect when properly administered to a patient. Other chemistry terms herein are used according to conventional usage in the art, as exemplified by *The McGraw-Hill Dictionary of Chemical Terms* (Parker, S., Ed., McGraw-Hill, San Francisco (1985)), incorporated herein by reference).

The term “anti-inflammatory” or “immuno-modulatory” agent is used herein to refer to agents that have the functional



property of inhibiting inflammation, including inflammatory disease in a subject, including in a human. In various embodiments of this invention, the inflammatory disease may be, but is not limited to inflammatory diseases of the gastrointestinal tract including Crohn's disease, ulcerative colitis, diverticula disease, gastritis, liver disease, primary biliary sclerosis, sclerosing cholangitis. Inflammatory diseases also include but are not limited to abdominal disease (including peritonitis, appendicitis, biliary tract disease), acute transverse myelitis, allergic dermatitis (including allergic skin, allergic eczema, skin atopy, atopic eczema, atopic dermatitis, cutaneous inflammation, inflammatory eczema, inflammatory dermatitis, flea skin, miliary dermatitis, miliary eczema, house dust mite skin), ankylosing spondylitis (Reiters syndrome), asthma, airway inflammation, atherosclerosis, arteriosclerosis, biliary atresia, bladder inflammation, breast cancer, cardiovascular inflammation (including vasculitis, rheumatoid nail-fold infarcts, leg ulcers, polymyositis, chronic vascular inflammation, pericarditis, chronic obstructive pulmonary disease), chronic pancreatitis, perineural inflammation, colitis (including amoebic colitis, infective colitis, bacterial colitis, Crohn's colitis, ischemic colitis, ulcerative colitis, idiopathic proctocolitis, inflammatory bowel disease, pseudomembranous colitis), collagen vascular disorders (rheumatoid arthritis, SLE, progressive systemic sclerosis, mixed connective tissue disease, diabetes mellitus), Crohn's disease (regional enteritis, granulomatous ileitis, ileocolitis, digestive system inflammation), demyelinating disease (including myelitis, multiple sclerosis, disseminated sclerosis, acute disseminated encephalomyelitis, perivenous demyelination, vitamin B12 deficiency, Guillain-Barre syndrome, MS-associated retrovirus), dermatomyositis, diverticulitis, exudative diarrhea, gastritis, granulomatous hepatitis, granulomatous inflammation, cholecystitis, insulin-dependent diabetes mellitus, liver inflammatory diseases (liver fibrosis primary biliary cirrhosis, hepatitis, sclerosing cholangitis), lung inflammation (idiopathic pulmonary fibrosis, eosinophilic granuloma of the lung, pulmonary histiocytosis X, peribronchiolar inflammation, acute bronchitis), lymphogranuloma venereum, malignant melanoma, mouth/tooth disease (including gingivitis, periodontal disease), mucositis, musculoskeletal system inflammation (myositis), nonalcoholic steatohepatitis (nonalcoholic fatty liver disease), ocular & orbital inflammation (including uveitis, optic neuritis, peripheral rheumatoid ulceration, peripheral corneal inflammation), osteoarthritis, osteomyelitis, pharyngeal inflammation, polyarthritis, proctitis, psoriasis, radiation injury, sarcoidosis, sickle cell necropathy, superficial thrombophlebitis, systemic inflammatory response syndrome, thyroiditis, systemic lupus erythematosus, graft versus host disease, acute burn injury, Behçet's syndrome, Sjögren's syndrome.

The terms patient and subject include human and veterinary subjects.

#### Human Anti-MAdCAM Antibodies and Characterization Thereof

In one embodiment, the invention provides anti-MAdCAM antibodies comprising human CDR sequences. In a preferred embodiment, the invention provides human anti-MAdCAM antibodies. In some embodiments, human anti-MAdCAM antibodies are produced by immunizing a non-human transgenic animal, e.g., a rodent, whose genome comprises human immunoglobulin genes so that the transgenic animal produces human antibodies. In some embodiments, the invention provides an anti-MAdCAM antibody that does not bind complement.

In a preferred embodiment, the anti-MAdCAM antibody is 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1,

7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod. In another preferred embodiment, the anti-MAdCAM antibody comprises a light chain comprising an amino acid sequence selected from SEQ ID NO: 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 54, 58, 62, 66 or 68 (with or without the signal sequence) or the variable region of any one of said amino acid sequences, or one or more CDRs from these amino acid sequences. In another preferred embodiment, the anti-MAdCAM antibody comprises a heavy chain comprising an amino acid sequence selected from SEQ ID NO: 2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 52, 56, 60 or 64 (with or without the signal sequence) or the amino acid sequence of the variable region, or of one or more CDRs from said amino acid sequences. Also included in the invention are human anti-MAdCAM antibodies comprising the amino acid sequence from the beginning of the CDR1 to the end of the CDR3 of any one of the above-mentioned sequences. The invention further provides an anti-MAdCAM antibody comprising one or more FR regions of any of the above-mentioned sequences.

The invention further provides an anti-MAdCAM antibody comprising one of the afore-mentioned amino acid sequences in which one or more modifications have been made. In some embodiments, cysteines in the antibody, which may be chemically reactive, are substituted with another residue, such as, without limitation, alanine or serine. In one embodiment, the substitution is at a non-canonical cysteine. The substitution can be made in a CDR or framework region of a variable domain or in the constant domain of an antibody. In some embodiments, the cysteine is canonical.

In some embodiments, an amino acid substitution is made to eliminate potential proteolytic sites in the antibody. Such sites may occur in a CDR or framework region of a variable domain or in the constant domain of an antibody. Substitution of cysteine residues and removal of proteolytic sites may decrease the heterogeneity in the antibody product. In some embodiments, asparagine-glycine pairs, which form potential deamidation sites, are eliminated by altering one or both of the residues. In some embodiments, an amino acid substitution is made to add or to remove potential glycosylation sites in the variable region of an antibody of the invention.

In some embodiments, the C-terminal lysine of the heavy chain of the anti-MAdCAM antibody of the invention is cleaved. In various embodiments of the invention, the heavy and light chains of the anti-MAdCAM antibodies may optionally include a signal sequence.

In one aspect, the invention provides twelve inhibitory human anti-MAdCAM monoclonal antibodies and the hybridoma cell lines that produce them. Table 1 lists the sequence identifiers (SEQ ID NO:) of the nucleic acids encoding the full-length heavy and light chains (including signal sequence), and the corresponding full-length deduced amino acid sequences.

TABLE 1

| HUMAN ANTI-MAdCAM ANTIBODIES |                                  |         |       |         |
|------------------------------|----------------------------------|---------|-------|---------|
| Monoclonal Antibody          | SEQUENCE IDENTIFIER (SEQ ID NO:) |         |       |         |
|                              | Full Length                      |         |       |         |
|                              | Heavy                            |         | Light |         |
|                              | DNA                              | Protein | DNA   | Protein |
| 1.7.2                        | 1                                | 2       | 3     | 4       |
| 1.8.2                        | 5                                | 6       | 7     | 8       |
| 6.14.2                       | 9                                | 10      | 11    | 12      |



TABLE 1-continued

| HUMAN ANTI-MAdCAM ANTIBODIES |                                  |         |       |         |
|------------------------------|----------------------------------|---------|-------|---------|
| Monoclonal                   | SEQUENCE IDENTIFIER (SEQ ID NO:) |         |       |         |
|                              | Full Length                      |         |       |         |
|                              | Heavy                            |         | Light |         |
| Antibody                     | DNA                              | Protein | DNA   | Protein |
| 6.22.2                       | 13                               | 14      | 15    | 16      |
| 6.34.2                       | 17                               | 18      | 19    | 20      |
| 6.67.1                       | 21                               | 22      | 23    | 24      |
| 6.73.2                       | 25                               | 26      | 27    | 28      |
| 6.77.1                       | 29                               | 30      | 31    | 32      |
| 7.16.6                       | 33                               | 34      | 35    | 36      |
| 7.20.5                       | 37                               | 38      | 39    | 40      |
| 7.26.4                       | 41                               | 42      | 43    | 44      |
| 9.8.2                        | 45                               | 46      | 47    | 48      |

In another aspect, the invention provides a modified version of certain of the above-identified human anti-MAdCAM monoclonal antibodies. Table 2 lists the sequence identifiers for the DNA and protein sequences of the modified antibodies.

TABLE 2

| HUMAN ANTI-MAdCAM ANTIBODIES |                                  |         |       |         |
|------------------------------|----------------------------------|---------|-------|---------|
| Modified                     | SEQUENCE IDENTIFIER (SEQ ID NO:) |         |       |         |
|                              | Full Length                      |         |       |         |
|                              | Heavy                            |         | Light |         |
| Antibody                     | DNA                              | Protein | DNA   | Protein |
| 6.22.2-mod                   | 51                               | 52      | 53    | 54      |
| 6.34.2-mod                   | 55                               | 56      | 57    | 58      |
| 6.67.1-mod                   | 59                               | 60      | 61    | 62      |
| 6.77.1-mod                   | 63                               | 64      | 65    | 66      |
| 7.26.4-mod                   | 41                               | 42      | 67    | 68      |

#### Class and Subclass of Anti-MAdCAM Antibodies

The antibody may be an IgG, an IgM, an IgE, an IgA or an IgD molecule. In a preferred embodiment, the antibody is an IgG class and is an IgG<sub>1</sub>, IgG<sub>2</sub>, IgG<sub>3</sub> or IgG<sub>4</sub> subclass. In a more preferred embodiment, the anti-MAdCAM antibody is subclass IgG<sub>2</sub> or IgG<sub>4</sub>. In another preferred embodiment, the anti-MAdCAM antibody is the same class and subclass as antibody 1.7.2, 1.8.2, 7.16.6, 7.20.5, 7.26.4, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod which is IgG<sub>2</sub>, or 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1 or 9.8.2, which is IgG<sub>4</sub>.

The class and subclass of anti-MAdCAM antibodies may be determined by any method known in the art. In general, the class and subclass of an antibody may be determined using antibodies that are specific for a particular class and subclass of antibody. Such antibodies are available commercially. ELISA, Western Blot as well as other techniques can determine the class and subclass. Alternatively, the class and subclass may be determined by sequencing all or a portion of the constant domains of the heavy and/or light chains of the antibodies, comparing their amino acid sequences to the known amino acid sequences of various classes and subclasses of immunoglobulins, and determining the class and subclass of the antibodies as the class showing the highest sequence identity.

#### Species and Molecule Selectivity

In another aspect of the invention, the anti-MAdCAM antibody demonstrates both species and molecule selectivity. In

one embodiment, the anti-MAdCAM antibody binds to human, cynomolgus or dog MAdCAM. In some embodiments, the anti-MAdCAM antibody does not bind to a New World monkey species such as a marmoset. Following the teachings of the specification, one may determine the species selectivity for the anti-MAdCAM antibody using methods well known in the art. For instance, one may determine species selectivity using Western blot, FACS, ELISA or immunohistochemistry. In a preferred embodiment, one may determine the species selectivity using immunohistochemistry.

In some embodiments, an anti-MAdCAM antibody that specifically binds MAdCAM has selectivity for MAdCAM over VCAM, fibronectin or any other antigen that is at least 10 fold, preferably at least 20, 30, 40, 50, 60, 70, 80 or 90 fold, most preferably at least 100 fold. In a preferred embodiment, the anti-MAdCAM antibody does not exhibit any appreciable binding to VCAM, fibronectin or any other antigen other than MAdCAM. One may determine the selectivity of the anti-MAdCAM antibody for MAdCAM using methods well known in the art following the teachings of the specification. For instance, one may determine the selectivity using Western blot, FACS, ELISA, or immunohistochemistry.

#### Binding Affinity of Anti-MAdCAM Antibodies to MAdCAM

In another aspect of the invention, the anti-MAdCAM antibodies specifically bind to MAdCAM with high affinity. In one embodiment, the anti-MAdCAM antibody specifically binds to MAdCAM with a  $K_d$  of  $3 \times 10^{-8}$  M or less, as measured by surface plasmon resonance, such as BIAcore. In more preferred embodiments, the antibody specifically binds to MAdCAM with a  $K_d$  of  $1 \times 10^{-8}$  or less or  $1 \times 10^{-9}$  M or less. In an even more preferred embodiment, the antibody specifically binds to MAdCAM with a  $K_d$  of  $1 \times 10^{-10}$  M or less. In other preferred embodiments, an antibody of the invention specifically binds to MAdCAM with a  $K_d$  of  $2.66 \times 10^{-10}$  M or less,  $2.35 \times 10^{-11}$  M or less or  $9 \times 10^{-12}$  M or less. In another preferred embodiment, the antibody specifically binds to MAdCAM with a  $K_d$  of  $1 \times 10^{-11}$  M or less. In another preferred embodiment, the antibody specifically binds to MAdCAM with substantially the same  $K_d$  as an antibody selected from 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod. An antibody with "substantially the same  $K_d$ " as a reference antibody has a  $K_d$  that is  $\pm 100$  pM, preferably  $\pm 50$  pM, more preferably  $\pm 20$  pM, still more preferably  $\pm 10$  pM,  $\pm 5$  pM or  $\pm 2$  pM, compared to the  $K_d$  of the reference antibody in the same experiment. In another preferred embodiment, the antibody binds to MAdCAM with substantially the same  $K_d$  as an antibody that comprises one or more variable domains or one or more CDRs from an antibody selected from 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod- 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod. In still another preferred embodiment, the antibody binds to MAdCAM with substantially the same  $K_d$  as an antibody that comprises one of the amino acid sequences selected from SEQ ID NOS: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46 48, 52, 54, 56, 58, 62, 64, 66 or 68 (with or without the signal sequence), or the variable domain thereof. In another preferred embodiment, the antibody binds to MAdCAM with substantially the same  $K_d$  as an antibody that comprises one or more CDRs from an antibody that comprises an amino acid sequence selected from SEQ ID NOS: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46 48, 52, 54, 56, 58, 62, 64, 66 or 68.

The binding affinity of an anti-MAdCAM antibody to MAdCAM may be determined by any method known in the



art. In one embodiment, the binding affinity can be measured by competitive ELISAs, RIAs or surface plasmon resonance, such as BIAcore. In a more preferred embodiment, the binding affinity is measured by surface plasmon resonance. In an even more preferred embodiment, the binding affinity and dissociation rate is measured using a BIAcore. An example of determining binding affinity is described below in Example II.

#### Half-Life of Anti-MAdCAM Antibodies

According to another object of the invention, the anti-MAdCAM antibody has a half-life of at least one day in vitro or in vivo. In a preferred embodiment, the antibody or portion thereof has a half-life of at least three days. In a more preferred embodiment, the antibody or portion thereof has a half-life of four days or longer. In another embodiment, the antibody or portion thereof has a half-life of eight days or longer. In another embodiment, the antibody or antigen-binding portion thereof is derivatized or modified such that it has a longer half-life, as discussed below. In another preferred embodiment, the antibody may contain point mutations to increase serum half life, such as described WO 00/09560, published Feb. 24, 2000.

The antibody half-life may be measured by any means known to one having ordinary skill in the art. For instance, the antibody half life may be measured by Western blot, ELISA or RIA over an appropriate period of time. The antibody half-life may be measured in any appropriate animal, such as a primate, e.g., cynomolgus monkey, or a human.

#### Identification of MAdCAM Epitopes Recognized by Anti-MAdCAM Antibody

The invention also provides a human anti-MAdCAM antibody that binds the same antigen or epitope as a human anti-MAdCAM antibody provided herein. Further, the invention provides a human anti-MAdCAM antibody that competes or cross-competes with a human anti-MAdCAM antibody. In a preferred embodiment, the human anti-MAdCAM antibody is 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod. In another preferred embodiment, the human anti-MAdCAM antibody comprises one or more variable domains or one or more CDRs from an antibody selected from 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod. In still another preferred embodiment, the human anti-MAdCAM antibody comprises one of the amino acid sequences selected from SEQ ID NOS: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 52, 54, 56, 58, 62, 64, 66 or 68 (with or without the signal sequence), or a variable domain thereof. In another preferred embodiment, the human anti-MAdCAM antibody comprises one or more CDRs from an antibody that comprises one of the amino acid sequences selected from SEQ ID NOS: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 52, 54, 56, 58, 62, 64, 66 or 68. In a highly preferred embodiment, the anti-MAdCAM antibody is another human antibody.

One may determine whether an anti-MAdCAM antibody binds to the same antigen as another anti-MAdCAM antibody using a variety of methods known in the art. For instance, one can use a known anti-MAdCAM antibody to capture the antigen, elute the antigen from the anti-MAdCAM antibody, and then determine whether the test antibody will bind to the eluted antigen. One may determine whether an antibody competes with an anti-MAdCAM antibody by binding the anti-MAdCAM antibody to MAdCAM under saturating conditions, and then measuring the ability of the test antibody to

bind to MAdCAM. If the test antibody is able to bind to the MAdCAM at the same time as the anti-MAdCAM antibody, then the test antibody binds to a different epitope than the anti-MAdCAM antibody. However, if the test antibody is not able to bind to the MAdCAM at the same time, then the test antibody competes with the human anti-MAdCAM antibody. This experiment may be performed using ELISA, or surface plasmon resonance or, preferably, BIAcore. To test whether an anti-MAdCAM antibody cross-competes with another anti-MAdCAM antibody, one may use the competition method described above in two directions, i.e. determining if the known antibody blocks the test antibody and vice versa.

#### Light and Heavy Chain Gene Usage

The invention also provides an anti-MAdCAM antibody that comprises a light chain variable region encoded by a human K gene. In a preferred embodiment, the light chain variable region is encoded by a human V $\kappa$  A2, A3, A26, B3, O12 or O18 gene family. In various embodiments, the light chain comprises no more than eleven, no more than six or no more than three amino acid substitutions from the germline human V $\kappa$  A2, A3, A26, B3, O12 or O18 sequence. In a preferred embodiment, the amino acid substitutions are conservative substitutions.

SEQ ID NOS: 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44 and 48 provide the amino acid sequences of the full-length kappa light chains of twelve anti-MAdCAM antibodies, 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4 and 9.8.2. FIGS. 1K-1T are alignments of the amino acid sequences of the light chain variable domains of twelve anti-MAdCAM antibodies with the germline sequences from which they are derived. FIG. 2A shows an alignment of the amino acid sequences of the light chain variable domains of the kappa light chains of twelve anti-MAdCAM antibodies to each other. Following the teachings of this specification, one of ordinary skill in the art could determine the differences between the germline sequences and the antibody sequences of additional anti-MAdCAM antibodies. SEQ ID NOS: 54, 58, 62, 66 or 68 provide the amino acid sequences of the full length kappa light chains of five additional anti-MAdCAM antibodies, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod and 7.26.4-mod, modified by amino acid substitution from their parent anti-MAdCAM antibodies, 6.22.2, 6.34.2, 6.67.1, 6.77.1 or 7.26.4, respectively.

In a preferred embodiment, the VL of the anti-MAdCAM antibody contains the same mutations, relative to the germline amino acid sequence, as any one or more of the VL of antibodies 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod. The invention includes an anti-MAdCAM antibody that utilizes the same human V $\kappa$  and human J $\kappa$  genes as an exemplified antibody. In some embodiments, the antibody comprises one or more of the same mutations from germline as one or more exemplified antibodies. In some embodiments, the antibody comprises different substitutions at one or more of the same positions as one or more of the exemplified antibodies. For example, the VL of the anti-MAdCAM antibody may contain one or more amino acid substitutions that are the same as those present in antibody 7.16.6, and another amino acid substitution that is the same as antibody 7.26.4. In this manner, one can mix and match different features of antibody binding in order to alter, e.g., the affinity of the antibody for MAdCAM or its dissociation rate from the antigen. In another embodiment, the mutations are made in the same position as those found in any one or more of the VL of antibodies 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4,



9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod, but conservative amino acid substitutions are made rather than using the same amino acid. For example, if the amino acid substitution compared to the germline in one of the antibodies 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod is glutamate, one may conservatively substitute aspartate. Similarly, if the amino acid substitution is serine, one may conservatively substitute threonine.

In another preferred embodiment, the light chain comprises an amino acid sequence that is the same as the amino acid sequence of the VL of 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod. In another highly preferred embodiment, the light chain comprises amino acid sequences that are the same as the CDR regions of the light chain of 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod. In another preferred embodiment, the light chain comprises an amino acid sequence with at least one CDR region of the light chain of 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod. In another preferred embodiment, the light chain comprises amino acid sequences with CDRs from different light chains that use the same V<sub>K</sub> and J<sub>K</sub> genes. In a more preferred embodiment, the CDRs from different light chains are obtained from 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod. In another preferred embodiment, the light chain comprises an amino acid sequence selected from SEQ ID NOS: 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 54, 58, 62, 64, 66 or 68 with or without the signal sequence. In another embodiment, the light chain comprises an amino acid sequence encoded by a nucleotide sequence selected from SEQ ID NOS: 3, 7, 11, 15, 19, 23, 27, 31, 35, 39, 43, 47, 53, 57, 61, 65 or 67 (with or without the signal sequence), or a nucleotide sequence that encodes an amino acid sequence having 1-11 amino acid insertions, deletions or substitutions therefrom. Preferably, the amino acid substitutions are conservative amino acid substitutions. In another embodiment, the antibody or portion thereof comprises a lambda light chain.

The present invention also provides an anti-MAdCAM antibody or portion thereof that comprises a human VH gene sequence or a sequence derived from a human VH gene. In one embodiment, the heavy chain amino acid sequence is derived from a human VH 1-18, 3-15, 3-21, 3-23, 3-30, 3-33 or 4-4 gene family. In various embodiments, the heavy chain comprises no more than fifteen, no more than six or no more than three amino acid changes from germline human VH 1-18, 3-15, 3-21, 3-23, 3-30, 3-33 or 4-4 gene sequence.

SEQ ID NOS: 2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42 and 46 provide the amino acid sequences of the full-length heavy chains of twelve anti-MAdCAM antibodies. FIGS. 1A-1J are alignments of the amino acid sequences of the heavy chain variable regions of twelve anti-MAdCAM antibodies with the germline sequences from which they are derived. FIG. 2B shows the alignments of the amino acid sequences of the heavy chain variable regions of twelve anti-MAdCAM antibodies to each other. Following the teachings of this specification and the nucleotide sequences of the invention, one of ordinary skill in the art could determine the encoded amino acid sequence of the twelve anti-MAdCAM heavy chains and the germline heavy chains and determine the differences

between the germline sequences and the antibody sequences. SEQ ID NOS: 52, 56, 60 and 64 provide the amino acid sequences of the full length heavy chains of anti-MAdCAM antibodies, 6.22.2-mod, 6.34.2-mod and 6.67.1-mod, modified by amino acid substitution from their parent anti-MAdCAM antibodies, 6.22.2, 6.34.2 and 6.67.1 respectively. One further modified anti-MAdCAM antibody, 7.26.4-mod, has a full length heavy chain amino acid sequence which is SEQ ID NO: 42.

In a preferred embodiment, the VH of the anti-MAdCAM antibody contains the same mutations, relative to the germline amino acid sequence, as any one or more of the VH of antibodies 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod. Similar to that discussed above, the antibody comprises one or more of the same mutations from germline as one or more exemplified antibodies. In some embodiments, the antibody comprises different substitutions at one or more of the same positions as one or more of the exemplified antibodies. For example, the VH of the anti-MAdCAM antibody may contain one or more amino acid substitutions that are the same as those present in antibody 7.16.6, and another amino acid substitution that is the same as antibody 7.26.4. In this manner, one can mix and match different features of antibody binding in order to alter, e.g., the affinity of the antibody for MAdCAM or its dissociation rate from the antigen. In another embodiment, an amino acid substitution compared to germline is made at the same position as a substitution from germline as found in any one or more of the VH of reference antibody 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod, but the position is substituted with a different residue, which is a conservative substitution compared to the reference antibody.

In another preferred embodiment, the heavy chain comprises an amino acid sequence that is the same as the amino acid sequence of the VH of 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod. In another highly preferred embodiment, the heavy chain comprises amino acid sequences that are the same as the CDR regions of the heavy chain of 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod. In another preferred embodiment, the heavy chain comprises an amino acid sequence from at least one CDR region of the heavy chain of 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.4, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod. In another preferred embodiment, the heavy chain comprises amino acid sequences with CDRs from different heavy chains. In a more preferred embodiment, the CDRs from different heavy chains are obtained from 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod. In another preferred embodiment, the heavy chain comprises an amino acid sequence selected from SEQ ID NOS: 2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 52, 56, 60 or 64 with or without the signal sequence. In another embodiment, the heavy chain comprises an amino acid sequence encoded by a nucleotide sequence selected from SEQ ID NOS: 1, 5, 9, 13, 17, 21, 25, 29, 33, 37, 41, 45, 51, 55, 59 or 63, or a nucleotide sequence that encodes an amino acid sequence having 1-15 amino acid insertions, deletions or substitutions therefrom. In another embodiment, the substitutions are conservative amino acid substitutions.



### Methods of Producing Antibodies and Antibody-Producing Cell Lines

#### Immunization

In one embodiment of the instant invention, human antibodies are produced by immunizing a non-human animal comprising some or all of the human immunoglobulin heavy and light chain loci with an MAdCAM antigen. In a preferred embodiment, the non-human animal is a XENOMOUSE™ animal, which is an engineered mouse strain that comprises large fragments of the human immunoglobulin loci and is deficient in mouse antibody production. See, e.g., Green et al., *Nature Genetics* 7:13-21 (1994) and U.S. Pat. Nos. 5,916,771, 5,939,598, 5,985,615, 5,998,209, 6,075,181, 6,091,001, 6,114,598 and 6,130,364. See also WO 91/10741, WO 94/02602, WO 96/34096 and WO 96/33735, WO 98/16654, WO 98/24893, WO 98/50433, WO 99/45031, WO 99/53049, WO 00 09560 and WO 00/037504. The XENOMOUSE™ animal produces an adult-like human repertoire of fully human antibodies and generates antigen-specific human mAbs. A second generation XENOMOUSE™ animal contains approximately 80% of the human antibody V gene repertoire through introduction of megabase sized, germline configuration YAC fragments of the human heavy chain loci and  $\kappa$  light chain loci. In other embodiments, XENOMOUSE™ mice contain approximately all of the human heavy chain and  $\lambda$  light chain locus. See Mendez et al., *Nature Genetics* 15:146-156 (1997), Green and Jakobovits, *J. Exp. Med.* 188:483-495 (1998), the disclosures of which are hereby incorporated by reference.

The invention also provides a method for making anti-MAdCAM antibodies from non-human, non-mouse animals by immunizing non-human transgenic animals that comprise human immunoglobulin loci. One may produce such animals using the methods described immediately above. The methods disclosed in these documents can be modified as described in U.S. Pat. No. 5,994,619 (the "619 patent"), which is here incorporated by reference. The '619 patent describes methods for producing novel cultured inner cell mass (CICM) cells and cell lines, derived from pigs and cows, and transgenic CICM cells into which heterologous DNA has been inserted. CICM transgenic cells can be used to produce cloned transgenic embryos, fetuses, and offspring. The '619 patent also describes methods of producing transgenic animals that are capable of transmitting the heterologous DNA to their progeny. In a preferred embodiment, the non-human animals may be rats, sheep, pigs, goats, cattle or horses.

In another embodiment, the non-human animal comprising human immunoglobulin loci are animals that have a "minilocus" of human immunoglobulins. In the minilocus approach, an exogenous Ig locus is mimicked through the inclusion of individual genes from the Ig locus. Thus, one or more VH genes, one or more DH genes, one or more JH genes, a  $\mu$  constant domain(s), and a second constant domain(s) (preferably a gamma constant domain(s) are formed into a construct for insertion into an animal. This approach is described, inter alia, in U.S. Pat. No. 5,45,807, 5,545,806, 5,625,126, 5,633,425, 5,661,016, 5,770,429, 5,789,650, 5,814,318, 5,591,669, 5,612,205, 5,721,367, 5,789,215, and 5,643,763, hereby incorporated by reference.

An advantage of the minilocus approach is the rapidity with which constructs including portions of the Ig locus can be generated and introduced into animals. However, a potential disadvantage of the minilocus approach is that there may not be sufficient immunoglobulin diversity to support full B-cell development, such that there may be lower antibody production.

To produce a human anti-MAdCAM antibody, a non-human animal comprising some or all of the human immunoglobulin loci is immunized with a MAdCAM antigen and an antibody or the antibody-producing cell is isolated from the animal. The MAdCAM antigen may be isolated and/or purified MAdCAM and is preferably a human MAdCAM. In another embodiment, the MAdCAM antigen is a fragment of MAdCAM, preferably the extracellular domain of MAdCAM. In another embodiment, the MAdCAM antigen is a fragment that comprises at least one epitope of MAdCAM. In another embodiment, the MAdCAM antigen is a cell that expresses MAdCAM on its cell surface, preferably a cell that overexpresses MAdCAM on its cell surface.

Immunization of animals may be done by any method known in the art. See, e.g., Harlow and Lane, *Antibodies: A Laboratory Manual*, New York: Cold Spring Harbor Press (1990). Methods for immunizing non-human animals such as mice, rats, sheep, goats, pigs, cattle and horses are well known in the art. See, e.g., Harlow and Lane and U.S. Pat. No. 5,994,619. In a preferred embodiment, the MAdCAM antigen is administered with an adjuvant to stimulate the immune response. Such adjuvants include complete or incomplete Freund's adjuvant, RIBI (muramyl dipeptides) or ISCOM (immunostimulating complexes). Such adjuvants may protect the polypeptide from rapid dispersal by sequestering it in a local deposit, or they may contain substances that stimulate the host to secrete factors that are chemotactic for macrophages and other components of the immune system. Preferably, if a polypeptide is being administered, the immunization schedule will involve two or more administrations of the polypeptide, spread out over several weeks.

Example I provides a protocol for immunizing a XENOMOUSE™ animal with full-length human MAdCAM in phosphate-buffered saline.

#### Production of Antibodies and Antibody-Producing Cell Lines

After immunization of an animal with a MAdCAM antigen, antibodies and/or antibody-producing cells may be obtained from the animal. An anti-MAdCAM antibody-containing serum is obtained from the animal by bleeding or sacrificing the animal. The serum may be used as it is obtained from the animal, an immunoglobulin fraction may be obtained from the serum, or the anti-MAdCAM antibodies may be purified from the serum.

In another embodiment, antibody-producing immortalized cell lines may be prepared from the immunized animal. After immunization, the animal is sacrificed and B cells are immortalized using methods well-known in the art. Methods of immortalizing cells include, but are not limited to, transfecting them with oncogenes, infecting them with an oncogenic virus and cultivating them under conditions that select for immortalized cells, subjecting them to carcinogenic or mutating compounds, fusing them with an immortalized cell, e.g., a myeloma cell, and inactivating a tumor suppressor gene. See, e.g., Harlow and Lane, *supra*. In embodiments involving the myeloma cells, the myeloma cells do not secrete immunoglobulin polypeptides (a non-secretory cell line). After immortalization and antibiotic selection, the immortalized cells, or culture supernatants thereof, are screened using MAdCAM, a portion thereof, or a cell expressing MAdCAM. In a preferred embodiment, the initial screening is performed using an enzyme-linked immunoassay (ELISA) or a radioimmunoassay (RIA), preferably an ELISA. An example of ELISA screening is provided in PCT Publication No. WO 00/37504, herein incorporated by reference.

In another embodiment, antibody-producing cells may be prepared from a human who has an autoimmune disorder and who expresses anti-MAdCAM antibodies. Cells expressing



the anti-MAdCAM antibodies may be isolated by isolating white blood cells and subjecting them to fluorescence-activated cell sorting (FACS) or by panning on plates coated with MAdCAM or a portion thereof. These cells may be fused with a human non-secretory myeloma to produce human hybridomas expressing human anti-MAdCAM antibodies. In general, this is a less preferred embodiment because it is likely that the anti-MAdCAM antibodies will have a low affinity for MAdCAM.

Anti-MAdCAM antibody-producing cells, e.g., hybridomas are selected, cloned and further screened for desirable characteristics, including robust cell growth, high antibody production and desirable antibody characteristics, as discussed further below. Hybridomas may be cultured and expanded *in vivo* in syngeneic animals, in animals that lack an immune system, e.g., nude mice, or in cell culture *in vitro*. Methods of selecting, cloning and expanding hybridomas are well known to those of ordinary skill in the art.

Preferably, the immunized animal is a non-human animal that expresses human immunoglobulin genes and the splenic B cells are fused to a myeloma derived from the same species as the non-human animal. More preferably, the immunized animal is a XENOMOUSE™ animal and the myeloma cell line is a non-secretory mouse myeloma, such as the myeloma cell line is P3-X63-AG8-653 (ATCC). See, e.g., Example I.

Thus, in one embodiment, the invention provides methods for producing a cell line that produces a human monoclonal antibody or a fragment thereof directed to MAdCAM comprising (a) immunizing a non-human transgenic animal described herein with MAdCAM, a portion of MAdCAM or a cell or tissue expressing MAdCAM; (b) allowing the transgenic animal to mount an immune response to MAdCAM; (c) isolating antibody-producing cells from transgenic animal; (d) immortalizing the antibody-producing cells; (e) creating individual monoclonal populations of the immortalized antibody-producing cells; and (f) screening the immortalized antibody-producing cells or culture supernatants thereof to identify an antibody directed to MAdCAM.

In one aspect, the invention provides hybridomas that produce human anti-MAdCAM antibodies. In a preferred embodiment, the hybridomas are mouse hybridomas, as described above. In another embodiment, the hybridomas are produced in a non-human, non-mouse species such as rats, sheep, pigs, goats, cattle or horses. In another embodiment, the hybridomas are human hybridomas, in which a human non-secretory myeloma is fused with a human cell expressing an anti-MAdCAM antibody.

Nucleic Acids Vectors, Host Cells and Recombinant Methods of Making Antibodies

Nucleic Acids

Nucleic acid molecules encoding anti-MAdCAM antibodies of the invention are provided. In one embodiment, the nucleic acid molecule encodes a heavy and/or light chain of an anti-MAdCAM immunoglobulin. In a preferred embodiment, a single nucleic acid molecule encodes a heavy chain of an anti-MAdCAM immunoglobulin and another nucleic acid molecule encodes the light chain of an anti-MAdCAM immunoglobulin. In a more preferred embodiment, the encoded immunoglobulin is a human immunoglobulin, preferably a human IgG. The encoded light chain may be a  $\lambda$  chain or a  $\kappa$  chain, preferably a  $\kappa$  chain.

In a preferred embodiment the nucleic acid molecule encoding the variable region of the light chain comprises the germline sequence of a human V $\kappa$  the A2, A3, A26, B3, O12 or O18 gene or a variant of said sequence. In a preferred embodiment, the nucleic acid molecule encoding the light chain comprises a sequence derived from a human J $\kappa$ 1, J $\kappa$ 2,

J $\kappa$ 3, J $\kappa$ 4 or J $\kappa$ 5 gene. In a preferred embodiment, the nucleic acid molecule encoding the light chain encodes no more than eleven amino acid changes from the germline A2, A3, A26, B3, O12 or O18 V $\kappa$  gene, preferably no more than six amino acid changes, and even more preferably no more than three amino acid changes. In a more preferred embodiment, the nucleic acid encoding the light chain is the germline sequence.

The invention provides a nucleic acid molecule that encodes a variable region of the light chain (VL) containing up to eleven amino acid changes compared to the germline sequence, wherein the amino acid changes are identical to amino acid changes from the germline sequence from the VL of one of the antibodies 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod. The invention also provides a nucleic acid molecule comprising a nucleotide sequence that encodes the amino acid sequence of the variable region of the light chain of 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod. The invention also provides a nucleic acid molecule comprising a nucleotide sequence that encodes the amino acid sequence of one or more of the CDRs of any one of the light chains of 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod. In a preferred embodiment, the nucleic acid molecule comprises a nucleotide sequence that encodes the amino acid sequence of all of the CDRs of any one of the light chains of 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod. In another embodiment, the nucleic acid molecule comprises a nucleotide sequence that encodes the amino acid sequence of one of SEQ ID NOS: 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 54, 58, 62, 66, 68 or comprises a nucleotide sequence of one of SEQ ID NOS: 3, 7, 11, 15, 19, 23, 27, 31, 35, 39, 43, 47, 53, 57, 61, 65 or 67. In another preferred embodiment, the nucleic acid molecule comprises a nucleotide sequence that encodes the amino acid sequence of one or more of the CDRs of any one of SEQ ID NOS: 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 54, 58, 62, 66, 68 or comprises a nucleotide sequence of one or more of the CDRs of any one of SEQ ID NOS: 3, 7, 11, 15, 19, 23, 27, 31, 35, 39, 43, 47, 53, 57, 61, 65, or 67. In a more preferred embodiment, the nucleic acid molecule comprises a nucleotide sequence that encodes the amino acid sequence of all of the CDRs of any one of SEQ ID NOS: 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 54, 58, 62, 66, 68 or comprises a the nucleotide sequence of all the CDRs of any one of SEQ ID NOS: 3, 7, 11, 15, 19, 23, 27, 31, 35, 39, 43, 47, 53, 57, 61, 65, or 67.

The invention also provides a nucleic acid molecule that encodes an amino acid sequence of a VL that has an amino acid sequence that is at least 70%, 75%, 80%, 85%, 90%, 95%, 96%, 97%, 98% or 99% identical to a VL described above, particularly to a VL that comprises an amino acid sequence of one of SEQ ID NOS: 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 54, 58, 62, 66 or 68. The invention also provides a nucleotide sequence that is at least 70%, 75%, 80%, 85%, 90%, 95%, 96%, 97%, 98% or 99% identical to a nucleotide sequence of one of SEQ ID NOS: 3, 7, 11, 15, 19, 23, 27, 31, 35, 39, 43, 47, 53, 57, 61, 65 or 67.

In another embodiment, the invention provides a nucleic acid molecule that hybridizes under highly stringent conditions to a nucleic acid molecule encoding a VL as described above, particularly a nucleic acid molecule that comprises a



nucleotide sequence encoding an amino acid sequence of SEQ ID NOS: 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 54, 58, 62, 66 or 68. The invention also provides a nucleic acid molecule that hybridizes under highly stringent conditions to a nucleic acid molecule comprising a nucleotide sequence of one of SEQ ID NOS: 3, 7, 11, 15, 19, 23, 27, 31, 35, 39, 43, 47, 53, 57, 61, 65 or 67.

The invention also provides a nucleic acid molecule encoding a heavy chain variable region (VH) that utilizes a human VH 1-18, 3-15, 3-21, 3-23, 3-30, 3-33 or 4-4 VH gene. In some embodiments, the nucleic acid molecule encoding the VH gene further utilizes a human JH4 or JH6 family gene. In some embodiments, the nucleic acid molecule encoding the VH gene utilize the human JH4b or JH6b gene. In another embodiment, the nucleic acid molecule comprises a sequence derived from a human D 3-10, 4-23, 5-5, 6-6 or 6-19 gene. In an even more preferred embodiment, the nucleic acid molecule encoding the VH contains no more than fifteen amino acid changes from the germline VH 1-18, 3-15, 3-21, 3-23, 3-30, 3-33 or 4-4 genes, preferably no more than six amino acid changes, and even more preferably no more than three amino acid changes. In a highly preferred embodiment, the nucleic acid molecule encoding the VH contains at least one amino acid change compared to the germline sequence, wherein the amino acid change is identical to an amino acid change from the germline sequence from the heavy chain of one of the antibodies 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod. In an even more preferred embodiment, the VH contains no more than fifteen amino acid changes compared to the germline sequences, wherein the changes are identical to those changes from the germline sequence from the VH of one of the antibodies 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod.

In one embodiment, the nucleic acid molecule comprises a nucleotide sequence that encodes the amino acid sequence of the VH of 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod. In another embodiment, the nucleic acid molecule comprises a nucleotide sequence that encodes the amino acid sequence of one or more of the CDRs of the heavy chain of 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod. In a preferred embodiment, the nucleic acid molecule comprises nucleotide sequences that encode the amino acid sequences of all of the CDRs of the heavy chain of 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod. In another preferred embodiment, the nucleic acid molecule comprises a nucleotide sequence that encodes the amino acid sequence of one of SEQ ID NOS: 2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 52, 56, 60 or 64 or that comprises a nucleotide sequence of one of SEQ ID NOS: 1, 5, 9, 13, 17, 21, 25, 29, 33, 37, 41, 45, 51, 55, 59 or 63. In another preferred embodiment, the nucleic acid molecule comprises a nucleotide sequence that encodes the amino acid sequence of one or more of the CDRs of any one of SEQ ID NOS: 2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 52, 56, 60 or 64 or comprises a nucleotide sequence of one or more of the CDRs of any one of SEQ ID NOS: 1, 5, 9, 13, 17, 21, 25, 29, 33, 37, 41, 45, 51, 55, 59 or 63. In a preferred embodiment, the nucleic acid molecule comprises a nucleotide sequence that encodes the amino acid sequences of all of the CDRs of any one of SEQ ID NOS: 2, 6, 10, 14, 18, 22, 26,

30, 34, 38, 42, 46, 52, 56, 60 or 64 or comprises a nucleotide sequence of all of the CDRs of any one of SEQ ID NOS: 1, 5, 9, 13, 17, 21, 25, 29, 33, 37, 41, 45, 51, 55, 59 or 63. In some embodiments the nucleic acid molecule comprises a nucleotide sequence encoding a contiguous region from the beginning of CDR1 to the end of CDR3 of a heavy or light chain of any of the above-mentioned anti-MAdCAM antibodies.

In another embodiment, the nucleic acid molecule encodes an amino acid sequence of a VH that is at least 70%, 75%, 80%, 85%, 90%, 95%, 96%, 97%, 98% or 99% identical to one of the amino acid sequences encoding a VH as described immediately above, particularly to a VH that comprises an amino acid sequence of one of SEQ ID NOS: 2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 52, 56, 60 or 64. The invention also provides a nucleotide sequence that is at least 70%, 75%, 80%, 85%, 90%, 95%, 96%, 97%, 98% or 99% identical to a nucleotide sequence of one of SEQ ID NOS: 1, 5, 9, 13, 17, 21, 25, 29, 33, 37, 41, 45, 51, 55, 59 or 63.

In another embodiment, the nucleic acid molecule encoding a VH is one that hybridizes under highly stringent conditions to a nucleotide sequence encoding a VH as described above, particularly to a VH that comprises an amino acid sequence of one of SEQ ID NOS: 2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 52, 56, 60 or 64. The invention also provides a nucleotide sequence encoding a VH that hybridizes under highly stringent conditions to a nucleic acid molecule comprising a nucleotide sequence of one of SEQ ID NOS: 1, 5, 9, 13, 17, 21, 25, 29, 33, 37, 41, 45, 51, 55, 59 or 63.

The nucleotide sequence encoding either or both of the entire heavy and light chains of an anti-MAdCAM antibody or the variable regions thereof may be obtained from any source that produces an anti-MAdCAM antibody. Methods of isolating mRNA encoding an antibody are well-known in the art. See, e.g., Sambrook et al., *Molecular Cloning: A Laboratory Manual*, 2d ed., Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N. Y. (1989). The mRNA may be used to produce cDNA for use in the polymerase chain reaction (PCR) or cDNA cloning of antibody genes. In one embodiment of the invention, the nucleic acid molecules may be obtained from a hybridoma that expresses an anti-MAdCAM antibody, as described above, preferably a hybridoma that has as one of its fusion partners a transgenic animal cell that expresses human immunoglobulin genes, such as a XENOMOUSE™ animal, a non-human mouse transgenic animal or a non-human, non-mouse transgenic animal. In another embodiment, the hybridoma is derived from a non-human, non-transgenic animal, which may be used, e.g., for humanized antibodies.

A nucleic acid molecule encoding the entire heavy chain of an anti-MAdCAM antibody may be constructed by fusing a nucleic acid molecule encoding the entire variable domain of a heavy chain or an antigen-binding domain thereof with a constant domain of a heavy chain. Similarly, a nucleic acid molecule encoding the light chain of an anti-MAdCAM antibody may be constructed by fusing a nucleic acid molecule encoding the variable domain of a light chain or an antigen-binding domain thereof with a constant domain of a light chain. Nucleic acid molecules encoding the VH and VL regions may be converted to full-length antibody genes by inserting them into expression vectors already encoding heavy chain constant and light chain constant regions, respectively, such that the VH segment is operatively linked to the heavy chain constant region (CH) segment(s) within the vector and the VL segment is operatively linked to the light chain constant region (CL) segment within the vector. Alternatively, the nucleic acid molecules encoding the VH or VL chains are converted into full-length antibody genes by link-



ing, e.g., ligating, the nucleic acid molecule encoding a VH chain to a nucleic acid molecule encoding a CH chain using standard molecular biological techniques. The same may be achieved using nucleic acid molecules encoding VL and CL chains. The sequences of human heavy and light chain constant region genes are known in the art. See, e.g., Kabat et al., Sequences of Proteins of Immunological Interest, 5th Ed., NIH Publ. No. 91-3242 (1991). Nucleic acid molecules encoding the full-length heavy and/or light chains may then be expressed from a cell into which they have been introduced and the anti-MAdCAM antibody isolated.

In a preferred embodiment, the nucleic acid encoding the variable region of the heavy chain encodes the variable region of amino acid sequences of SEQ ID NOS: 2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 52, 56, 60 or 64, and the nucleic acid molecule encoding the variable region of the light chains encodes the variable region of amino acid sequence of SEQ ID NOS: 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 54, 58, 62, 66 or 68.

In one embodiment, a nucleic acid molecule encoding either the heavy chain of an anti-MAdCAM antibody or an antigen-binding portion thereof, or the light chain of an anti-MAdCAM antibody or an antigen-binding portion thereof may be isolated from a non-human, non-mouse animal that expresses human immunoglobulin genes and has been immunized with a MAdCAM antigen. In other embodiment, the nucleic acid molecule may be isolated from an anti-MAdCAM antibody-producing cell derived from a non-transgenic animal or from a human patient who produces anti-MAdCAM antibodies. mRNA from the anti-MAdCAM antibody-producing cells may be isolated by standard techniques, cloned and/or amplified using PCR and library construction techniques, and screened using standard protocols to obtain nucleic acid molecules encoding anti-MAdCAM heavy and light chains.

The nucleic acid molecules may be used to recombinantly express large quantities of anti-MAdCAM antibodies, as described below. The nucleic acid molecules may also be used to produce chimeric antibodies, single chain antibodies, immunoadhesins, diabodies, mutated antibodies and antibody derivatives, as described further below. If the nucleic acid molecules are derived from a non-human, non-transgenic animal, the nucleic acid molecules may be used for antibody humanization, also as described below.

In another embodiment, the nucleic acid molecules of the invention may be used as probes or PCR primers for specific antibody sequences. For instance, a nucleic acid molecule probe may be used in diagnostic methods or a nucleic acid molecule PCR primer may be used to amplify regions of DNA that could be used, inter alia, to isolate nucleotide sequences for use in producing variable domains of anti-MAdCAM antibodies. In a preferred embodiment, the nucleic acid molecules are oligonucleotides. In a more preferred embodiment, the oligonucleotides are from highly variable regions of the heavy and light chains of the antibody of interest. In an even more preferred embodiment, the oligonucleotides encode all or a part of one or more of the CDRs.

#### Vectors

The invention provides vectors comprising the nucleic acid molecules of the invention that encode the heavy chain or the antigen-binding portion thereof. The invention also provides vectors comprising the nucleic acid molecules of the invention that encode the light chain or antigen-binding portion thereof. The invention also provides vectors comprising nucleic acid molecules encoding fusion proteins, modified antibodies, antibody fragments, and probes thereof.

To express the antibodies, or antibody portions of the invention, DNAs encoding partial or full-length light and heavy chains, obtained as described above, are inserted into expression vectors such that the genes are operatively linked to transcriptional and translational control sequences. Expression vectors include plasmids, retroviruses, adenoviruses, adeno-associated viruses (AAV), plant viruses such as cauliflower mosaic virus, tobacco mosaic virus, cosmids, YACs, EBV derived episomes, and the like. The antibody gene is ligated into a vector such that transcriptional and translational control sequences within the vector serve their intended function of regulating the transcription and translation of the antibody gene. The expression vector and expression control sequences are chosen to be compatible with the expression host cell used. The antibody light chain gene and the antibody heavy chain gene can be inserted into separate vector. In a preferred embodiment, both genes are inserted into the same expression vector. The antibody genes are inserted into the expression vector by standard methods (e.g., ligation of complementary restriction sites on the antibody gene fragment and vector, or blunt end ligation if no restriction sites are present).

A convenient vector is one that encodes a functionally complete human CH or CL immunoglobulin sequence, with appropriate restriction sites engineered so that any VH or VL sequence can be easily inserted and expressed, as described above. In such vectors, splicing usually occurs between the splice donor site in the inserted J region and the splice acceptor site preceding the human C region, and also at the splice regions that occur within the human CH exons. Polyadenylation and transcription termination occur at native chromosomal sites downstream of the coding regions. The recombinant expression vector can also encode a signal peptide that facilitates secretion of the antibody chain from a host cell. The antibody chain gene may be cloned into the vector such that the signal peptide is linked in-frame to the amino terminus of the antibody chain gene. The signal peptide can be an immunoglobulin signal peptide or a heterologous signal peptide (i.e., a signal peptide from a non-immunoglobulin protein).

In addition to the antibody chain genes, the recombinant expression vectors of the invention carry regulatory sequences that control the expression of the antibody chain genes in a host cell. It will be appreciated by those skilled in the art that the design of the expression vector, including the selection of regulatory sequences may depend on such factors as the choice of the host cell to be transformed, the level of expression of protein desired, etc. Preferred regulatory sequences for mammalian host cell expression include viral elements that direct high levels of protein expression in mammalian cells, such as promoters and/or enhancers derived from retroviral LTRs, cytomegalovirus (CMV) (such as the CMV promoter/enhancer), Simian Virus 40 (SV40) (such as the SV40 promoter/enhancer), adenovirus, (e.g., the adenovirus major late promoter (AdMLP)), polyoma and strong mammalian promoters such as native immunoglobulin and actin promoters. For further description of viral regulatory elements, and sequences thereof, see e.g., U.S. Pat. Nos. 5,168,062, 4,510,245, and 4,968,615, each of which is hereby incorporated by reference. Methods for expressing antibodies in plants, including a description of promoters and vectors, as well as transformation of plants are known in the art. See, e.g., U.S. Pat. No. 6,517,529. Methods of expressing polypeptides in bacterial cells or fungal cells, e.g., yeast cells, are also well known in the art.

In addition to the antibody chain genes and regulatory sequences, the recombinant expression vectors of the invention may carry additional sequences, such as sequences that



regulate replication of the vector in host cells (e.g., origins of replication) and selectable marker genes. The selectable marker gene facilitates selection of host cells into which the vector has been introduced (see, e.g., U.S. Pat. Nos. 4,399, 216, 4,634,665 and 5,179,017). For example, typically the selectable marker gene confers resistance to drugs, such as G418, hygromycin or methotrexate, on a host cell into which the vector has been introduced. Preferred selectable marker genes include the dihydrofolate reductase (DHFR) gene (for use in dhfr<sup>-</sup> host cells with methotrexate selection/amplification) and the neo gene (for G418 selection), and the glutamate synthetase gene

#### Non-Hybridoma Host Cells and Methods of Recombinantly Producing Protein

Nucleic acid molecules encoding the heavy chain or an antigen-binding portion thereof and/or the light chain or an antigen-binding portion thereof of an anti-MAdCAM antibody, and vectors comprising these nucleic acid molecules, can be used for transformation of a suitable mammalian plant, bacterial or yeast host cell. Transformation can be by any known method for introducing polynucleotides into a host cell. Methods for introduction of heterologous polynucleotides into mammalian cells are well known in the art and include dextran-mediated transfection, calcium phosphate precipitation, polybrene-mediated transfection, protoplast fusion, electroporation, encapsulation of the polynucleotide (s) in liposomes, biolistic injection and direct microinjection of the DNA into nuclei. In addition, nucleic acid molecules may be introduced into mammalian cells by viral vectors. Methods of transforming cells are well known in the art. See, e.g., U.S. Pat. Nos. 4,399,216, 4,912,040, 4,740,461, and 4,959,455 (which patents are hereby incorporated herein by reference). Methods of transforming plant cells are well known in the art, including, e.g., *Agrobacterium*-mediated transformation, biolistic transformation, direct injection, electroporation and viral transformation. Methods of transforming bacterial and yeast cells are also well known in the art.

Mammalian cell lines available as hosts for expression are well known in the art and include many immortalized cell lines available from the American Type Culture Collection (ATCC). These include, inter alia, Chinese hamster ovary (CHO) cells, NS0, SP2 cells, HEK-293T cells, NIH-3T3 cells, HeLa cells, baby hamster kidney (BHK) cells, monkey kidney cells (COS), human hepatocellular carcinoma cells (e.g., Hep G2), A549 cells, 3T3 cells, and a number of other cell lines. Mammalian host cells include human, mouse, rat, dog, monkey, pig, goat, bovine, horse and hamster cells. Cell lines of particular preference are selected through determining which cell lines have high expression levels. Other cell lines that may be used are insect cell lines, such as Sf9 cells, amphibian cells, bacterial cells, plant cells and fungal cells. When recombinant expression vectors encoding the heavy chain or antigen-binding portion thereof, the light chain and/or antigen-binding portion thereof are introduced into mammalian host cells, the antibodies are produced by culturing the host cells for a period of time sufficient to allow for expression of the antibody in the host cells or, more preferably, secretion of the antibody into the culture medium in which the host cells are grown. Antibodies can be recovered from the culture medium using standard protein purification methods. Plant host cells include, e.g., *Nicotiana*, *Arabidopsis*, duckweed, corn, wheat, potato, etc. Bacterial host cells include *E. coli* and *Streptomyces* species. Yeast host cells include *Schizosaccharomyces pombe*, *Saccharomyces cerevisiae* and *Pichia pastoris*.

Further, expression of antibodies of the invention (or other moieties therefrom) from production cell lines can be enhanced using a number of known techniques. For example, the glutamine synthetase gene expression system (the GS system) is a common approach for enhancing expression under certain conditions. The GS system is discussed in whole or part in connection with European Patent Nos. 0 216 846, 0 256 055, 0 338 841 and 0 323 997.

It is likely that antibodies expressed by different cell lines or in transgenic animals will have different glycosylation from each other. However, all antibodies encoded by the nucleic acid molecules provided herein, or comprising the amino acid sequences provided herein are part of the instant invention, regardless of the glycosylation of the antibodies.

#### Transgenic Animals and Plants

The invention also provides transgenic non-human animals and transgenic plants comprising one or more nucleic acid molecules of the invention that may be used to produce antibodies of the invention. Antibodies can be produced in and recovered from tissue or bodily fluids, such as milk, blood or urine, of goats, cows, horses, pigs, rats, mice, rabbits, hamsters or other mammals. See, e.g., U.S. Pat. Nos. 5,827,690, 5,756,687, 5,750,172, and 5,741,957. As described above, non-human transgenic animals that comprise human immunoglobulin loci can be immunized with MAdCAM or a portion thereof. Methods for making antibodies in plants are described, e.g., in U.S. Pat. Nos. 6,046,037 and 5,959,177, incorporated herein by reference.

In another embodiment, non-human transgenic animals and transgenic plants are produced by introducing one or more nucleic acid molecules of the invention into the animal or plant by standard transgenic techniques. See Hogan, *supra*. The transgenic cells used for making the transgenic animal can be embryonic stem cells, somatic cells or fertilized egg cells. The transgenic non-human organisms can be chimeric, nonchimeric heterozygotes, and nonchimeric homozygotes. See, e.g., Hogan et al., *Manipulating the Mouse Embryo: A Laboratory Manual* 2ed., Cold Spring Harbor Press (1999); Jackson et al., *Mouse Genetics and Transgenics: A Practical Approach*, Oxford University Press (2000); and Pinkert, *Transgenic Animal Technology: A Laboratory Handbook*, Academic Press (1999). In another embodiment, the transgenic non-human organisms may have a targeted disruption and replacement that encodes a heavy chain and/or a light chain of interest. In a preferred embodiment, the transgenic animals or plants comprise and express nucleic acid molecules encoding heavy and light chains that combine to bind specifically to MAdCAM, preferably human MAdCAM. In another embodiment, the transgenic animals or plants comprise nucleic acid molecules encoding a modified antibody such as a single-chain antibody, a chimeric antibody or a humanized antibody. The anti-MAdCAM antibodies may be made in any transgenic animal. In a preferred embodiment, the non-human animals are mice, rats, sheep, pigs, goats, cattle or horses. The non-human transgenic animal expresses said encoded polypeptides in blood, milk, urine, saliva, tears, mucus and oilier bodily fluids.

#### Phage Display Libraries

The invention provides a method for producing an anti-MAdCAM antibody or antigen-binding portion thereof comprising the steps of synthesizing a library of human antibodies on phage, screening the library with a MAdCAM or a portion thereof, isolating phage that bind MAdCAM, and obtaining the antibody from the phage. One method to prepare the library of antibodies comprises the steps of immunizing a non-human host animal comprising a human immunoglobulin locus with MAdCAM or an antigenic portion thereof to



create an immune response, extracting cells from the host animal the cells that are responsible for production of antibodies; isolating RNA from the extracted cells, reverse transcribing the RNA to produce cDNA, amplifying the cDNA using a primer, and inserting the cDNA into phage display vector such that antibodies are expressed on the phage. Recombinant anti-MAdCAM antibodies of the invention may be obtained in this way.

Recombinant anti-MAdCAM human antibodies of the invention in addition to the anti-MAdCAM antibodies disclosed herein can be isolated by screening of a recombinant combinatorial antibody library, preferably a scFv phage display library, prepared using human VL and VH cDNAs prepared from mRNA isolated from human lymphocytes. Methodologies for preparing and screening such libraries are known in the art. There are commercially available kits for generating phage display libraries (e.g., the Pharmacia Recombinant Phage Antibody System, catalog no. 27-9400-01; and the Stratagene SurfZAP™ phage display kit, catalog no. 240612). There are also other methods and reagents that can be used in generating and screening antibody display libraries (see, e.g., U.S. Pat. No. 5,223,409; PCT Publication No. WO 92/18619; PCT Publication No. WO 91/17271; PCT Publication No. WO 92/20791; PCT Publication No. WO 92/15679; PCT Publication No. WO 93/01288; PCT Publication No. WO 92/01047; PCT Publication No. WO 92/09690; Fuchs et al. (1991), *Biotechnology*, 9:1369-1372; Hay et al., *Hum. Antibod. Hybridomas*, 3:81-85 (1992); Huse et al., *Science*, 246:1275-1281 (1989); McCafferty et al., *Nature*, 348:552-554 (1990); Griffiths et al., *EMBO J*, 12:725-734 (1993); Hawkins et al., *J. Mol. Biol.*, 226:889-896 (1992); Clackson et al., *Nature*, 352:624-628 (1991); Gram et al., *Proc. Natl. Acad. Sci. USA*, 89:3576-3580 (1992); Garrad et al., *Biotechnology*, 9:1373-1377 (1991); Hoogenboom et al., *Nuc Acid Res*, 19:4133-4137 (1991); and Barbas et al., *Proc. Natl. Acad. Sci. USA*, 88:7978-7982 (1991).

In a preferred embodiment, to isolate human anti-MAdCAM antibodies with the desired characteristics, a human anti-MAdCAM antibody as described herein is first used to select human heavy and light chain sequences having similar binding activity toward MAdCAM, using the epitope imprinting methods described in Hoogenboom et al., PCT Publication No. WO 93/06213. The antibody libraries used in this method are preferably scFv libraries prepared and screened as described in McCafferty et al., PCT Publication No. WO 92/01047, McCafferty et al., *Nature*, 348:552-554 (1990); and Griffiths et al., *EMBO J*, 12:725-734 (1993). The scFv antibody libraries preferably are screened using human MAdCAM as the antigen.

Once initial human VL and VH segments are selected, "mix and match" experiments, in which different pairs of the initially selected VL and VH segments are screened for MAdCAM binding, are performed to select preferred VL/VH pair combinations. Additionally, to further improve the quality of the antibody, the VL and VH segments of the preferred VL/VH pair(s) can be randomly mutated, preferably within the CDR3 region of VH and/or VL, in a process analogous to the *in vivo* somatic mutation process responsible for affinity maturation of antibodies during a natural immune response. This *in vitro* affinity maturation can be accomplished by amplifying VH and VL regions using PCR primers complementary to the VH CDR3 or VL CDR3, respectively, which primers have been "spiked" with a random mixture of the four nucleotide bases at certain positions such that the resultant PCR products encode VH and VL segments into which random mutations have been introduced into the VH and/or VL

CDR3 regions. These randomly mutated VH and VL segments can be rescreened for binding to MAdCAM.

Following screening and isolation of an anti-MAdCAM antibody of the invention from a recombinant immunoglobulin display library, nucleic acid encoding the selected antibody can be recovered from the display package (e.g., from the phage genome) and subcloned into other expression vectors by standard recombinant DNA techniques. If desired, the nucleic acid can be further manipulated to create other antibody forms of the invention, as described below. To express a recombinant human antibody isolated by screening of a combinatorial library, the DNA encoding the antibody is cloned into a recombinant expression vector and introduced into a mammalian host cells, as described above.

#### Class Switching

Another aspect of the instant invention is to provide a mechanism by which the class of an anti-MAdCAM antibody may be switched with another. In one aspect of the invention, a nucleic acid molecule encoding VL or VH is isolated using methods well-known in the art such that it does not include any nucleotide sequences encoding CL or CH. The nucleic acid molecule encoding VL or VH is then operatively linked to a nucleotide sequence encoding a CL or CH from a different class of immunoglobulin molecule. This may be achieved using a vector or nucleic acid molecule that comprises a CL or CH encoding sequence, as described above. For example, an anti-MAdCAM antibody that was originally IgM may be class switched to an IgG. Further, the class switching may be used to convert one IgG subclass to another, e.g., from IgG<sub>4</sub> to IgG<sub>2</sub>. A preferred method for producing an antibody of the invention comprising a desired isotype or antibody subclass comprises the steps of isolating a nucleic acid encoding the heavy chain of an anti-MAdCAM antibody and a nucleic acid encoding the light chain of an anti-MAdCAM antibody, obtaining the variable region of the heavy chain, ligating the variable region of the heavy chain with the constant domain of a heavy chain of the desired isotype, expressing the light chain and the ligated heavy chain in a cell, and collecting the anti-MAdCAM antibody with the desired isotype.

#### Antibody Derivatives

One may use the nucleic acid molecules described above to generate antibody derivatives using techniques and methods known to one of ordinary skill in the art.

#### Humanized Antibodies

The immunogenicity of non-human antibodies can be reduced to some extent using techniques of humanization, potentially employing display techniques using appropriate libraries. It will be appreciated that murine antibodies or antibodies from other species can be humanized or primate-ized using techniques well known in the art. See, e.g., Winter and Harris, *Immunol Today*, 14:43-46 (1993) and Wright et al., *Crit. Reviews in Immunol.*, 12:125-168 (1992). The antibody of interest may be engineered by recombinant DNA techniques to substitute the C<sub>H</sub>1, C<sub>H</sub>2, C<sub>H</sub>3, hinge domains, and/or the framework domain with the corresponding human sequence (see WO 92/02190 and U.S. Pat. Nos. 5,530,101, 5,585,089, 5,693,761, 5,693,792, 5,714,350, and 5,777,085). In another embodiment, a non-human anti-MAdCAM antibody can be humanized by substituting the C<sub>H</sub>1, hinge domain, C<sub>H</sub>2, C<sub>H</sub>3, and/or the framework domains with the corresponding human sequence of a anti-MAdCAM antibody of the invention.

#### Mutated Antibodies

In another embodiment, the nucleic acid molecules, vectors and host cells may be used to make mutated anti-MAdCAM antibodies. The antibodies may be mutated in the variable domains of the heavy and/or light chains to alter a



binding property of the antibody. For example, a mutation may be made in one or more of the CDR regions to increase or decrease the  $K_d$  of the antibody for MAdCAM. Techniques in site-directed mutagenesis are well-known in the art. See, e.g., Sambrook et al., and Ausubel et al., supra. In a preferred embodiment, mutations are made at an amino acid residue that is known to be changed compared to germline in a variable region of an anti-MAdCAM antibody. In a more preferred embodiment, one or more mutations are made at an amino acid residue that is known to be changed compared to the germline in a variable region or CDR region of one of the anti-MAdCAM antibodies 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod. In another embodiment, one or more mutations are made at an amino acid residue that is known to be changed compared to the germline in a variable region or CDR region whose amino acid sequence is presented in SEQ ID NOS: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 52, 54, 56, 58, 62, 64, 66 or 68, or whose nucleotide sequence is presented in SEQ ID NOS: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 51, 53, 55, 57, 61, 63, 65 or 67. In another embodiment, the nucleic acid molecules are mutated in one or more of the framework regions. A mutation may be made in a framework region or constant domain to increase the half-life of the anti-MAdCAM antibody. See, e.g., WO 00/09560, published Feb. 24, 2000, herein incorporated by reference. In one embodiment, there may be one, three or five or ten point mutations and no more than fifteen point mutations. A mutation in a framework region or constant domain may also be made to alter the immunogenicity of the antibody, to provide a site for covalent or non-covalent binding to another molecule, or to alter such properties as complement fixation. Mutations may be made in each of the framework regions, the constant domain and the variable regions in a single mutated antibody. Alternatively, mutations may be made in only one of the framework regions, the variable regions or the constant domain in a single mutated antibody.

In one embodiment, there are no greater than fifteen amino acid changes in either the VH or VL regions of the mutated anti-MAdCAM antibody compared to the anti-MAdCAM antibody prior to mutation. In a more preferred embodiment, there is no more than ten amino acid changes in either the VH or VL regions of the mutated anti-MAdCAM antibody, more preferably no more than five amino acid changes, or even more preferably no more than three amino acid changes. In another embodiment, there are no more than fifteen amino acid changes in the constant domains, more preferably, no more than ten amino acid changes, even more preferably, no more than five amino acid changes.

#### Modified Antibodies

In another embodiment, a fusion antibody or immunoadhesin may be made which comprises all or a portion of an anti-MAdCAM antibody linked to another polypeptide. In a preferred embodiment, only the variable regions of the anti-MAdCAM antibody are linked to the polypeptide. In another preferred embodiment, the VH domain of an anti-MAdCAM antibody are linked to a first polypeptide, while the VL domain of an anti-MAdCAM antibody are linked to a second polypeptide that associates with the first polypeptide in a manner in which the VH and VL domains can interact with one another to form an antibody binding site. In another preferred embodiment, the VH domain is separated from the VL domain by a linker such that the VH and VL domains can interact with one another (see below under Single Chain Antibodies). The VH-linker-VL antibody is then linked to the

polypeptide of interest. The fusion antibody is useful to directing a polypeptide to a MAdCAM-expressing cell or tissue. The polypeptide may be a therapeutic agent, such as a toxin, growth factor or other regulatory protein, or may be a diagnostic agent, such as an enzyme that may be easily visualized, such as horseradish peroxidase. In addition, fusion antibodies can be created in which two (or more) single-chain antibodies are linked to one another. This is useful if one wants to create a divalent or polyvalent antibody on a single polypeptide chain, or if one wants to create a bispecific antibody.

To create a single chain antibody, (scFv) the VH- and VL-encoding DNA fragments are operatively linked to another fragment encoding a flexible linker, e.g., encoding the amino acid sequence (Gly<sub>4</sub>-Ser)<sub>3</sub> (SEQ ID NO: 147), such that the VH and VL sequences can be expressed as a contiguous single-chain protein, with the VL and VH regions joined by the flexible linker (see, e.g., Bird et al., Science, 242:423-426 (1988); Huston et al., Proc. Natl. Acad. Sci. USA, 85:5879-5883 (1988); McCafferty et al., Nature, 348:552-554 (1990)). The single chain antibody may be monovalent, if only a single VH and VL are used, bivalent, if two VH and VL are used, or polyvalent, if more than two VH and VL are used.

In another embodiment, other modified antibodies may be prepared using anti-MAdCAM-encoding nucleic acid molecules. For instance, "Kappa bodies" (Ill et al., Protein Eng, 10: 949-57(1997)), "Minibodies" (Martin et al., EMBO J, 13: 5303-9(1994)), "Diabodies" (Holliger et al., PNAS USA, 90: 6444-6448(1993)), or "Janusins" (Traunecker et al., EMBO J, 10:3655-3659 (1991) and Traunecker et al., "Janusin: new molecular design for bispecific reagents," Int J Cancer Suppl, 7:51-52 (1992)) may be prepared using standard molecular biological techniques following the teachings of the specification.

In another aspect, chimeric and bispecific antibodies can be generated. A chimeric antibody may be made that comprises CDRs and framework regions from different antibodies. In a preferred embodiment, the CDRs of the chimeric antibody comprises all of the CDRs of the variable region of a light chain or heavy chain of a human anti-MAdCAM antibody, while the framework regions are derived from one or more different antibodies. In a more preferred embodiment, the CDRs of the chimeric antibody comprise all of the CDRs of the variable regions of the light chain and the heavy chain of a human anti-MAdCAM antibody. The framework regions may be from another species and may, in a preferred embodiment, be humanized. Alternatively, the framework regions may be from another human antibody.

A bispecific antibody can be generated that binds specifically to MAdCAM through one binding domain and to a second molecule through a second binding domain. The bispecific antibody can be produced through recombinant molecular biological techniques, or may be physically conjugated together. In addition, a single chain antibody containing more than one VH and VL may be generated that binds specifically to MAdCAM and to another molecule. Such bispecific antibodies can be generated using techniques that are well known for example, in connection with (i) and (ii) see, e.g., Fanger et al., Immunol Methods 4: 72-81 (1994) and Wright and Harris, supra. and in connection with (iii) see, e.g., Traunecker et al., Int. J. Cancer (Suppl.) 7:51-52 (1992). In a preferred embodiment, the bispecific antibody binds to MAdCAM and to another molecule expressed at high level on endothelial cells. In a more preferred embodiment, the other molecule is VCAM, ICAM or L-selectin.

In various embodiments, the modified antibodies described above are prepared using one or more of the vari-



able regions or one or more CDR regions from one of the antibodies selected from 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod or 7.26.4-mod. In another embodiment, the modified antibodies are prepared using one or more of the variable regions or one or more CDR regions whose amino acid sequence is presented in SEQ ID NOS: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 52, 54, 56, 58, 62, 64, 66 or 68 or whose nucleotide sequence is presented in SEQ ID NOS: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 51, 53, 55, 57, 61, 63, 65 or 67.

#### Derivatized and Labeled Antibodies

An antibody or antibody portion of the invention can be derivatized or linked to another molecule (e.g., another peptide or protein). In general, the antibodies or portions thereof are derivatized such that the MAdCAM binding is not affected adversely by the derivatization or labeling. Accordingly, the antibodies and antibody portions of the invention are intended to include both intact and modified forms of the human anti-MAdCAM antibodies described herein. For example, an antibody or antibody portion of the invention can be functionally linked (by chemical coupling, genetic fusion, noncovalent association or otherwise) to one or more other molecular entities, such as another antibody (e.g., a bispecific antibody or a diabody), a detection agent, a cytotoxic agent, a pharmaceutical agent, and/or a protein or peptide that can mediate association of the antibody or antibody portion with another molecule (such as a streptavidin core region or a polyhistidine tag).

One type of derivatized antibody is produced by crosslinking two or more antibodies (of the same type or of different types, e.g., to create bispecific antibodies). Suitable crosslinkers include those that are heterobifunctional, having two distinctly reactive groups separated by an appropriate spacer (e.g., m-maleimidobenzoyl-N-hydroxysuccinimide ester) or homobifunctional (e.g., disuccinimidyl suberate). Such linkers are available from Pierce Chemical Company, Rockford, Ill.

Another type of derivatized antibody is a labeled antibody. Useful detection agents with which an antibody or antibody portion of the invention may be derivatized include fluorescent compounds, including fluorescein, fluorescein isothiocyanate, rhodamine, 5-dimethylamine-1-naphthalenesulfonyl chloride, phycoerythrin, lanthanide phosphors and the like. An antibody may also be labeled with enzymes that are useful for detection, such as horseradish peroxidase,  $\beta$ -galactosidase, luciferase, alkaline phosphatase, glucose oxidase and the like. When an antibody is labeled with a detectable enzyme, it is detected by adding additional reagents that the enzyme uses to produce a reaction product that can be discerned. For example, when the agent horseradish peroxidase is present, the addition of hydrogen peroxide and diaminobenzidine leads to a colored reaction product, which is detectable. An antibody may also be labeled with biotin, and detected through indirect measurement of avidin or streptavidin binding. An antibody may be labeled with a magnetic agent, such as gadolinium. An antibody may also be labeled with a predetermined polypeptide epitope recognized by a secondary reporter (e.g., leucine zipper pair sequences, binding sites for secondary antibodies, metal binding domains, epitope tags). In some embodiments, labels are attached by spacer arms of various lengths to reduce potential steric hindrance.

An anti-MAdCAM antibody may also be labeled with a radiolabeled amino acid. The radiolabel may be used for both diagnostic and therapeutic purposes. For instance, the radio-

label may be used to detect MAdCAM-expressing tissues by x-ray or other diagnostic techniques. Further, the radiolabel may be used therapeutically as a toxin for diseased tissue or MAdCAM expressing tumors.

Examples of labels for polypeptides include, but are not limited to, the following radioisotopes or radionuclides— $^3\text{H}$ ,  $^{14}\text{C}$ ,  $^{15}\text{N}$ ,  $^{35}\text{S}$ ,  $^{90}\text{Y}$ ,  $^{99}\text{Tc}$ ,  $^{111}\text{In}$ ,  $^{125}\text{I}$ ,  $^{131}\text{I}$ .

An anti-MAdCAM antibody may also be derivatized with a chemical group such as polyethylene glycol (PEG), a methyl or ethyl group, or a carbohydrate group. These groups may be useful to improve the biological characteristics of the antibody, e.g., to increase serum half-life or to increase tissue binding. This methodology would also apply to any antigen-binding fragments or versions of anti-MAdCAM antibodies.

#### Pharmaceutical Compositions and Kits

In a further aspect, the invention provides compositions comprising an inhibitory human anti-MAdCAM antibody and methods for treating subjects with such compositions. In some embodiments, the subject of treatment is human. In other embodiments, the subject is a veterinary subject. In some embodiments, the veterinary subject is a dog or a non-human primate.

Treatment may involve administration of one or more inhibitory anti-MAdCAM monoclonal antibodies of the invention, or antigen-binding fragments thereof, alone or with a pharmaceutically acceptable carrier. Inhibitory anti-MAdCAM antibodies of the invention and compositions comprising them, can be administered in combination with one or more other therapeutic, diagnostic or prophylactic agents. Additional therapeutic agents include anti-inflammatory or immunomodulatory agents. These agents include, but are not limited to, the topical and oral corticosteroids such as prednisolone, methylprednisolone, NCX-1015 or budesonide; the aminosaliclates such as mesalazine, olsalazine, balsalazide or NCX-456; the class of immunomodulators such as azathioprine, 6-mercaptopurine, methotrexate, cyclosporin, FK506, IL-10 (Ilodecakin), IL-11 (Oprelevkin), IL-12, MIF/CD74 antagonists, CD40 antagonists, such as TNX-100/5-D12, OX40L antagonists, GM-CSF, pimecrolimus or rapamycin; the class of anti-TNF $\alpha$  agents such as infliximab, adalimumab, CDP-870, onercept, etanercept; the class of anti-inflammatory agents, such as PDE-4 inhibitors (roflumilast, etc), TACE inhibitors (DPC-333, RDP-58, etc) and ICE inhibitors (VX-740, etc) as well as IL-2 receptor antagonists, such as daclizumab, the class of selective adhesion molecule antagonists, such as natalizumab, MLN-02, or alicaforsen, classes of analgesic agents such as, but not limited to, COX-2 inhibitors, such as rofecoxib, valdecoxib, celecoxib, P/Q-type voltage sensitive channel ( $\alpha 2\delta$ ) modulators, such as gabapentin and pregabalin, NK-1 receptor antagonists, cannabinoid receptor modulators, and delta opioid receptor agonists, as well as anti-neoplastic, anti-tumor, anti-angiogenic or chemotherapeutic agents. Such additional agents may be included in the same composition or administered separately. In some embodiments, one or more inhibitory anti-MAdCAM antibodies of the invention can be used as a vaccine or as adjuvants to a vaccine. In particular, because MAdCAM is expressed in lymphoid tissue, vaccine antigens can be advantageously targeted to lymphoid tissue by conjugating the antigen to an anti-MAdCAM antibody of the invention.

As used herein, "pharmaceutically acceptable carrier" means any and all solvents, dispersion media, coatings, antibacterial and antifungal agents, isotonic and absorption enhancing or delaying agents, and the like that are physiologically compatible. Some examples of pharmaceutically acceptable carriers are water, saline, phosphate buffered



saline, acetate buffer with sodium chloride, dextrose, glycerol, Polyethylene glycol, ethanol and the like, as well as combinations thereof. In many cases, it will be preferable to include isotonic agents, for example, sugars, polyalcohols such as mannitol, sorbitol, or sodium chloride in the composition. Additional examples of pharmaceutically acceptable substances are surfactants, wetting agents or minor amounts of auxiliary substances such as wetting or emulsifying agents, preservatives or buffers, which enhance the shelf life or effectiveness of the antibody.

The compositions of this invention may be in a variety of forms, for example, liquid, semi-solid and solid dosage forms, such as liquid solutions (e.g., injectable and infusible solutions), dispersions or suspensions, tablets, pills, lyophilized cake, dry powders, liposomes and suppositories. The preferred form depends on the intended mode of administration and therapeutic application. Typical preferred compositions are in the form of injectable or infusible solutions, such as compositions similar to those used for passive immunization of humans. The preferred mode of administration is parenteral (e.g., intravenous, subcutaneous, intraperitoneal, intramuscular, intradermal). In a preferred embodiment, the antibody is administered by intravenous infusion or injection. In another preferred embodiment, the antibody is administered by intramuscular, intradermal or subcutaneous injection.

Therapeutic compositions typically must be sterile and stable under the conditions of manufacture and storage. The composition can be formulated as a solution, lyophilized cake, dry powder, microemulsion, dispersion, liposome, or other ordered structure suitable to high drug concentration. Sterile injectable solutions can be prepared by incorporating the anti-MAdCAM antibody in the required amount in an appropriate solvent with one or a combination of ingredients enumerated above, as required, followed by sterilization. In the case of sterile powders for the preparation of sterile injectable solutions, the preferred methods of preparation are vacuum drying and freeze-drying that yields a powder of the active ingredient plus any additional desired ingredient from a previously sterile solution thereof. Generally, dispersions are prepared by incorporating the active compound into a sterile vehicle that contains a basic dispersion medium and the required other ingredients from those enumerated above. The desired characteristics of a solution can be maintained, for example, by the use of surfactants and the required particle size in the case of dispersion by the use of surfactants, phospholipids and polymers. Prolonged absorption of injectable compositions can be brought about by including in the composition an agent that delays absorption, for example, monostearate salts, polymeric materials, oils and gelatin.

The antibodies of the present invention can be administered by a variety of methods known in the art, although for many therapeutic applications, the preferred route/mode of administration is subcutaneous, intramuscular, intradermal or intravenous infusion. As will be appreciated by the skilled artisan, the route and/or mode of administration will vary depending upon the desired results.

In certain embodiments, the antibody compositions may be prepared with a carrier that will protect the antibody against rapid release, such as a controlled release formulation, including implants, transdermal patches, and microencapsulated delivery systems. Biodegradable, biocompatible polymers can be used, such as ethylene vinyl acetate, polyanhydrides, polyglycolic acid, collagen, polyorthoesters, and polylactic acid. Many methods for the preparation of such formulations are patented or generally known to those skilled

in the art. See, e.g., Sustained and Controlled Release Drug Delivery Systems (J. R. Robinson, ed., Marcel Dekker, Inc., New York (1978)).

In certain embodiments, an anti-MAdCAM antibody of the invention can be orally administered, for example, with an inert diluent or an assimilable edible carrier. The compound (and other ingredients, if desired) can also be enclosed in a hard or soft shell gelatin capsule, compressed into tablets, or incorporated directly into the subject's diet. For oral therapeutic administration, the anti-MAdCAM antibodies can be incorporated with excipients and used in the form of ingestible tablets, buccal tablets, troches, capsules, elixirs, suspensions, syrups, wafers, and the like. To administer a compound of the invention by other than parenteral administration, it may be necessary to coat the compound with, or co-administer the compound with, a material to prevent its inactivation.

The compositions of the invention may include a "therapeutically effective amount" or a "prophylactically effective amount" of an antibody or antigen-binding portion of the invention. A "therapeutically effective amount" refers to an amount effective, at dosages and for periods of time necessary, to achieve the desired therapeutic result. A therapeutically effective amount of the antibody or antibody portion may vary according to factors such as the disease state, age, sex, and weight of the individual, and the ability of the antibody or antibody portion to elicit a desired response in the individual. A therapeutically effective amount is also one in which any toxic or detrimental effects of the antibody or antibody portion are outweighed by the therapeutically beneficial effects. A "prophylactically effective amount" refers to an amount effective, at dosages and for periods of time necessary, to achieve the desired prophylactic result. Typically, since a prophylactic dose is used in subjects prior to or at an earlier stage of disease, the prophylactically effective amount may be less than the therapeutically effective amount.

Dosage regimens can be adjusted to provide the optimum desired response (e.g., a therapeutic or prophylactic response). For example, a single bolus can be administered, several divided doses can be administered over time or the dose can be proportionally reduced or increased as indicated by the exigencies of the therapeutic situation. It is especially advantageous to formulate parenteral compositions in dosage unit form for ease of administration and uniformity of dosage. Dosage unit form as used herein refers to physically discrete units suited as unitary dosages for the mammalian subjects to be treated; each unit containing a pre-determined quantity of active compound calculated to produce the desired therapeutic effect in association with the required pharmaceutical carrier. The specification for the dosage unit forms of the invention are dictated by and directly dependent on (a) the unique characteristics of the anti-MAdCAM antibody or portion thereof and the particular therapeutic or prophylactic effect to be achieved, and (b) the limitations inherent in the art of compounding such an antibody for the treatment of sensitivity in individuals.

An exemplary, non-limiting range for a therapeutically or prophylactically effective amount of an antibody or antibody portion of the invention is 0.025 to 50 mg/kg, more preferably 0.1 to 50 mg/kg, more preferably 0.1-25, 0.1 to 10 or 0.1 to 3 mg/kg. In some embodiments, a formulation contains 5 mg/mL of antibody in a buffer of 20 mM sodium acetate, pH 5.5, 140 mM NaCl, and 0.2 mg/mL polysorbate 80. It is to be noted that dosage values may vary with the type and severity of the condition to be alleviated. It is to be further understood that for any particular subject, specific dosage regimens should be adjusted over time according to the individual need and the professional judgment of the person administering or



supervising the administration of the compositions, and that dosage ranges set forth herein are exemplary only and are not intended to limit the scope or practice of the claimed composition.

Another aspect of the present invention provides kits comprising an anti-MAdCAM antibody or antibody portion of the invention or a composition comprising such an antibody. A kit may include, in addition to the antibody or composition, diagnostic or therapeutic agents. A kit can also include instructions for use in a diagnostic or therapeutic method. In a preferred embodiment, the kit includes the antibody or a composition comprising it and a diagnostic agent that can be used in a method described below. In another preferred embodiment, the kit includes the antibody or a composition comprising it and one or more therapeutic agents that can be used in a method described below.

#### Gene Therapy

The nucleic acid molecules of the instant invention can be administered to a patient in need thereof via gene therapy. The therapy may be either *in vivo* or *ex vivo*. In a preferred embodiment, nucleic acid molecules encoding both a heavy chain and a light chain are administered to a patient. In a more preferred embodiment, the nucleic acid molecules are administered such that they are stably integrated into chromosomes of B cells because these cells are specialized for producing antibodies. In a preferred embodiment, precursor B cells are transfected or infected *ex vivo* and re-transplanted into a patient in need thereof. In another embodiment, precursor B cells or other cells are infected *in vivo* using a recombinant virus known to infect the cell type of interest. Typical vectors used for gene therapy include liposomes, plasmids and viral vectors. Exemplary viral vectors are retroviruses, adenoviruses and adeno-associated viruses. After infection either *in vivo* or *ex vivo*, levels of antibody expression can be monitored by taking a sample from the treated patient and using any immunoassay known in the art or discussed herein.

In a preferred embodiment, the gene therapy method comprises the steps of administering an isolated nucleic acid molecule encoding the heavy chain or an antigen-binding portion thereof of an anti-MAdCAM antibody and expressing the nucleic acid molecule. In another embodiment, the gene therapy method comprises the steps of administering an isolated nucleic acid molecule encoding the light chain or an antigen-binding portion thereof of an anti-MAdCAM antibody and expressing the nucleic acid molecule. In a more preferred method, the gene therapy method comprises the steps of administering of an isolated nucleic acid molecule encoding the heavy chain or an antigen-binding portion thereof and an isolated nucleic acid molecule encoding the light chain or the antigen-binding portion thereof of an anti-MAdCAM antibody of the invention and expressing the nucleic acid molecules. The gene therapy method may also comprise the step of administering another anti-inflammatory or immunomodulatory agent.

#### Diagnostic Methods of Use

The anti-MAdCAM antibodies may be used to detect MAdCAM in a biological sample *in vitro* or *in vivo*. The anti-MAdCAM antibodies may be used in a conventional immunoassay, including, without limitation, an ELISA, an RIA, FACS, tissue immunohistochemistry, Western blot or immunoprecipitation. The anti-MAdCAM antibodies of the invention may be used to detect MAdCAM from humans. In another embodiment, the anti-MAdCAM antibodies may be used to detect MAdCAM from Old World primates such as cynomolgus and rhesus monkeys, chimpanzees and apes. The invention provides a method for detecting MAdCAM in a biological sample comprising contacting a biological sample

with an anti-MAdCAM antibody of the invention and detecting the antibody bound to MAdCAM. In one embodiment, the anti-MAdCAM antibody is directly derivatized with a detectable label. In another embodiment, the anti-MAdCAM antibody (the first antibody) is unlabeled and a second antibody or other molecule that can bind the anti-MAdCAM antibody is labeled. As is well known to one of skill in the art, a second antibody is chosen that is able to specifically bind the specific species and class of the first antibody. For example, if the anti-MAdCAM antibody is a human IgG, then the secondary antibody may be an anti-human-IgG. Other molecules that can bind to antibodies include, without limitation, Protein A and Protein G, both of which are available commercially, e.g., from Pierce Chemical Co.

Suitable labels for the antibody or secondary have been disclosed supra, and include various enzymes, prosthetic groups, fluorescent materials, luminescent materials, magnetic agents and radioactive materials. Examples of suitable enzymes include horseradish peroxidase, alkaline phosphatase,  $\beta$ -galactosidase, or acetylcholinesterase; examples of suitable prosthetic group complexes include streptavidin/biotin and avidin/biotin; examples of suitable fluorescent materials include umbelliferone, fluorescein, fluorescein isothiocyanate, rhodamine, dichlorotriazinylamine fluorescein, dansyl chloride or phycoerythrin; an example of a luminescent material includes luminol; an example of a magnetic agent includes gadolinium; and examples of suitable radioactive material include  $^{125}\text{I}$ ,  $^{131}\text{I}$ ,  $^{35}\text{S}$  or  $^3\text{H}$ .

In an alternative embodiment, MAdCAM can be assayed in a biological sample by a competition immunoassay utilizing MAdCAM standards labeled with a detectable substance and an unlabeled anti-MAdCAM antibody. In this assay, the biological sample, the labeled MAdCAM standards and the anti-MAdCAM antibody are combined and the amount of labeled MAdCAM standard bound to the unlabeled antibody is determined. The amount of MAdCAM in the biological sample is inversely proportional to the amount of labeled MAdCAM standard bound to the anti-MAdCAM antibody.

One may use the immunoassays disclosed above for a number of purposes. In one embodiment, the anti-MAdCAM antibodies may be used to detect MAdCAM in cells in cell culture. In a preferred embodiment, the anti-MAdCAM antibodies may be used to determine the level of cell surface MAdCAM expression after treatment of the cells with various compounds. This method can be used to test compounds that may be used to activate or inhibit MAdCAM. In this method, one sample of cells is treated with a test compound for a period of time while another sample is left untreated, cell surface expression could then be determined by flow cytometry, immunohistochemistry, Western blot, ELISA or RIA. In addition, the immunoassays may be scaled up for high throughput screening in order to test a large number of compounds for either activation or inhibition of MAdCAM.

The anti-MAdCAM antibodies of the invention may also be used to determine the levels of MAdCAM on a tissue or in cells derived from the tissue. In a preferred embodiment, the tissue is a diseased tissue. In a more preferred embodiment, the tissue is inflamed gastrointestinal tract or a biopsy thereof. In a preferred embodiment of the method, a tissue or a biopsy thereof is excised from a patient. The tissue or biopsy is then used in an immunoassay to determine, e.g., MAdCAM levels, cell surface levels of MAdCAM, or localization of MAdCAM by the methods discussed above. The method can be used to determine if an inflamed tissue expresses MAdCAM at a high level.

The above-described diagnostic method can be used to determine whether a tissue expresses high levels of MAd-



CAM, which may be indicative that the tissue will respond well to treatment with anti-MAdCAM antibody. Further, the diagnostic method may also be used to determine whether treatment with anti-MAdCAM antibody (see below) is causing a tissue to express lower levels of MAdCAM and thus can be used to determine whether the treatment is successful.

The antibodies of the present invention may also be used in vivo to localize tissues and organs that express MAdCAM. In a preferred embodiment, the anti-MAdCAM antibodies can be used to localize inflamed tissue. The advantage of the anti-MAdCAM antibodies of the present invention is that they will not generate an immune response upon administration. The method comprises the steps of administering an anti-MAdCAM antibody or a pharmaceutical composition thereof to a patient in need of such a diagnostic test and subjecting the patient to imaging analysis determine the location of the MAdCAM-expressing tissues. Imaging analysis is well known in the medical art, and includes, without limitation, x-ray analysis, gamma scintigraphy, magnetic resonance imaging (MRI), positron emission tomography or computed tomography (CT). In another embodiment of the method, a biopsy is obtained from the patient to determine whether the tissue of interest expresses MAdCAM rather than subjecting the patient to imaging analysis. In a preferred embodiment, the anti-MAdCAM antibodies may be labeled with a detectable agent that can be imaged in a patient. For example, the antibody may be labeled with a contrast agent, such as barium, which can be used for x-ray analysis, or a magnetic contrast agent, such as a gadolinium chelate, which can be used for MRI or CT. Other labeling agents include, without limitation, radioisotopes, such as  $^{99}\text{Tc}$ . In another embodiment, the anti-MAdCAM antibody will be unlabeled and will be imaged by administering a second antibody or other molecule that is detectable and that can bind the anti-MAdCAM antibody.

The anti-MAdCAM antibodies of the invention may also be used to determine the levels of soluble MAdCAM present in donor blood, serum, plasma, or other biofluid, including, but not limited to, stool, urine, sputum or biopsy sample. In a preferred embodiment, the biofluid is plasma. The biofluid is then used in an immunoassay to determine levels of soluble MAdCAM. Soluble MAdCAM could be a surrogate marker for ongoing gastrointestinal inflammation and the method of detection could be used as a diagnostic marker to measure disease severity.

The above-described diagnostic method can be used to determine whether an individual expresses high levels of soluble MAdCAM, which may be indicative that the individual will respond well to treatment with an anti-MAdCAM antibody. Further, the diagnostic method may also be used to determine whether treatment with anti-MAdCAM antibody (see below) or other pharmaceutical agent of the disease is causing an individual to express lower levels of MAdCAM and thus can be used to determine whether the treatment is successful.

Inhibition of  $\alpha_4\beta_7$ /MAdCAM-dependent Adhesion by Anti-MAdCAM Antibody:

In another embodiment, the invention provides an anti-MAdCAM antibody that binds MAdCAM and inhibits the binding and adhesion of  $\alpha_4\beta_7$ -integrin bearing cells to MAdCAM or other cognate ligands, such as L-selectin, to MAdCAM. In a preferred embodiment, the MAdCAM is human and is either a soluble form, or expressed on the surface of a cell. In another preferred embodiment, the anti-MAdCAM antibody is a human antibody. In another embodiment, the antibody or portion thereof inhibits binding between  $\alpha_4\beta_7$  and MAdCAM with an  $\text{IC}_{50}$  value of no more than 50 nM. In

a preferred embodiment, the  $\text{IC}_{50}$  value is no more than 5 nM. In a more preferred embodiment, the  $\text{IC}_{50}$  value is less than 5 nM. In a more preferred embodiment, the  $\text{IC}_{50}$  value is less than 0.05  $\mu\text{g}/\text{mL}$ , 0.04  $\mu\text{g}/\text{mL}$  or 0.03  $\mu\text{g}/\text{mL}$ . In another preferred embodiment the  $\text{IC}_{50}$  value is less than 0.5  $\mu\text{g}/\text{mL}$ , 0.4  $\mu\text{g}/\text{mL}$  or 0.3  $\mu\text{g}/\text{mL}$ . The  $\text{IC}_{50}$  value can be measured by any method known in the art. Typically, an  $\text{IC}_{50}$  value can be measured by ELISA or adhesion assay. In a preferred embodiment, the  $\text{IC}_{50}$  value is measured by adhesion assay using either cells or tissue which natively express MAdCAM or cells or tissue which have been engineered to express MAdCAM.

Inhibition of Lymphocyte Recruitment to Gut-associated Lymphoid Tissue by Anti-MAdCAM Antibodies

In another embodiment, the invention provides an anti-MAdCAM antibody that binds natively expressed MAdCAM and inhibits the binding of lymphocytes to specialised gastrointestinal lymphoid tissue. In a preferred embodiment, the natively-expressed MAdCAM is human or primate MAdCAM and is either a soluble form, or expressed on the surface of a cell. In another preferred embodiment, the anti-MAdCAM antibody is a human antibody. In another embodiment, the antibody or portion thereof inhibits the recruitment of gut-trophic  $\alpha_4\beta_7^+$  lymphocytes to tissues expressing MAdCAM with an  $\text{IC}_{50}$  value of no more than 5 mg/kg. In a preferred embodiment, the  $\text{IC}_{50}$  value is no more than 1 mg/kg. In a more preferred embodiment, the  $\text{IC}_{50}$  value is less than 0.1 mg/kg. In one embodiment, the  $\text{IC}_{50}$  value can be determined by measuring the dose effect relationship of recruitment of technetium-labeled peripheral blood lymphocytes to the gastrointestinal tract using gamma scintigraphy or single photon emission computed tomography. In another embodiment, the  $\text{IC}_{50}$  value can be determined by measuring the increase in gut-trophic  $\alpha_4\beta_7^+$  lymphocytes, such as, but not limited to,  $\text{CD4}^+$   $\alpha_4\beta_7^+$  memory T-cells, in the peripheral circulation using flow cytometry as a function of the dose of anti-MAdCAM antibody.

In order that this invention may be better understood, the following examples are set forth. These examples are for purposes of illustration only and are not to be construed as limiting the scope of the invention in any manner.

#### Example 1

##### Generation of Anti-MAdCAM Producing Hybridomas

Antibodies of the invention were prepared, assayed and selected in accordance with the present Example  
Primary Immunogen Preparation:

Two immunogens were prepared for immunisation of the XenoMouse<sup>TM</sup> mice: (i) a MAdCAM-IgG<sub>1</sub> Fc fusion protein and (ii) cell membranes prepared from cells stably transfected with MAdCAM.

(i) MAdCAM-IgG<sub>1</sub> Fc Fusion Protein

Expression Vector Construction:

An EcoRI/BglIII cDNA fragment encoding the mature extracellular, immunoglobulin-like domain of MAdCAM was excised from a pINCY Incyte clone (3279276) and cloned into EcoRI/BamHI sites of the pIG1 vector (Simmons, D. L. (1993) in Cellular Interactions in Development: A Practical Approach, ed. Hartley, D. A. (Oxford Univ. Press, Oxford), pp. 93-127.) to generate an in frame IgG<sub>1</sub> Fc fusion. The resulting insert was excised with EcoRI/NotI and cloned into pCDNA3.1+ (Invitrogen). The MAdCAM-IgG<sub>1</sub> Fc



cDNA in the vector was sequence confirmed. The amino acid sequence of the MAdCAM-IgG<sub>1</sub> Fc fusion protein is shown below:

MAdCAM-IgG<sub>1</sub> Fc Fusion Protein:

(SEQ ID NO: 107)

MCFGLALLLAGLLGLLLQSLQVKPLQVEPPEPVVAVALGASRQLTCRLA  
**CADRGASVQWRGLDTSLGAVQSDTGRSVLTVRNASLSAAGTRVCVGC**  
**RTFQHTVQLLVYAFPDQLTVSPAALVPGDPEVACTAHKVTVPDPNALSFS**  
**LLVGGQLEGAQALGPEVQEEEEEPQGDVDFRVTFRWRPLPLGTPVPP**  
**ALYCQATMRLPGLLELSHRQAI PVLHSPTSPEPPDPTTSPESPDTTSPESP**  
**TTSQEPDPTTSPQEPDPTTSPQEPDPTTSPPEPDKTSPEPAPQOCSTHTPRS**  
**PGSTRTRRPEIQPKSCDKTHTCPPCPAPELLGGPSVFLFPPKPKD**  
**TLMIS**  
**RTPEVTCVVVDVSHEDPEVKFNWYVDGVEVHNAKTKPREEQYNSTYRVVS**  
**VLTVLHQDWLNGKEYKCKVSNKALPAPIEKTI SKAKGQPREPQVYTLPPS**  
**RDELTKNQVSLTCLVKGFYPSDIAVEWESNGQPENNYKATPPVLDSDGSF**  
**FLYSKLTVDKSRWQQGNVRS**  
**CSVMHEALHNHYTQKSLSLSPGK**

Underlined: signal peptide

Bold: MAdCAM extracellular domain

Recombinant Protein Expression/Purification:

CHO-DHFR cells were transfected with pCDNA3.1+vector containing MAdCAM-IgG<sub>1</sub> Fc fusion protein cDNA and stable clones expressing MAdCAM-IgG<sub>1</sub> Fc fusion protein selected in Iscove's media containing 600 µg/mL G418 and 100 ng/mL methotrexate. For protein expression, a hollow fibre bioreactor was seeded with stably expressing MAdCAM-IgG<sub>1</sub> Fc CHO cells in Iscove's media containing 10% low IgG fetal bovine serum (Gibco), non essential amino acids (Gibco), 2 mM glutamine (Gibco), sodium pyruvate (Gibco), 100 µg/ml G418 and 100 ng/mL methotrexate, and used to generate concentrated media supernatant. The MAdCAM-IgG<sub>1</sub> Fc fusion protein was purified from the harvested supernatant by affinity chromatography. Briefly, supernatant was applied to a HiTrap Protein G Sepharose (5 mL, Pharmacia) column (2 mL/min), washed with 25 mM Tris pH 8, 150 mM NaCl (5 column volumes) and eluted with 100 mM glycine pH 2.5 (1 mL/min), immediately neutralising fractions to pH 7.5 with 1M Tris pH 8. Fractions containing MAdCAM-IgG<sub>1</sub> Fc fusion protein were identified by SDS-PAGE, pooled together and applied to a Sephacryl S100 column (Pharmacia), pre-equilibrated with 35 mM BisTris pH 6.5, 150 mM NaCl. The gel filtration was performed at 0.35 mL/min, collecting a peak of MAdCAM-IgG<sub>1</sub> Fc fusion protein in ca. 3×5 mL fractions. These samples were pooled and applied to a Resource Q (6 mL, Pharmacia) column, pre-equilibrated in 35 mM BisTris pH 6.5. The column was washed with 5 column volumes of 35 mM Bis Tris pH 6.5, 150 mM NaCl (6 mL/min) and MAdCAM-IgG<sub>1</sub> Fc fusion protein eluted into a 4-6 mL fraction with 35 mM Bis Tris pH 6.5, 400 mM NaCl. At this stage the protein was 90% pure and migrating as a single band at approximately 68 kD by SDS-PAGE. For use as an immunogen and all subsequent assays, the material was buffer exchanged into 25 mM HEPES pH 7.5, 1 mM EDTA, 1 mM DTT, 100 mM NaCl, 50% glycerol and stored as aliquots at -80° C.

(ii) Cell Membranes Stably Expressing MAdCAM

A SacI/NotI fragment comprising nucleotides 645-1222 of the published MAdCAM sequence (Shyjan A M, et al., J Immunol, 156, 2851-7 (1996)) was PCR amplified from a colon cDNA library and cloned into SacI/NotI sites of pIND-

Hygro vector (Invitrogen). A SacI fragment, comprising the additional 5' coding sequence was sub-cloned into this construct from pCDNA3.1 MAdCAM-IgG<sub>1</sub> Fc, to generate the full length MAdCAM cDNA. A KpnI/NotI fragment containing the MAdCAM cDNA was then cloned into corresponding sites in a pEF5FRTV5GWCAT vector (Invitrogen) and replacing the CAT coding sequence. The cDNA insert was sequence verified and used in transfections to generate single stably expressing clones in FlpIn NIH 3T3 cells (Invitrogen) by Flp recombinase technology, according to the manufacturer's instructions. Stably expressing clones were selected by their ability to support the binding of a  $\alpha_4\beta_7$ + JY human B lymphoblastoid cell line (Chan B M, et al, J. Biol. Chem., 267:8366-70 (1992)), outlined below. Stable clones of CHO cells expressing MAdCAM were prepared in the same way, using FlpIn CHO cells (Invitrogen).

MAdCAM-expressing FlpIn NIH-3T3 cells were grown in Dulbecco's modified Eagles Medium (Gibco), containing 2 mM L-glutamine, 10% Donor calf serum (Gibco) and 200 µg/mL Hygromycin B (Invitrogen) and expanded in roller bottles. MAdCAM-expressing FlpIn CHO cells were grown in Ham's F12/Dulbecco's modified Eagles Medium (Gibco), containing 2 mM L-glutamine, 10% Donor calf serum (Gibco) and 350 µg/mL Hygromycin B (Invitrogen) and expanded in roller bottles. Cells were harvested by use of a non-enzymatic cell dissociation solution (Sigma) and scraping, washing in phosphate buffered saline by centrifugation. Cell membranes were prepared from the cell pellet by two rounds of polytron homogenization in 25 mM Bis Tris pH 8, 10 mM MgCl<sub>2</sub>, 0.015% (w/v) aprotinin, 100 U/ml bacitracin and centrifugation. The final pellet was resuspended in the same buffer, and 50×10<sup>6</sup> cell equivalents aliquoted into thick-walled eppendorfs and spun at >100,000 g to generate cell membrane pellets for Xenomouse mice immunisations. Supernatant was decanted and membranes were stored in eppendorfs at -80° C. until required. Confirmation of protein expression in the cell membranes was determined by SDS-PAGE and Western blotting with a rabbit anti-peptide antibody raised against the N-terminal residues of MAdCAM ([C]-KPLQVEPPEP) (SEQ ID NO: 134).

Immunization and Hybridoma Generation:

Eight to ten week old XENOMOUSE™ mice were immunized intraperitoneally or in their hind footpads with either the purified recombinant MAdCAM-IgG<sub>1</sub> Fc fusion protein (10 µg/dose/mouse), or cell membranes prepared from either stably expressing MAdCAM-CHO or NIH 3T3 cells (10×10<sup>6</sup> cells/dose/mouse). This dose was repeated five to seven times over a three to eight week period. Four days before fusion, the mice received a final injection of the extracellular domain of human MAdCAM in PBS. Spleen and lymph node lymphocytes from immunized mice were fused with the non-secretory myeloma P3-X63-Ag8.653 cell line and were subjected to HAT selection as previously described (Galfré and Milstein, Methods Enzymol. 73:3-46 (1981)). A panel of hybridomas all secreting MAdCAM specific human IgG<sub>2</sub>κ and IgG<sub>4</sub>κ antibodies were recovered and sub-cloned. Twelve hybridoma sub-clones, 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4 and 9.8.2, producing monoclonal antibodies specific for MAdCAM were recovered and detected with assays described below. The parental lines 1.7, 1.8, 6.14, 6.22, 6.34, 6.67, 6.73, 6.77, 7.16, 7.20, 7.26 and 9.8, from which the sub-clone hybridoma lines, 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4 and 9.8.2, were derived all had anti-MAdCAM activity.



## ELISA Assays:

Detection of antigen-specific antibodies in mouse serum and hybridoma supernatant was determined by ELISA as described (Coligan et al., Unit 2.1 "Enzyme-linked immunosorbent assays," in Current Protocols in Immunology (1994)) using MAdCAM-IgG<sub>1</sub> Fc fusion protein to capture the antibodies. For animals that were immunised with MAdCAM-IgG<sub>1</sub> Fc fusion protein, antibodies were screened for non-specific reactivity against human IgG<sub>1</sub> and for the ability to bind to FlpIn CHO MAdCAM cells by flow cytometry.

In a preferred ELISA assay, the following techniques are used:

ELISA plates were coated overnight at 4° C. with 100 µL/well of MAdCAM-IgG<sub>1</sub> Fc fusion (4.5 µg/mL) in plate containing buffer (100 mM sodium carbonate/bicarbonate buffer pH 9.6). After incubation, coating buffer was removed and the plate blocked with 200 µL/well blocking buffer (5% BSA, 0.1% Tween 20, in phosphate buffered saline) and incubated at room temperature for 1 hour. Blocking buffer was removed and 50 µL/well of hybridoma supernatant or other serum or supernatant (e.g., positive control) added for 2 hours at room temperature. After incubation the plate was washed with PBS (3×100 µL/well) and the binding of the hybridoma mAb detected with HRP-conjugated secondary antibodies (i.e. 1:1000 mouse anti-human IgG<sub>2</sub>-HRP (SB Cat No. 9060-05) for IgG<sub>2</sub> antibodies or 1:1000 mouse anti-human IgG<sub>4</sub>-HRP (Zymed Cat. No. 3840) for IgG<sub>4</sub> antibodies) diluted in PBS. The plates were incubated at room temperature for 1 hour, washed in PBS (3×100 µL/well) and finally developed with 100 µL OPD (o-phenylenediamine (DAKO S2405) + 5 µL 30% H<sub>2</sub>O<sub>2</sub>/12 mL). The plates were allowed to develop 10-20 mins, stopping the reaction with 100 µL 2M H<sub>2</sub>SO<sub>4</sub>. The plates were read at 490 nm.

## Adhesion Assays:

Antibodies that demonstrated binding to MAdCAM-IgG<sub>1</sub> Fc fusion protein by ELISA, were assessed for antagonist activity in an adhesion assays with  $\alpha_4\beta_7^+$  JY cells and either (i) MAdCAM-IgG<sub>1</sub> Fc fusion protein or (ii) MAdCAM-CHO cells.

(i) MAdCAM-IgG<sub>1</sub> Fc Fusion Assay

100 µL of a 4.5 µg/mL solution of purified MAdCAM-IgG<sub>1</sub> Fc fusion protein in Dulbecco's PBS was adsorbed to 96 well Black Microfluor "B" u-bottom (Dynex #7805) plates overnight at 4° C. The MAdCAM coated plates were then inverted and excess liquid blotted off, prior to blocking at 37° C. for at least 1 hour in 10% BSA/PBS. During this time cultured JY cells were counted using trypan blue exclusion (should be approximately 8×10<sup>5</sup> cells/mL) and 20×10<sup>6</sup> cells/assay plate pipetted into a 50 mL centrifuge tube. JY cells were cultured in RPMI1640 media (Gibco), containing 2 mM L-glutamine and 10% heat-inactivated fetal bovine serum (Life Technologies #10108-165) and seeded at 1-2×10<sup>5</sup>/mL every 2-3 days to prevent the culture from differentiating. The cells were washed twice with RPMI 1640 media (Gibco) containing 2 mM L-glutamine (Gibco) by centrifugation (240 g), resuspending the final cell pellet at 2×10<sup>6</sup> cells/mL in RPMI 1640 for Calcein AM loading. Calcein AM (Molecular Probes #C-3099) was added to the cells as a 1:200 dilution in DMSO (ca. final concentration 5 µM) and the cells protected from light during the course of the incubation (37° C. for 30 min). During this cell incubation step the antibodies to be tested, were diluted as follows: for single dose testing, the antibodies were made up to 3 µg/mL (1 µg/mL final) in 0.1 mg/mL BSA (Sigma#A3059) in PBS; for full IC<sub>50</sub> curves, the antibodies were diluted in 0.1 mg/mL BSA/PBS, with 3 µg/mL (1 µg/mL final) being the top concentration, then doubling dilutions

(1:2 ratio) across the plate. The final well of the row was used for determining total binding, so 0.1 mg/ml BSA in PBS was used.

After blocking, the plate contents were flicked out and 50 µL of antibodies/controls were added to each well and the plate incubated at 37° C. for 20 min. During this time, Calcein-loaded JY cells were washed once with RPMI 1640 media containing 10% fetal bovine serum and once with 1 mg/mL BSA/PBS by centrifugation, resuspending the final cell pellet to 1×10<sup>6</sup>/mL in 1 mg/mL BSA/PBS. 100 µL of cells were added to each well of the U bottomed plate, the plate sealed, briefly centrifuged (1000 rpm for 2 min) and the plate then incubated at 37° C. for 45 min. At the end of this time, the plates were washed with a Skatron plate washer and fluorescence measured using a Wallac Victor<sup>2</sup> 1420 Multilabel Reader (excitation λ 485 nm, emission λ 535 nm count from top, 8 mm from bottom of plate, for 0.1 sec with normal emission aperture). For each antibody concentration, percent adhesion was expressed as a percentage of maximal fluorescence response in the absence of any antibody minus fluorescence associated with non-specific binding. The IC<sub>50</sub> value is defined as the anti-MAdCAM antibody concentration at which the adhesion response is decreased to 50% of the response in the absence of anti-MAdCAM antibody. Antibodies that were able to inhibit the binding of JY cells to MAdCAM-IgG<sub>1</sub> Fc fusion with an IC<sub>50</sub> value <0.1 µg/mL, were considered to have potent antagonist activity and were progressed to the MAdCAM-CHO adhesion assay. All twelve of the tested Abs showed potent antagonist activity (Table 3). Monoclonal antibodies 1.7.2, 1.8.2, 7.16.6, 7.20.5 and 7.26.4 were derived from IgG<sub>2</sub>κ lineages, and monoclonal antibodies 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1 and 9.8.2 were derived from IgG<sub>4</sub>κ lineages.

## (ii) MAdCAM-CHO Cell Adhesion Assay.

JY cells were cultured as above. MAdCAM-expressing CHO cells were generated with the pEF5FRT MAdCAM cDNA construct and using the Flp recombinase technology (Invitrogen) as described above. Single stable clones of MAdCAM-expressing CHO cells were selected based on their ability to support the adhesion of JY cells and the binding, by flow cytometry, of the rabbit anti-peptide antibody, raised against the N-terminus of MAdCAM and described above. MAdCAM-expressing CHO cells were cultured in a DMEM/F12 media (Gibco # 21331-020) containing 2 mM L-glutamine, 10% fetal bovine serum (Gibco) and 350 µg/mL Hygromycin B (Invitrogen), splitting 1:5 every 2/3 days. For the adhesion assay, MAdCAM-expressing CHO cells were seeded at 4×10<sup>4</sup> cells/well in 96 well black plates-clear bottom (Costar # 3904) in 200 µL culture medium and cultured overnight at 37° C./5% CO<sub>2</sub>.

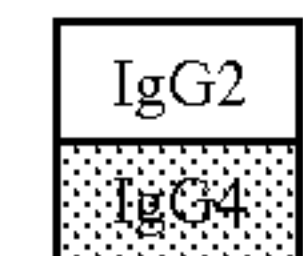
The following day, hybridoma supernatant or purified monoclonal antibody was diluted from a starting concentration of 30 µg/mL (equivalent to a final concentration of 10 µg/mL) in 1 mg/mL BSA/PBS, as described above. For the MAdCAM CHO plates, the plate contents were flicked out and 50 µL of antibodies/controls were added to each well and the plate incubated at 37° C. for 20 min. The final well of the row was used for determining total binding, so 0.1 mg/mL BSA in PBS was used. Calcein AM-loaded JY cells, to a final concentration of 1×10<sup>6</sup>/mL in 1 mg/mL BSA/PBS, were prepared as above, then 100 µL added to the plate after the 20 min incubation period with the antibody. The plate was then incubated at 37° C. for 45 min, then washed on a Tecan plate washer (PW 384) and fluorescence measured using the Wallac plate reader as described above. For each antibody concentration, percent adhesion was expressed as a percentage of maximal fluorescence response in the absence of any anti-



body minus fluorescence associated with non-specific binding. Antibodies that were able to inhibit the binding of JY cells to MAdCAM CHO cells with an  $IC_{50}$  value  $<1 \mu\text{g/mL}$  were considered to have potent antagonist activity. As before, the  $IC_{50}$  value is defined as the anti-MAdCAM antibody concentration at which the adhesion response had decreased to 50% of the response in the absence of anti-MAdCAM antibody. The  $IC_{50}$  potencies for 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4 and 9.8.2 in this assay are described below in Table 3.

TABLE 3

| IC <sub>50</sub> values of exemplified anti-MAdCAM antibodies |   |   |                                       |    |
|---|---|---|---------------------------------------|----|
| Clone   | MAdCAM IgG <sub>1</sub><br>Fc fusion Mean |   | MAdCAM FlpIn<br>CHO Assay Mean        |    |
|   | IC <sub>50</sub> ( $\mu\text{g/mL}$ )     | n | IC <sub>50</sub> ( $\mu\text{g/mL}$ ) | n  |
| 1.7.2   | 0.030 $\pm$ 0.011                         | 6 | 0.502 $\pm$ 0.280                     | 9  |
| 1.8.2   | 0.027 $\pm$ 0.011                         | 4 | 0.424 $\pm$ 0.107                     | 8  |
| 7.16.6  | 0.019 $\pm$ 0.009                         | 7 | 0.389 $\pm$ 0.093                     | 16 |
| 7.20.5  | 0.025 $\pm$ 0.027                         | 7 | 0.387 $\pm$ 0.202                     | 9  |
| 7.26.4  | 0.021 $\pm$ 0.040                         | 4 | 0.574 $\pm$ 0.099                     | 15 |
| 6.14.2  | 0.011 $\pm$ 0.005                         | 4 | 0.291 $\pm$ 0.096                     | 6  |
| 6.22.2  | 0.018 $\pm$ 0.011                         | 4 | 0.573 $\pm$ 0.168                     | 7  |
| 6.34.2  | 0.013 $\pm$ 0.008                         | 4 | 0.285 $\pm$ 0.073                     | 7  |
| 6.67.1  | 0.013 $\pm$ 0.070                         | 4 | 0.298 $\pm$ 0.115                     | 8  |
| 6.73.2  | 0.020 $\pm$ 0.010                         | 4 | 0.369 $\pm$ 0.103                     | 8  |
| 6.77.1  | 0.022 $\pm$ 0.004                         | 4 | 0.520 $\pm$ 0.100                     | 4  |
| 9.8.2   | 0.020 $\pm$ 0.050                         | 4 | 0.440 $\pm$ 0.342                     | 8  |



To measure the antagonist potency of anti-MAdCAM mAbs in flow-based assays, under sheer stress conditions that are designed to mimic the microvascular environment on the high endothelial venules which serve the gut associated lymphoid tissue, CHO cells expressing MAdCAM were plated in glass microslides (50x4 mm) and allowed to adhere to form a confluent monolayer (ca.  $2.5 \times 10^5$  cells). The cells were then incubated with affinity-purified mAb over a range of concentrations (0.1-10  $\mu\text{g/mL}$ ) for 20 mins at 37° C., before being connected to the flow assay system. An isotype matched IgG<sub>2</sub> or IgG<sub>4</sub> mAb (10  $\mu\text{g/mL}$ ) was used as a negative control. Normal donor peripheral blood lymphocytes (PBLs) were perfused over the cell monolayer at a constant shear stress of 0.05 Pa. Experiments were videoed and total adhesion of lymphocytes (rolling+firm adhesion) was calculated. All of the tested monoclonal antibodies were shown to be potent antagonists under the conditions described.

#### (iii) Stamper-Woodruff Assays

To visualise MAdCAM<sup>+</sup> vessels, biotinylated anti-MAdCAM mAb was generated on 1-2 mg of affinity-purified protein, using a 20 molar excess of biotin-NHS (Pierce) in phosphate buffer saline, according to manufacturer's instructions. The reaction was allowed to sit at room temperature (30 min), and desalted with a PD-10 (Pharmacia) column and the protein concentration determined.

Normal liver lymph node was removed from a donor organ, snap-frozen in liquid nitrogen and stored at -70° C. until use. 10  $\mu\text{m}$  cryostat sections were cut, air-dried on poly-L lysine coated slides, and fixed in acetone prior to the assay. Sections were blocked using an avidin-biotin blocking system (DAKO), and then incubated with biotinylated anti-MAdCAM mAb over a range of concentrations (1-50  $\mu\text{g/mL}$ ) at room temperature (2 hrs). An isotype matched IgG<sub>2</sub> or IgG<sub>4</sub>

mAb (50  $\mu\text{g/mL}$ ) was used as a negative control and a blocking anti- $\beta_7$  antibody (50  $\mu\text{g/mL}$ ) as a positive control.

Peripheral blood lymphocytes, taken from normal donors, were labeled with a mouse anti-human CD2 mAb (DAKO) to allow subsequent visualisation of adherent cells.  $5 \times 10^5$  PBLs were added to each lymph node section and incubated for 30 mins before being gently rinsed off to avoid detachment of adherent cells. Sections were then re-fixed in acetone, and re-incubated with biotinylated anti-MAdCAM mAb (10  $\mu\text{g/mL}$ ), followed by biotinylated goat-anti-mouse mAb (to recognise CD2 labeled PBLs and unstained MAdCAM<sup>+</sup> vessels) and then streptABcomplex/HRP (DAKO). Finally MAdCAM<sup>+</sup> vessels & CD2 labeled PBLs were visualised by addition of DAB substrate (DAKO) to the sections, with a brown reaction product showing areas of positive staining. Lymphocyte adhesion was quantified by counting the number of lymphocytes adhering to 50 MAdCAM-1<sup>+</sup> vessels of portal tracts, veins or sinusoids. Data, expressed as mean values, were then normalised to percent adhesion, using the adhesion of PBLs in the absence of any antibody taken as 100%. The data were compiled on the basis of n=3 different PBL donors and for different liver lymph node donors. Representative data for biotinylated purified monoclonal antibodies 1.7.2 and 7.16.6 are depicted in FIG. 4 compared to a blocking anti- $\beta_7$  antibody control.

#### Selectivity Assays:

VCAM and fibronectin are close structural and sequence homologues to MAdCAM. Affinity-purified anti-MAdCAM mAbs were assessed for MAdCAM-specificity by determining their ability to block the binding of  $\alpha_4\beta_1^+/\alpha_5\beta_1^+$  Jurkat T-cells (ATCC) to their cognate cell adhesion molecule. 100  $\mu\text{L}$  of a 4.5  $\mu\text{g/mL}$  solution of Fibronectin cell binding fragment (110 Kd, Europa Bioproducts Ltd, Cat. No. UBF4215-18) or VCAM (Panvera) in Dulbecco's PBS was adsorbed to 96 well Black Microflour "B" u-bottom (Dynex #7805) plates overnight at 4° C. The coated plates were then inverted and excess liquid blotted off, prior to blocking at 37° C. for at least 1 hour in 10% BSA/PBS. During this time cultured Jurkat T cells were counted using tryptan blue exclusion and loaded with Calcein AM dye as previously described for JY cells above. The antibodies to be tested, were diluted from a top concentration of 10  $\mu\text{g/mL}$  in 0.1 mg/ml BSA in PBS. The final well of the row was used for determining total binding, so 0.1 mg/ml BSA in PBS was used. Echinatin (Bachem, Cat. No. H-9010) prepared in PBS was used at a top concentration of 100 nM to block the  $\alpha_5\beta_1$ /Fibronectin interaction. An anti-CD106 mAb (Clone 51-10C9, BD Pharmingen Cat. No. 555645) at a top concentration of 1  $\mu\text{g/mL}$  was used to block the  $\alpha_4\beta_1$ /VCAM interaction.

After blocking, the plate contents were flicked out and 50  $\mu\text{L}$  of antibodies/controls were added to each well and the plate incubated at 37° C. for 20 min. Calcein-loaded Jurkat T cells were washed once as before, resuspending the final cell pellet to  $1 \times 10^6/\text{mL}$  in 1 mg/mL BSA/PBS. 100  $\mu\text{L}$  of cells were added to each well of the U bottomed plate, the plate sealed, briefly centrifuged (1000 rpm for 2 min) and the plate then incubated at 37° C. for 45 min. At the end of this time, the plates were washed with a Skatron plate washer and fluorescence measured using a Wallac Victor<sup>2</sup> 1420 Multilabel Reader (excitation  $\lambda$ 485 nm, emission  $\lambda$ 535 nm count from top, 8 mm from bottom of plate, for 0.1 sec with normal emission aperture). For each antibody, the degree of inhibition is expressed below pictorially, in Table 4 (-negligible inhibition of adhesion, \*\*\* complete inhibition of adhesion). All mAbs exemplified are potent and selective anti-MAd-



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CAM antagonists, demonstrating substantially greater than 100 fold selectivity for MAdCAM over VCAM and fibronectin.

TABLE 4

| Comparative selectivity of anti-MAdCAM antibody for MAdCAM over other cell adhesion molecules, Fibronectin and VCAM |  |   |  |
|---|--|---|--|
| Clone   | Inhibition in $\alpha 5\beta 1$ /Fibronectin assay (10 $\mu\text{g}/\text{mL}$ ) | Inhibition in $\alpha 4\beta 1$ /VCAM assay (10 $\mu\text{g}/\text{mL}$ ) | Inhibition in $\alpha 4\beta 7$ /MAdCAM assay (0.1 $\mu\text{g}/\text{mL}$ ) |
| 1.7.2   | -  | -   | ***  |
| 1.8.2   | -  | -   | ***  |
| 7.16.6  | -  | -   | ***  |
| 7.20.5  | -  | -   | ***  |
| 7.26.4  | -  | -   | ***  |
| 6.14.2  | -  | -   | ***  |
| 6.22.2  | -  | -   | ***  |
| 6.34.2  | -  | -   | ***  |
| 6.67.1  | -  | -   | ***  |
| 6.73.2  | -  | -   | ***  |
| 6.77.1  | -  | -   | ***  |
| 9.8.2   | -  | -   | ***  |

IgG2  
IgG4

Hybridomas were deposited under terms in accordance with the Budapest Treaty in the European Collection of Cell Cultures (ECACC), H.P.A at CAMR, Porton Down, Salisbury, Wiltshire SP4 OJG on 9 Sep. 2003 with the following deposit numbers:

| Hybridoma | Deposit No. |
|-----------|-------------|
| 1.7.2     | 03090901    |
| 1.8.2     | 03090902    |
| 6.14.2    | 03090903    |
| 6.22.2    | 03090904    |
| 6.34.2    | 03090905    |
| 6.67.1    | 03090906    |
| 6.73.2    | 03090907    |
| 6.77.1    | 03090908    |
| 7.16.6    | 03090909    |
| 7.20.5    | 03090910    |
| 7.26.4    | 03090911    |
| 9.8.2     | 03090912    |

## Example II

Determination of Affinity Constants ( $K_D$ ) of Fully Human Anti-MAdCAM Monoclonal Antibodies by BIAcore

We performed affinity measures of purified antibodies by surface plasmon resonance using the BIAcore 3000 instrument, following the manufacturer's protocols.

## Protocol 1

To perform kinetic analyses, a high density mouse anti-human (IgG<sub>2</sub> and IgG<sub>4</sub>) antibody surface over a CM5 BIAcore sensor chip was prepared using routine amine coupling. Hybridoma supernatants were diluted 10, 5, 2-fold in HBS-P (10 mM HEPES pH 7.4, 150 mM NaCl, 0.005% Surfactant P20) running buffer containing 100  $\mu\text{g}/\text{mL}$  BSA and 10 mg/mL carboxymethyl dextran or used neat. Each mAb was captured onto a separate surface using a 1 min contact time and a 5 min wash for stabilization of the mAb baseline. MAdCAM-IgG<sub>1</sub> Fc (141 nM) fusion protein was then

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injected at over all surfaces for one minute, followed by a 3 min dissociation. The data were normalized for the amount of antibody captured on each surface and evaluated with global fit Langmuir 1:1, using baseline drift models available on the BIAevaluation software provided by BIAcore.

## Protocol 2

Affinity-purified mAb were immobilized onto the dextran layer of a CM5 biosensor chip using amine coupling. Chips were prepared using pH 4.5 acetate buffer as the immobilization buffer and protein densities of 2.5-5.5 kRU were achieved. Samples of MAdCAM-IgG<sub>1</sub> Fc fusion protein in running buffer were prepared at concentrations ranging from 0.2-55 nM (a 0 nM solution comprising running buffer alone was included as a zero reference). Samples were randomized and injected in duplicate for 3 min each across 4 flow cells using HBS-EP (10 mM HEPES pH 7.4, 150 mM NaCl, 3 mM EDTA, 0.005% Surfactant P20) as running buffer. A flow rate of 100  $\mu\text{L}/\text{min}$  was used to minimize mass transport limitations. Dissociation of MAdCAM-IgG<sub>1</sub> Fc fusion protein was monitored for 180 mins, the surface regenerated by a 6 sec injection of 25 mM H<sub>3</sub>PO<sub>4</sub> (50  $\mu\text{L}/\text{min}$ ), or 10 mM (6.22.2), 20 mM (6.67.1, 6.73.2, 6.77.1) to 25 mM (6.34.2) and 45 mM NaOH (6.14.2) and the data analysed using the BIAevaluation (v3.1) software package.

Table 5 lists affinity measurements for representative anti-MAdCAM antibodies of the present invention:

TABLE 5

| Determination of affinity constant $K_D$ by surface plasmon resonance (BIAcore) |                   |                      |            |                   |                      |            |
|---|-------------------|----------------------|------------|-------------------|----------------------|------------|
| CLONE   | Protocol 1        |                      |            | Protocol 2        |                      |            |
|   | $k_{on}$ (1/Ms)   | $k_{off}$ (1/s)      | $K_D$ (pM) | $k_{on}$ (1/Ms)   | $k_{off}$ (1/s)      | $K_D$ (pM) |
| 1.7.2   | $2.4 \times 10^5$ | $1 \times 10^{-5}$   | 42         | $5.5 \times 10^3$ | $1.3 \times 10^{-7}$ | 23.6       |
| 1.8.2   | $2.9 \times 10^5$ | $1 \times 10^{-5}$   | 35         | $1.8 \times 10^5$ |                      | 128        |
| 7.16.6  | $1.5 \times 10^6$ | $2.2 \times 10^{-6}$ | 1.5        | $2.9 \times 10^5$ | $1.4 \times 10^{-6}$ | 4.8        |
| 7.20.5  | $4.5 \times 10^5$ | $1.9 \times 10^{-5}$ | 42.2       | $1.6 \times 10^5$ | $1.2 \times 10^{-5}$ | 75         |
| 7.26.4  | $9.6 \times 10^5$ | $2.6 \times 10^{-4}$ | 271        | $1.5 \times 10^5$ | $1.2 \times 10^{-5}$ | 80         |
| 6.14.2  | $1.3 \times 10^5$ | $1 \times 10^{-5}$   | 7.7        | $5 \times 10^5$   | $<5 \times 10^{-6}$  | <10        |
| 6.22.2  | $1.5 \times 10^6$ | $1.4 \times 10^{-5}$ | 9.3        | $2.3 \times 10^5$ | $8.7 \times 10^{-7}$ | 3.8        |
| 6.34.2  | $1.2 \times 10^6$ | $1.9 \times 10^{-5}$ | 15.8       | $3.3 \times 10^5$ | $<5 \times 10^{-6}$  | <15        |
| 6.67.1  | $5.9 \times 10^5$ | $1 \times 10^{-5}$   | 17         | $2.4 \times 10^5$ | $<5 \times 10^{-6}$  | <20        |
| 6.73.2  | $1.4 \times 10^5$ | $1.3 \times 10^{-4}$ | 93         |                   |                      |            |
| 6.77.1  | $1.5 \times 10^5$ | $1 \times 10^{-5}$   | 6.7        |                   |                      |            |
| 9.8.2   | $2.3 \times 10^6$ | $2.3 \times 10^{-4}$ | 100        | $4.4 \times 10^5$ | $1.4 \times 10^{-5}$ | 32.5       |

IgG2  
IgG4

The kinetic analyses indicate that the antibodies prepared in accordance with the invention possess high affinities and strong binding constants for the extracellular domain of MAdCAM.

## Example III

Identification of Epitope Selectivity and Species Cross-reactivity of Anti-MAdCAM mAbs

Antibodies recognize surface-exposed epitopes on antigens as regions of linear (primary) sequence or structural (secondary) sequence. Luminex epitope binning, BIAcore binning and species immunohistochemical analysis were used in concert, in order to define the functional epitope landscape of the anti-MAdCAM antibodies.



Luminex-based Epitope Binning:

MxhlgG 2,3,4-conjugated beads (Calbiochem M11427) were coupled to the primary unknown anti-MAdCAM antibody. We added 150  $\mu\text{L}$  of primary unknown antibody dilution (0.1  $\mu\text{g}/\text{mL}$  diluted in hybridoma medium) to the well of a 96-well tissue culture plate. The bead stock was gently vortexed and diluted in supernatant to a concentration of  $0.5 \times 10^5$  beads/mL. The beads were incubated in the supernatant on a shaker overnight in the dark at  $4^\circ\text{C}$ .

Each well of a 96-well microtiter filter plate (Millipore #MABVN1250) was pre-wetted by adding 200  $\mu\text{L}$  wash buffer (PBS containing 0.05% Tween 20) and removed by aspiration. Next, 50  $\mu\text{L}/\text{well}$  of the  $0.5 \times 10^5$  beads/mL stock was added to the filter plate, and the wells washed with wash buffer ( $2 \times 100$   $\mu\text{L}/\text{well}$ ). 60  $\mu\text{L}/\text{well}$  of MAdCAM-IgG<sub>1</sub> Fc antigen diluted in hybridoma medium (0.1  $\mu\text{g}/\text{mL}$ ) was added. The plates were covered and incubated at room temperature with gentle shaking for one hour. The wells were washed twice by addition of 100  $\mu\text{L}/\text{well}$  wash buffer followed by aspiration. Next, we added 60  $\mu\text{L}/\text{well}$  of secondary unknown anti-MAdCAM antibody diluted in hybridoma medium (0.1  $\mu\text{g}/\text{mL}$ ). The plates were shaken at room temperature in the dark for two hours. Next, the wells were washed twice by addition of 100  $\mu\text{L}/\text{well}$  wash buffer followed by aspiration. Next, 60  $\mu\text{L}/\text{well}$  of biotinylated MxhlgG 2,3,4 (0.5  $\mu\text{g}/\text{mL}$ ) was added. The plates were shaken at room temperature in the dark for one hour. The wells were washed twice by addition of 100  $\mu\text{L}/\text{well}$  wash buffer followed by aspiration. To each well, 60  $\mu\text{L}$  of 1  $\mu\text{g}/\text{mL}$  MxhlgG 2,3,4 Streptavidin-PE (Pharmacia #554061) diluted in hybridoma medium was added. The plates were shaken at room temperature in the dark for twenty minutes. The wells were washed twice by addition of 100  $\mu\text{L}/\text{well}$  wash buffer followed by aspiration. Next, each well was resuspended in 80  $\mu\text{L}$  blocking buffer (PBS with 0.5% bovine serum albumin, 0.1% TWEEN and 0.01% Thimerosal) carefully pipetted up and down to resuspend the beads.

Using Luminex 100 and its accompanying software (Luminex® Corporation) the plates were read to determine luminescence readings. Based on the luminescence data obtained for the various anti-MAdCAM antibodies tested, the anti-MAdCAM antibodies were grouped according to their binding specificities. The anti-MAdCAM antibodies that were tested fall into a series of epitope bins, represented in Table 8.

BIAcore Binning:

In a similar method to that described above, BIAcore can also be used to determine the epitope exclusivity of the anti-MAdCAM antibodies exemplified by this invention. Nine anti-MAdCAM antibody clones, 6.22.2, 6.34.2, 6.67.1, 6.77.1, 7.20.5, 9.8.2, 1.7.2, 7.26.4 and 7.16.6, were immobilized onto the dextran layer of separate flow cells of a CM5 biosensor chip using amine coupling. The immobilization buffer was either 10 mM acetate buffer pH 4.5 (clones 6.22.2, 6.34.2, 7.20.5, 9.8.2, 1.7.2, 7.26.4 and 7.16.6) or 10 mM acetate buffer pH 5.5 (clones 6.67.1 and 6.77.1). A protein density of approximately 3750 RU was achieved in all cases. Deactivation of unreacted N-hydroxysuccinimide esters was performed using 1 M ethanolamine hydrochloride, pH 8.5.

MAdCAM-IgG<sub>1</sub> Fc fusion protein was diluted to a concentration of 1.5  $\mu\text{g}/\text{mL}$  (approximately 25 nM) in HBS-EP running buffer (0.01 M HEPES pH 7.4, 0.15 M NaCl, 3 mM EDTA, 0.005% Polysorbate 20). It was then injected across the first flow cell, in a volume of 50  $\mu\text{L}$  at a rate of 5  $\mu\text{L}/\text{min}$ . After the injection was complete, the first antibody probe was added to the same flow cell. All test antibodies were diluted to a concentration of approximately 20  $\mu\text{g}/\text{mL}$  in HBS-EP, and also injected in a volume of 50  $\mu\text{L}$  at a flow rate of 5  $\mu\text{L}/\text{min}$ .

When no binding of the test antibody was observed, the next test clone was injected immediately afterwards. When binding did occur, the sensor surface was regenerated to remove both the MAdCAM-IgG<sub>1</sub> Fc fusion protein and the test antibody. A variety of regeneration solutions were used depending upon the immobilized antibody and the test antibody present. A summary of the regeneration conditions used is depicted in Table 6.

TABLE 6

| Summary of regeneration conditions used to perform BIAcore epitope mapping |                              |                        |                  |
|--|------------------------------|------------------------|------------------|
| Immobilised antibody   | Antibody probe to be removed | Regeneration solution  | Injection volume |
| 7.16.6   | 6.22.2                       | 40 mM Phosphoric Acid  | 20 $\mu\text{L}$ |
|  | 6.34.2                       | 40 mM Phosphoric Acid  | 40 $\mu\text{L}$ |
|  | 7.20.5                       | 40 mM Phosphoric Acid  | 20 $\mu\text{L}$ |
| 6.77.1   | 9.8.2                        | 40 mM Phosphoric Acid  | 10 $\mu\text{L}$ |
|  | 1.7.2                        | 40 mM Phosphoric Acid  | 5 $\mu\text{L}$  |
|  | 7.16.6                       | 40 mM Phosphoric Acid  | 10 $\mu\text{L}$ |
| 1.7.2  | 6.77.1                       | 25 mM Phosphoric Acid  | 5 $\mu\text{L}$  |
|  | 9.8.2                        | 25 mM Phosphoric Acid  | 5 $\mu\text{L}$  |
|  | 7.20.5                       | 25 mM Phosphoric Acid  | 5 $\mu\text{L}$  |
| 6.22.2   | 6.22.2                       | 25 mM Phosphoric Acid  | 5 $\mu\text{L}$  |
|  | 6.34.2                       | 25 mM Sodium Hydroxide | 5 $\mu\text{L}$  |
|  | 6.67.1                       | 25 mM Sodium Hydroxide | 5 $\mu\text{L}$  |
| 6.22.2   | 9.8.2                        | 25 mM Sodium Hydroxide | 20 $\mu\text{L}$ |
|  | 7.26.4                       | 25 mM Sodium Hydroxide | 5 $\mu\text{L}$  |
|  | 6.34.2                       | 25 mM Sodium Hydroxide | 70 $\mu\text{L}$ |
| 6.67.1   | 1.7.2                        | 40 mM Sodium Hydroxide | 5 $\mu\text{L}$  |
|  | 7.26.4                       | 40 mM Sodium Hydroxide | 5 $\mu\text{L}$  |
|  | 9.8.2                        | 40 mM Sodium Hydroxide | 5 $\mu\text{L}$  |
| 7.20.5   | 1.7.2                        | 40 mM Sodium Hydroxide | 5 $\mu\text{L}$  |
|  | 9.8.2                        | 25 mM Phosphoric Acid  | 5 $\mu\text{L}$  |
|  | 1.7.2                        | 25 mM Phosphoric Acid  | 5 $\mu\text{L}$  |
| 7.26.4   | 7.26.4                       | 25 mM Phosphoric Acid  | 5 $\mu\text{L}$  |
|  | 9.8.2                        | 40 mM Sodium Hydroxide | 20 $\mu\text{L}$ |
|  | 6.22.2                       | 75 mM Phosphoric Acid  | 20 $\mu\text{L}$ |
| 9.8.2  | 7.20.5                       | 75 mM Phosphoric Acid  | 20 $\mu\text{L}$ |
|  | 7.16.6                       | 75 mM Phosphoric Acid  | 20 $\mu\text{L}$ |
|  | 9.8.2                        | 25 mM Phosphoric Acid  | 15 $\mu\text{L}$ |
| 6.22.2   | 6.22.2                       | 25 mM Phosphoric Acid  | 10 $\mu\text{L}$ |
|  | 7.20.5                       | 25 mM Phosphoric Acid  | 20 $\mu\text{L}$ |
|  | 7.16.6                       | 25 mM Phosphoric Acid  | 10 $\mu\text{L}$ |

(Flow rate was 50  $\mu\text{L}/\text{min}$  during all regeneration procedures)

After regeneration, MAdCAM-IgG<sub>1</sub> Fc fusion protein was bound again and further test antibodies were injected. These procedures were carried out until the entire panel of clones had been injected over the surface of the immobilised antibody, with bound MAdCAM-IgG<sub>1</sub> Fc fusion protein. A new flow cell with a different immobilised antibody and bound MAdCAM was then used for probing with the nine test clones. Anti-MAdCAM antibodies 1.7.2 and 1.8.2 were expected to recognise the same MAdCAM epitope, based on the close primary amino acid sequence homology of their heavy and kappa light chains, SEQ ID NOS: 2, 4, 6, 8 respectively. Accordingly, only 1.7.2 was assessed though the BIAcore response matrix. Antibodies 6.14.2 and 6.73.2 were omitted from this analysis, but all other combinations of anti-MAdCAM antibody pairs were tested in this way. An arbitrary level of 100 RU was chosen as the threshold between binding/non-binding and a response matrix, (Table 7), was created based on whether binding was observed.



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TABLE 7

| BIAcore epitope binding response matrix |                    |        |        |        |        |       |       |        |        |
|---|--------------------|--------|--------|--------|--------|-------|-------|--------|--------|
| Immobilised antibody                    | Secondary antibody |        |        |        |        |       |       |        |        |
|   | 6.22.2             | 6.34.2 | 6.67.1 | 6.77.1 | 7.20.5 | 9.8.2 | 1.7.2 | 7.26.4 | 7.16.6 |
| 6.22.2                                  | —                  | —      | —      | —      | —      | x     | x     | x      | x      |
| 6.34.2                                  | —                  | —      | —      | —      | —      | x     | x     | x      | x      |
| 6.67.1                                  | —                  | —      | —      | —      | —      | x     | x     | —      | —      |
| 6.77.1                                  | —                  | —      | —      | —      | —      | x     | x     | —      | x      |
| 7.20.5                                  | —                  | —      | —      | —      | —      | x     | x     | x      | x      |
| 9.8.2                                   | x                  | x      | x      | x      | x      | x     | —     | —      | x      |
| 1.7.2                                   | x                  | x      | x      | x      | x      | x     | —     | —      | x      |
| 7.26.4                                  | x                  | x      | —      | —      | x      | x     | —     | —      | x      |
| 7.16.6                                  | x                  | x      | —      | —      | x      | —     | —     | —      | x      |

Response matrix for all combinations of antibody pairs. — indicates no binding of the antibody probe, x indicates binding was observed (above a chosen threshold level of 100 RU).

The matrix diagonal in Table 7 (shaded grey) holds the binding data for identical probe pairs. In all instances, except for the two clones 7.16.6 and 9.8.2, the antibodies were self-blocking. Antibodies 7.16.6 and 9.8.2 do not cross compete. The lack of self-blocking could be due to a mAb-induced conformational change in the fusion protein that permits additional binding of the mAb to a second site on MAdCAM-IgFc.

Grouping the clones that show the same reactivity pattern gives rise to at least six different epitope bins, as shown in the graphical representation, FIG. 5).

Further precise identification of the MAdCAM epitope sequences with which an anti-MAdCAM antibody interacts can be determined by any of a number of methods, including, but not limited to, Western analysis of spotted peptide library arrays (Reineke et al., Curr. Topics in Microbiol. and Immunol 243: 23-36 (1999), M. Famulok, E-L Winnacker, C-H Wong eds., Springer-Verlag, Berlin), phage or bacterial flagellin/fliC expression library display, or simple MALDI-TOF analysis of bound protein fragments following limited proteolysis.

#### Immunohistochemical Assays:

OCT or sucrose-embedded frozen tissue specimens of ileum (Peyer's patches), mesenteric lymph node, spleen, stomach, duodenum, jejunum and colon were used as a positive staining controls for the anti-MAdCAM mAbs. For staining human sections with human IgG<sub>2</sub> mAbs, biotinylated derivatives of the anti-MAdCAM mAbs were generated. 10 μm frozen tissue sections were cut onto poly L-lysine coated slides, placed directly into 100% acetone 4°C. (10 min), then 3% hydrogen peroxide in methanol (10 min), washing between steps with PBS. The slides were blocked with Biotin Blocking System (DAKO Cat. No. X0590), prior to incubation with the primary antibody (1:100-1:1000) in PBS (1 hr), washed with PBS-Tween 20 (0.05%) and then binding developed with HRP-Streptavidin (BD Bioscience Cat. No. 550946, 30 min) and DAB substrate (Sigma Cat. No. D5905). For IgG<sub>4</sub> mAbs, an HRP-conjugated, mouse anti-human IgG<sub>4</sub> (Zymed Cat. No. 3840) secondary was used. The slides were counterstained with Mayer's Haemalum (1 min), washed and then mounted in DPX.

Binding affinity was compared for a number of species (mouse, rat, rabbit, dog, pig, cynomolgus and human tissue). There was no reactivity for rat, rabbit and pig tissue by immunohistochemistry and no cross-reactivity of the anti-MAdCAM antibodies for recombinant mouse MAdCAM, when

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analyzed by ELISA. The data for human, cynomolgus and dog tissue are presented in table form, Table 8 below:

TABLE 8

| Pattern of cross reactivity of anti-MAdCAM antibodies to MAdCAM species orthologues |             |                      |            |                |           |
|---|-------------|----------------------|------------|----------------|-----------|
| CLONE   | Luminex BIN | IHC cross-reactivity |            |                |           |
|   |             | human ileum          | cyno ileum | marmoset ileum | dog ileum |
| 1.7.2   | 3a          | ■                    | ■          |                |           |
| 1.8.2   | 3a          | ■                    | ■          |                |           |
| 7.16.6  | 3b          | ■                    | ■          |                |           |
| 7.20.5  | 2b          | ■                    | ■          | n.d.           |           |
| 7.26.4  | 3b          | ■                    | ■          | n.d.           |           |
| 6.14.2  | 2           | ■                    | ■          | n.d.           | ■         |
| 6.22.2  | 2           | ■                    | ■          | n.d.           |           |
| 6.34.2  | 6           | ■                    | ■          | n.d.           |           |
| 6.67.1  | 5           | ■                    | ■          | n.d.           | ■         |
| 6.73.2  | 3           | ■                    | n.d.       | n.d.           |           |
| 6.77.1  | 1           | ■                    | ■          | n.d.           |           |
| 9.8.2   | 3a          | ■                    | n.d.       |                |           |

IgG<sub>2</sub>IgG<sub>4</sub>

No Binding

Binding

n.d.: not determined

Anti-MAdCAM binding to specialised endothelial structures and lymphoid tissue is indicated by the shading, according to the key. The epitope bin based on Luminex epitope analysis and the pattern of MAdCAM cross-reactivity are indicated for each antibody. Luminex epitope binning data for anti-MAdCAM antibodies 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.3 and 6.77.1 (italics) were derived from separate experiments than that for 1.7.2, 1.8.2, 7.16.6, 7.20.5, 7.26.4 and 9.8.2 (bold type), as indicated by the difference in font character.

All anti-MAdCAM antibodies tested had the ability to recognize a human MAdCAM epitope expressed on vascular endothelial compartments of the gastrointestinal tract. Apart from 1.7.2 and 1.8.2, all other anti-MAdCAM antibodies tested were able to specifically bind the vascular endothelial compartments of the cynomolgus gastrointestinal tract. Certain other anti-MAdCAM antibodies, namely 6.14.2 and 6.67.1 also had the ability to specifically recognize the dog MAdCAM orthologue as well as cynomolgus MAdCAM. Generation of a Functionally Active Chimeric Cynomolgus/Human MAdCAM-expressing CHO Cell Line:

The differences in binding affinity of certain anti-MAdCAM antibodies for human and cynomolgus MAdCAM led us to determine whether a structural basis for this observation could be made.

Based on the published amino acid sequence for Macaque MAdCAM (Shyjan A M, et al., J Immunol., 156, 2851-7 (1996)), primers were designed to PCR amplify the cynomolgus MAdCAM α<sub>4</sub>β<sub>7</sub> binding domain sequence. Total RNA was prepared from frozen excised cynomolgus mesenteric lymph node (ca. 200 mg) using the Trizol method (Invitrogen) according to the manufacturer's instructions. 1-2 μg was oligo-dT primed and reverse transcribed with AMV reverse transcriptase (Promega). A proportion of the reverse transcribed product was subjected to PCR with forward 5'-AGC ATG GAT CGG GGC CTG GCC-3' (SEQ ID NO: 111) and reverse 5'-GTG CAG GAC CGG GAT GGC CTG-3' (SEQ ID NO: 112) primers with GC-2 polymerase in 1M GC melt



(Clontech) and at an annealing temperature of 62° C. An RT-PCR product of the appropriate size was excised and purified from a 1% agarose gel after electrophoresis, then TOPO-TA cloned (Invitrogen) between EcoRI sites of pCR2.1. The insert was sequence confirmed. The nucleotide and predicted translated amino acid sequences are shown in SEQ ID NOS: 49 and 50, respectively.

The predicted human and cynomolgus MAdCAM amino acid sequences for the  $\alpha_4\beta_7$  binding domain show a high degree of sequence identity (90.8%) when aligned (FIG. 3 provides this sequence alignment). To generate a functionally active cynomolgus MAdCAM-expressing cell line, which mimicked the anti-MAdCAM binding pattern represented by Table 8, a SacI fragment corresponding to the cynomolgus  $\alpha_4\beta_7$  binding domain sequence in pCR2.1, was subcloned directly into the C-terminal human MAdCAM pIND-Hygro construct containing carboxyl-terminal mucin stalk and transmembrane domain, described above. The sequence and orientation was verified, then a KpnI/NotI fragment was cloned into pEF5FRTV5GWCAT vector (Invitrogen), replacing the CAT coding sequence and used in transfections to generate single stably expressing clones in Flp In CHO cells (Invitrogen), according to the manufacturer's instructions.

The binding of anti-MAdCAM antibody clones to the CHO cells expressing cynomolgus/human MAdCAM chimera was assessed by flow cytometry and the functional activity of anti-MAdCAM antibodies was determined using a very similar JY cell adhesion assay as that described above. The binding and functional activity of anti-MAdCAM antibodies are expressed in Table 9.

TABLE 9

| Correlation between the functional activity in the cynomolgus/human MAdCAM-CHO/JY adhesion assay and human and cynomolgus/human MAdCAM CHO cell binding, as measured by FACS, for a range of anti-MAdCAM antibodies. |                                     |              |            |
|--|-------------------------------------|--------------|------------|
| CLONE  | Functional IC <sub>50</sub> (µg/mL) | FACS binding |            |
|  |                                     | human        | cyno/human |
| 1.7.2  | inactive                            | ■            | ■          |
| 1.8.2  | inactive                            | ■            | ■          |
| 7.16.6   | 0.72                                | ■            | ■          |
| 7.20.5   | 0.62                                | ■            | ■          |
| 7.26.4   | 0.96                                | ■            | ■          |
| 6.14.2   | 0.53                                | ■            | ■          |
| 6.22.2   | 0.83                                | ■            | ■          |
| 6.34.2   | 0.47                                | ■            | ■          |
| 6.67.1   | 0.75                                | ■            | ■          |
| 6.73.2   | inactive                            | ■            | □          |
| 6.77.1   | 0.64                                | ■            | ■          |
| 9.8.2  | 0.83                                | ■            | ■          |

|            |
|------------|
| IgG2       |
| IgG4       |
| No Binding |
| Binding    |

Taken together, there is a good correlation between the ability of a given anti-MAdCAM antibody to bind human or cynomolgus MAdCAM, as detected by immunohistochemistry (Table 8), with recombinant cell-based binding and functional activity (Table 9). Anti-MAdCAM antibodies 1.7.2, 1.8.2 and 6.73.2, for instance, demonstrated a consistent lack of binding to cynomolgus tissue and cells expressing a chimeric cynomolgus/human MAdCAM protein. Anti-MAdCAM antibodies 1.7.2, 1.8.2 and 6.73.2 also did not

have the ability to detect functional blocking activity in the cynomolgus/human MAdCAM/JY adhesion assay.

Similar approaches could be used to define the epitope of the anti-MAdCAM antibodies 6.14.2 and 6.67.1 that recognise dog MAdCAM.

## Example IV

## Use of Anti-MAdCAM mAbs in the Detection of Circulating Soluble MAdCAM as a Method of Disease Diagnosis

Anti-MAdCAM antibodies can be used for the detection of circulating soluble MAdCAM (sMAdCAM). Detection of sMAdCAM in clinical plasma, serum samples or other biofluid, such as, but not limited to, stool, urine, sputum is likely to be a useful surrogate disease biomarker for underlying disease, including, but not limited to, inflammatory bowel disease.

Based on the epitope binning data (Tables 7 and 8), anti-MAdCAM antibodies 1.7.2 and 7.16.6 appear to recognise different epitopes on human MAdCAM. ELISA plates were coated overnight at 4° C. with 100 µL/well of a 50 µg/mL solution of 1.7.2 in phosphate buffered saline (PBS). After incubation the plate was blocked for 1.5 hours with a PBS blocking buffer containing 10% milk (200 µL/well). After incubation the plate was washed with PBS (2×100 µL/well) and serial dilutions of MAdCAM-IgG1-Fc fusion protein, from a top concentration of 50 µg/mL down to approximately 5 ng/mL in PBS, to a final volume of 100 µL, were added to the plate for incubation of 2 hours at room temperature. In a similar approach the MAdCAM-IgG1-Fc protein can be diluted in plasma or serum, or some other such relevant biofluid and used to determine the expression of soluble MAdCAM in a clinical sample, as described below. As a negative control, only buffer was added to the wells containing the primary anti-MAdCAM antibody. After this time, the plate was washed with PBS (3×100 µL/well) and the plate then incubated in the dark with an Alexa488-labelled 7.16.6 (100 µL, 5 µg/mL). The Alexa488-labelled 7.16.6 was generated using a commercially available kit (Molecular Probes, A-20181), following Manufacturer's protocols.

The plate was washed with PBS containing 0.05% Tween-20, and binding of labeled 7.16.6 to captured soluble MAdCAM determined by measuring the fluorescence (Wallac Victor<sup>2</sup> 1420 Multilabel Reader, excitation  $\lambda$ 485 nm, emission  $\lambda$ 2535 nm count from top, 3 mm from bottom of plate, for 0.1 sec with normal emission aperture). When fluorescence is plotted as a function of the concentration of MAdCAM-IgG1-Fc fusion protein, FIG. 6, it indicates that 1.7.2 and a labeled 7.16.6 can be used for diagnostic purposes to determine the level of circulating soluble MAdCAM expressed in a biofluid or clinical sample. This sandwich ELISA approach is not restricted to the use of 1.7.2 and 7.16.6, but any combination of anti-MAdCAM antibodies that recognise different epitopes on MAdCAM, as outlined by the data and interpretation of table 7 and FIG. 5. Similar strategies could be applied to the development of similar assays, such as immunohistochemistry and Western Blot, with the other anti-MAdCAM antibodies described, using different partners, variants, labels, etc.

## Example V

## Amino Acid Structure of Anti-MAdCAM mAbs Prepared in Accordance to the Invention

In the following discussion, structural information related to the anti-MAdCAM mAbs prepared in accordance with the invention is provided.



To analyze structures of mAbs produced in accordance with the invention, we cloned the genes encoding the heavy and light chain fragments out of the specific hybridoma clone. Gene cloning and sequencing was accomplished as follows:

Poly(A)+ mRNA was isolated from approximately  $2 \times 10^5$  hybridoma cells derived from immunized Xenomouse mice using Fast-Track kit (Invitrogen). The generation of random primed cDNA was followed by PCR. Human VH or V $\kappa$  family specific primers (Marks et al., 'Oligonucleotide primers for polymerase chain reaction amplification of human immunoglobulin variable genes and design of family-specific oligonucleotide probes'; Eur. J. Immunol., 21, 985-991 (1991)) or a universal human VH primer, MG-30 (5'-CAG GTG CAG CTG GAG CAG TCI GG-3 (SEQ ID NO: 108) was used in conjunction with primers specific for the human C $\gamma$ 2, MG40-d (5'-GCT GAG GGA GTA GAG TCC TGA GGA-3 (SEQ ID NO: 109) or C $\gamma$ 4 constant region, MG-40d (5'-GCT GAG GGA GTA GAG TCC TGA GGA CTG T-3 (SEQ ID NO: 110), or C $\kappa$  constant region (h $\kappa$ P2; as previously described in Green et al., 1994). Sequences of the human mAb-derived heavy and kappa chain transcripts from

hybridomas were obtained by direct sequencing of PCR products generated from poly (A+) RNA using the primers described above. PCR products were cloned into pCR2.1 using a TOPO-TA cloning kit (Invitrogen) and both strands were sequenced using Prism dye terminator sequencing kits and an ABI 377 sequencing machine. All sequences were analysed by alignments to the 'V BASE sequence directory' (Tomlinson, et al, J. Mol. Biol., 227, 776-798 (1992); Hum. Mol. Genet., 3, 853-860 (1994); EMBO J, 14, 4628-4638 (1995).)

Further each of the antibodies, 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4, 9.8.2, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod and 7.26.4-mod, were subjected to full length DNA sequencing. For such, total RNA was isolated from approximately  $3-6 \times 10^6$  hybridoma cells using an RNeasy kit (Qiagen). The mRNA was reverse transcribed using oligo-dT and an AMV-based reverse transcriptase system (Promega). V BASE was used to design 5' specific amplification primers, containing an optimal Kozak sequence and ATG start codon (underlined) and 3' reverse primers for the specific heavy and kappa chains as depicted in Table 10.

TABLE 10

PCR primer pairs for cDNA amplification from anti-MAdCAM mAb-expressing hybridomas and primers used in the construction of modified versions of anti-MAdCAM antibodies.

|          | Oligo sequence  |
|----------|---|
| VH1-18   | 5' TATCTAAGCTTCTAGACTCGAGCGCCACCATGGACTGGACCTGGAGCATCCTT 3'<br>(SEQ ID NO: 70)  |
| VH3-15   | 5' TATCTAAGCTTCTAGACTCGAGCGCCACCATGGAGTTTGGGCTGAGCTGGATT 3'<br>(SEQ ID NO: 71)  |
| VH3-21   | 5' TATCTAAGCTTCTAGACTCGAGCGCCACCATGGAACTGGGGCTCCGCTGGGTT 3'<br>(SEQ ID NO: 72)  |
| VH3-23   | 5' TATCTAAGCTTCTAGACTCGAGCGCCACCATGGAGTTTGGGCTGAGCTGGCTT 3'<br>(SEQ ID NO: 73)  |
| VH3-30   | 5' TATCTAAGCTTCTAGACTCGAGCGCCACCATGGAGTTTGGGCTGAGCTGGGTT 3'<br>(SEQ ID NO: 74)  |
| VH3-33   | 5' TATCTAAGCTTCTAGACTCGAGCGCCACCATGGAGTTTGGGCTGAGCTGGGTT 3'<br>(SEQ ID NO: 75)  |
| VH4-4    | 5' TATCTAAGCTTCTAGACTCGAGCGCCACCATGAAACACCTGTGGTTCTTCCTC 3'<br>(SEQ ID NO: 76)  |
| A2/A3    | 5' TATCTAAGCTTCTAGACCCGGGCGCCACCATGAGGCTCCCTGCTCAGCTCCTG 3'<br>(SEQ ID NO: 77)  |
| A26      | 5' TATCTAAGCTTCTAGACCCGGGCGCCACCATGTTGCCATCACAACCTCATTGGG 3'<br>(SEQ ID NO: 78) |
| B3       | 5' TATCTAAGCTTCTAGACCCGGGCGCCACCATGGTGTTCAGACCCAGGTCTTC 3'<br>(SEQ ID NO: 79)   |
| O12      | 5' TATCTAAGCTTCTAGACCCGGGCGCCACCATGGACATGAGGGTCCCGCTCAG 3'<br>(SEQ ID NO: 80)   |
| O18      | 5' TATCTAAGCTTCTAGACCCGGGCGCCACCATGGACATGAGGGTCCCTGCTCAG 3'<br>(SEQ ID NO: 81)  |
| RevIgG2  | 5' TTCTCTGATCAGAATTCCTATCATTTACCCGAGACAGGGAGAG 3'<br>(SEQ ID NO: 82)            |
| RevIgG4  | 5' TTCTTTGATCAGAATTCCTACTAACACTCTCCCTGTTGAAGC 3'<br>(SEQ ID NO: 83)             |
| RevKappa | 5' TTCTCTGATCAGAATTCCTATCATTTACCCAGAGACAGGGAGAG 3'<br>(SEQ ID NO: 84)           |



TABLE 10-continued

PCR primer pairs for cDNA amplification from anti-MAdCAM mAb-expressing hybridomas and primers used in the construction of modified versions of anti-MAdCAM antibodies.

|                 | Oligo sequence   |
|-----------------|--|
| 6.22.2VK_F1     | 5'-GGA TCT GGG ACA GAT TTC ACC CTC ACC ATC AAT AGC CTG GAA GC-3'<br>(SEQ ID NO: 85)      |
| 6.22.2VK_R1     | 5'-GCT TCC AGG CTA TTG ATG GTG AGG GTG AAA TCT GTC CCA GAT CC-3'<br>(SEQ ID NO: 86)      |
| 6.22.2VH_F1     | 5'-GCA GCG TCT GGA TTC ACC TTC AGT AGC-3'<br>(SEQ ID NO: 87)                             |
| 6.22.2VH_R1     | 5'-GCT ACT GAA GGT GAA TCC AGA CGC TGC-3'<br>(SEQ ID NO: 88)                             |
| 6.22.2VH_CS*    | 5'-CGG AGG TGC TTC TAG AGC AGG GCG-3'<br>(SEQ ID NO: 89)                                 |
| 6.34.2VK_F1     | 5'-GCA AGT CAG AGT ATT AGT AGC TAT TTA AAT TGG TAT CAG CAG AAA CC-3'<br>(SEQ ID NO: 90)  |
| 6.34.2VK_R1     | 5'-GGT TTC TGC TGA TAC CAA TTT AAA TAG CTA CTA ATA CTC TGA CTT GC-3'<br>(SEQ ID NO: 91)  |
| 6.34.2VK_F2     | 5'-CCA TCA GTT CTC TGC AAC CTG AGG ATT TTG CAA CTT ACT ACT GTC ACC-3'<br>(SEQ ID NO: 92) |
| 6.34.2VK_R3     | 5'-GGT GAC AGT AGT AAG TTG CAA AAT CCT CAG GTT GCA GAG AAC TGA TGG-3'<br>(SEQ ID NO: 93) |
| 6.34.2VH_F16.34 | 5'-GCA AAT GAA CAG CCT GCG CGC TGA GGA CAC G-3'<br>(SEQ ID NO: 94)                       |
| .2VH_R1         | 5'-CGT GTC CTC AGC GCG CAG GCT GTT CAT TTG C-3'<br>(SEQ ID NO: 95)                       |
| 6.67.1VK_F1     | 5'-CAA TAA GAA CTA CTT AGC TTG GTA CCA ACA GAA ACC AGG ACA GCC-3'<br>(SEQ ID NO: 96)     |
| 6.67.1VK_R1     | 5'-GGC TGT CCT GGT TTC TGT TGG TAC CAA GCT AAG TAG TTC TTA TTG-3'<br>(SEQ ID NO: 97)     |
| 6.67.1VH_F1     | 5'-CCC TCA GGG GTC GAG TCA CCA TGT CAG TAG ACA CGT CCA AGA ACC-3'<br>(SEQ ID NO: 98)     |
| 6.67.1VH_R1     | 5'-GGT TCT TGG ACG TGT CTA CTG ACA TGG TGA CTC GAC CCC TGA GGG-3'<br>(SEQ ID NO: 99)     |
| 6.67.1VH_CS*    | 5'-ATT CTA GAG CAG GGC GCC AGG-3'<br>(SEQ ID NO: 100)                                    |
| 6.77.1VK_F1     | 5'-CCA TCT CCT GCA AGT CTA GTC AGA GCC TCC-3'<br>(SEQ ID NO: 101)                        |
| 6.77.1VK_R1     | 5'-GGA GGC TCT GAC TAG ACT TGC AGG AGA TGG-3'<br>(SEQ ID NO: 102)                        |
| 6.77.1VK_F2     | 5'-GGT TTATTA CTG CAT GCA AAG TAT ACA GCT TAT GTCACAG TTT TGG CC-3'<br>(SEQ ID NO: 103)  |
| 6.77.1VK_R2     | 5'-GGC CAA AAC TGG ACA TAA GCT GTA TAC TTT GCA TGC AGT AAT AAA CC-3'<br>(SEQ ID NO: 104) |
| 7.26.4K_F1      | 5'-CCT GCA AGT CTA GTC AGA GCC TCC-3'<br>(SEQ ID NO: 105)                                |
| 7.26.4K_R1      | 5'-GGA GGC TCT GAC TAG ACT TGC AGG-3'<br>(SEQ ID NO: 106)                                |



The primers pairs were used to amplify the cDNAs using Expand High Fidelity Taq polymerase (Roche), and the PCR products cloned into pCR2.1 TOPO-TA (Invitrogen) for subsequent sequencing. Heavy and kappa light chain sequence verified clones were then cloned into pEE6.1 and pEE12.1

#### Gene Utilization Analysis

Table 11 displays the heavy and kappa light chain gene utilization for each hybridoma outlined in the invention.

TABLE 11

| Heavy and Kappa light chain Gene Utilization |             |                |      |                   |     |
|--|-------------|----------------|------|-------------------|-----|
| CLONE  | Heavy Chain |                |      | Kappa light Chain |     |
|  | VH          | D              | JH   | Vκ                | Jκ  |
| 1.7.2  | VH3-15      | D6-19          | JH4b | A3                | JK5 |
| 1.8.2  | VH3-15      | D6-19          | JH4b | A3                | JK5 |
| 7.16.6                                       | VH1-18      | D6-6           | JH6b | A2                | JK1 |
| 7.20.5                                       | VH4-4       | D3-10          | JH6b | A3                | JK4 |
| 7.26.4                                       | VH1-18      | D6-6           | JH6b | A2                | JK1 |
| 6.14.2                                       | VH3-23      | D5-5           | JH4b | O12               | JK5 |
| 6.22.2                                       | VH3-33      | D5-12          | JH6b | A26               | JK4 |
| 6.34.2                                       | VH3-30      | D4-23          | JH6b | O12               | JK3 |
| 6.67.1                                       | VH4-4       | D3-10          | JH4b | B3                | JK4 |
| 6.73.2                                       | VH3-23      | D6-19          | JH6b | O12               | JK2 |
| 6.77.1                                       | VH3-21      | D6-19          | JH6b | A2                | JK2 |
| 9.8.2  | VH3-33      | D3-10 or D3-16 | JH4b | O18               | JK5 |

|      |
|------|
| IgG2 |
| IgG4 |

#### Sequence Analysis

To further examine antibody structure predicted amino acid sequences of the antibodies were obtained from the cDNAs obtained from the clones.

Sequence identifier numbers (SEQ ID NO:) 1-48 and 51-68 provide the nucleotide and amino acid sequences of the heavy and kappa light chains of the anti-MAdCAM antibodies 1.7.2 (SEQ ID NOS 1-4), 1.8.2 (SEQ ID NOS 5-8), 6.14.2 (SEQ ID NOS 9-12), 6.22.2 (SEQ ID NOS 13-16), 6.34.2 (SEQ ID NOS 17-20), 6.67.1 (SEQ ID NOS 21-24), 6.73.2 (SEQ ID NOS 25-28), 6.77.1 (SEQ ID NOS 29-32), 7.16.6 (SEQ ID NOS 33-36), 7.20.5 (SEQ ID NOS 37-40), 7.26.4 (SEQ ID NOS 41-44), 9.8.2 (SEQ ID NOS 45-48) and the modified anti-MAdCAM antibodies 6.22.2-mod (SEQ ID NOS 51-54), 6.34.2-mod (SEQ ID NOS 55-58), 6.67.1-mod (SEQ ID NOS 59-62) and 6.77.1-mod (SEQ ID NOS 63-66) and 7.26.4-mod (SEQ ID NOS 67-68). For each anti-MAdCAM antibody sequence cloned, the sequences of the signal peptide sequence (or the bases encoding the same) are indicated in lower case and underlined.

FIGS. 1A-1J provide sequence alignments between the predicted heavy chain amino acid sequences of antibodies 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.16.6, 7.20.5, 7.26.4 and 9.8.2 and the amino acid sequence of the respective germline gene products. The positions of the CDR1, CDR2 and CDR3 sequences of the antibodies are underlined, differences between the expressed sequence the corresponding germline sequence are indicated in bold and where there are additions in the expressed sequence compared to the germline these are indicated as a (-) in the germline sequence.

FIGS. 1K-1T provide sequence alignments between the predicted kappa light chain amino acid sequences of the antibodies 1.7.2, 1.8.2, 6.14.2, 6.22.2, 6.34.2, 6.67.1, 6.73.2,

6.77.1, 7.16.6, 7.20.5, 7.26.4 and 9.8.2 and the amino acid sequence of the respective germline gene products. The positions of the CDR1, CDR2 and CDR3 sequences of the antibodies are underlined, differences between the expressed sequence the corresponding germline they are indicated in bold and where there are additions in the expressed sequence compared to the germline these are indicated as a (-) in the germline sequence.

Presence of Post-translational Modification: Glycosylation and Deamidation:

The effect of some of the changes in the expressed anti-MAdCAM antibody sequence, compared with the derived germline sequence, is to introduce residues that potentially could be subject to N-linked glycosylation (Asn-X-Ser/Thr) and/or deamidation (Asn-Gly) (see table 12). The nucleic acid sequences encoding the kappa light chain variable domain amino acid sequences of the anti-MAdCAM antibodies 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.26.4 and 9.8.2, (SEQ ID NOS: 16, 20, 24, 28, 32, 44 and 48) and the heavy chain variable domain of antibody 6.14.2, (SEQ ID NO: 10), predict the presence of N-linked glycosylation. The presence of this post-translational modification was investigated using a combination of SDS-PAGE and Pro-Q® Emerald 488 Glycoprotein (Molecular Probes) staining with mAbs 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.26.4 and 9.8.2.

Briefly, approximately 2 µg of reduced anti-MAdCAM antibody was loaded onto a 4-12% SDS-polyacrylamide gel using a MOPS buffer. Following electrophoresis, the gel was fixed in 50% MeOH, 5% acetic acid and washed in 3% acetic acid. Any carbohydrates on the gel were then oxidised with periodic acid and stained using Pro-Q® Emerald 488 Glycoprotein Stain Kit (Molecular Probes). After a final wash step, glycoprotein staining was visualised using a fluorescence scanner set at a wavelength of 473 nm.

After glycoprotein staining, the gel was stained for total protein using SYPRO Ruby protein gel stain and analysed using a fluorescence scanner set at a wavelength of 473 nm. The kappa light chains of anti-MAdCAM antibodies, 6.22.2, 6.34.2, 6.67.1, 6.73.2, 6.77.1, 7.26.4 and 9.8.2, all stained positively for the presence of glycosylation. As an additional confirmation, anti-MAdCAM antibody 7.26.4, was subjected to tryptic/chymotryptic digestion, the LC-MS/MS analysis confirmed the presence of a modified tryptic peptide and provided additional confirmation of kappa light chain glycosylation.

Specific Asn-Gly sequences in the CDR1 regions of anti-MAdCAM antibodies, 1.7.2, 1.8.2, 6.22.2 and 7.20.5, render these regions sensitive to deamidation. Deamidation at neutral pH introduces a negative charge and can also lead to β-isomerisation, which could affect the properties of an antibody. For anti-MAdCAM antibodies 1.7.2, 1.8.2 and 7.20.5, the presence of deamidated Asn-isoaspartate residues was assessed by mass spectroscopy following trapping the isoaspartate side chain with MeOH.

In brief, for the anti-MAdCAM antibody 1.7.2, the status of the tryptic/Asp-N peptide SSQSLQSNNGYNYL (SEQ ID NO: 69) (1573.7 Da) was selected for monitoring by LC-MS/MS. Anti-MAdCAM antibody 1.7.2 was reduced in 10 mM DTT, alkylated in 5 mM Na iodoacetate and subsequently buffer exchanged into trypsin digestion buffer (50 mM Tris-HCl, 1 mM CaCl<sub>2</sub>, pH 7.6). The antibody was then mixed with sequencing grade modified trypsin (Promega) in a protease:protein ratio of 1:20. Protein was digested in trypsin for 15 hours at 30° C., and the resulting peptides separated by HPLC using a C-18 RPC on an Ettan LC system. The <sup>33</sup>Asn-containing peptide (4032 Da) was collected from the column and diluted in Asp-N digestion buffer (50 mM sodium phos-



phate buffer, pH 8.0). Endoproteinase Asp-N (Roche) was then added at an approximate peptide:enzyme ratio of 10:1.

Acetyl chloride (100  $\mu$ L) was added to a sample of methanol (1 mL,  $-20^{\circ}$  C.), the mixture warmed to room temperature. The tryptic+Asp-N digest was dried in a Speed-Vac and then 5  $\mu$ L of the methanol/acetyl chloride was added (45 min, room temp), then dried again in a Speed-Vac. The resulting residue was re-constituted in 0.1% TFA and peptides were analysed initially on the Voyager-DE STR MALDI-TOF mass spectrometer using either the nitrocellulose thin layer sample preparation method or reverse phase purification using C18 ZipTips (Millipore) followed by droplet mixing with  $\alpha$ -cyano matrix. The methylated peptide mixture was also analysed using LC-MS/MS on a Deca XP Plus Ion Trap Mass Spectrometer as above. The elution was plumbed straight into the Ion Trap MS and peptides were subsequently analysed by MS and MS/MS. The MS was set to analyse all ions between 300 and 2000 Da. The strongest ion in any particular scan was then subjected to MS/MS analysis.

TABLE 12

| Post-translational modification of anti-MAdCAM antibodies |                       |           |                       |           |                  |           |
|---|-----------------------|-----------|-----------------------|-----------|------------------|-----------|
| CLONE   | Heavy Chain           |           | Kappa light chain     |           |                  |           |
|   | Glycosylation (NXS/T) | Confirmed | Glycosylation (NXS/T) | Confirmed | Deamidation (NG) | Confirmed |
| 1.7.2   |                       |           |                       |           | LQSNQYN          | MS        |
| 1.8.2   |                       |           |                       |           | LQSNQYN          | MS        |
| 7.16.6  |                       |           |                       |           |                  |           |
| 7.20.5  |                       |           |                       |           | HGNGYNY          | MS        |
| 7.26.4  |                       |           | CKSNQSLLY             | MS/PAG    |                  |           |
| 6.14.2  | TFNNSAMT              | N.D       |                       |           |                  |           |
| 6.22.2  |                       |           | SGTNFTLTI             | PAGE      | LTINGLEA         | N.D       |
| 6.34.2  |                       |           | ASQNISSYL             | PAGE      |                  |           |
| 6.67.1  |                       |           | SSNNKTYLA             | PAGE      |                  |           |
| 6.73.2  |                       |           | RASQNITN              | PAGE      |                  |           |
| 6.77.1  |                       |           | SCNSSQSL              | PAGE      |                  |           |
| 9.8.2   |                       |           | HSDNLSIT              | PAGE      |                  |           |
| IgG2  |                       |           |                       |           |                  |           |
| IgG4  |                       |           |                       |           |                  |           |

Table 12 discloses SEQ ID NOS: 135-146 respectively in order from left to right, and top to bottom.

#### Mutagenesis Studies:

The primary amino acid sequence of the anti-MAdCAM antibodies exemplified in this invention can be modified, by site-directed mutagenesis, to remove potential sites of post-translational modification (e.g., glycosylation, deamidation) or to alter the isotype background, or to engineer other changes which may improve the therapeutic utility. As an example, PCR was used to engineer changes to the anti-MAdCAM antibodies 6.22.2, 6.34.2, 6.67.1, 6.77.1 and 7.26.4, to revert certain framework sequences to germline, to remove potential glycosylation sites and/or to change the isotype background to a human IgG2. pCR2.1 TOPO-TA cloned cDNAs (100 ng), corresponding to heavy chain nucleotide SEQ ID NOS: 13, 17, 21 and 29, and kappa light nucleotide SEQ ID NOS: 15, 19, 23, 31 and 43, were used as a template in a series of PCRs using overlap-extension and a panel of primer sets described in Table 10.

6.22.2 Heavy chain: PCR primer sets 6.22.2\_VH\_F1 and 6.22.2VH\_CS\* (1) and VH3-33 and 6.22.2\_VH\_R1 (2) were used to generate separate PCR products (1) and (2), using an Expand Taq polymerase and a pCR2.1 TOPO-TA cDNA template (100 ng) represented by nucleotide sequence SEQ ID NO: 13. Products (1) and (2) were purified and combined in a

third PCR step (ca. 50 ng each) along with VH3-33 and VK6.22.2\_CS\* primers, to generate the modified 6:22.2 heavy chain V-domain. This modified version contains a His/Phe mutation in FR1 and introduces an XbaI restriction site to enable in frame cloning into a pEE6.1 derived vector, termed pEE6.1CH, which contains the corresponding human IgG<sub>2</sub> constant domain. The final PCR fragment was cloned into the XbaI site of pEE6.1CH, checked for orientation and the insert full sequence verified. The nucleotide sequence for the modified 6.22.2 heavy chain is found in SEQ ID NO: 51 and the corresponding amino acid sequence in SEQ ID NO: 52. The changes in the nucleotide and amino acid sequences compared with the parent are indicated.

6.22.2 kappa light chain: PCR primer sets 6.22.2\_VK\_F1 and revKappa (1), and A26 and 6.22.2\_VK\_R1 (2) were used to generate separate PCR products (1) and (2), using an Expand Taq polymerase and a pCR2.1 TOPO-TA cDNA template (100 ng) represented by nucleotide sequence SEQ ID NO: 15. Products (1) and (2) were purified and combined in a

third PCR step (ca. 50 ng each) along with A26 and revKappa primers, to generate the modified 6.22.2 kappa light chain V-domain. This modified version contains Asn/Asp and Gly/Ser changes to the FR3 sequence. The resultant PCR product was cloned into pEE12.1 using HindIII/EcoR1 sites and fully sequence verified. The nucleotide sequence for the modified 6.22.2 kappa light chain is found in SEQ ID NO: 53 and the corresponding amino acid sequence in SEQ ID NO: 54. The changes in the nucleotide and amino acid sequences compared with the parent are indicated.

6.34.2 Heavy chain: PCR primer sets 6.34.2\_VH\_F1 and 6.22.2VH\_CS\* (1) and VH3-30 and 6.34.2\_VH\_R1 (2) were used to generate separate PCR products (1) and (2), using an Expand Taq polymerase and a pCR2.1 TOPO-TA cDNA template (100 ng) represented by nucleotide sequence SEQ ID NO: 17. Products (1) and (2) were purified and combined in a third PCR step (ca. 50 ng each) along with VH3-30 and VK6.22.2\_CS\* primers, to generate the modified 6.34.2 heavy chain V-domain. This modified version contains a Ser/Arg mutation in FR3 and introduces an XbaI restriction site to enable in frame cloning into a pEE6.1 derived vector, termed pEE6.1CH, which contains the corresponding human IgG<sub>2</sub> constant domain. The final PCR fragment was cloned into the



XbaI site of pEE6.1CH, checked for orientation and the insert full sequence verified. The nucleotide sequence for the modified 6.34.2 heavy chain is found in SEQ ID NO: 55 and the corresponding amino acid sequence in SEQ ID NO: 56. The changes in the nucleotide and amino acid sequences compared with the parent are indicated.

6.34.2 kappa light chain: PCR primer sets O12 and 6.34.2\_VK\_R1 (1), 6.34.2\_VK\_F1 and 6.34.2\_VK\_R2 (2), as well as 6.34.2\_VK\_F2 and revKappa (3) were used to generate separate PCR products (1), (2) and (3), using an ExpandTaq polymerase and a pCR2.1 TOPO-TA cDNA template (100 ng) represented by nucleotide sequence SEQ ID NO: 19. Products (1), (2) and (3) were purified and (1) and (2) were combined in a third PCR step (ca. 50 ng each), along with O12 and 6.34.2\_VK\_R2 primers, to generate the PCR product (4). PCR products (2) and (3) were combined in a fourth PCR step (ca. 50 ng each), along with 6.34.2\_VK\_F1 and revKappa, to generate the PCR product (5). PCR products (4) and (5) were purified and combined together (ca. 50 ng each) with primers O12 and revKappa to generate the modified 6.34.2 kappa light chain V-domain. This modified version contains an Asn/Ser change in CDR1, a Phe/Tyr change in FR2 and Arg-Thr/Ser-Ser, Asp/Glu and Ser/Tyr changes to the FR3 sequence. The resultant PCR product was cloned into pEE12.1 using HindII/EcoR1 sites and fully sequence verified. The nucleotide sequence for the modified 6.34.2 kappa light chain is found in SEQ ID NO: 57 and the corresponding amino acid sequence in SEQ ID NO: 58. The changes in the nucleotide and amino acid sequences compared with the parent are indicated.

6.67.1 Heavy chain: PCR primer sets 6.67.1\_VH\_F1 and 6.67.1VH\_CS\* (1) and VH4-4 and 6.67.1\_VH\_R1 (2) were used to generate separate PCR products (1) and (2), using an Expand Taq polymerase and a pCR2.1 TOPO-TA cDNA template (100 ng) represented by nucleotide sequence SEQ ID NO: 21. Products (1) and (2) were purified and combined in a third PCR step (ca. 50 ng each) along with VH4-4 and VK6.67.1\_CS\* primers, to generate the modified 6.67.1 heavy chain V-domain. This modified version contains an Ile-Leu-Ala/Met-Ser-Val conversion in FR3 and introduces an XbaI restriction site to enable in frame cloning into a pEE6.1 derived vector, termed pEE6.1CH, which contains the corresponding human IgG2 constant domain. The final PCR fragment was cloned into the XbaI site of pEE6.1CH, checked for orientation and the insert full sequence verified. The nucleotide sequence for the modified 6.67.1 heavy chain is found in SEQ ID NO: 59 and the corresponding amino acid sequence in SEQ ID NO: 60. The changes in the nucleotide and amino acid sequences compared with the parent are indicated.

6.67.1 kappa light chain: PCR primer sets 6.67.1\_VK\_F1 and revKappa (1), and B3 and 6.67.1\_VK\_R1 (2) were used to generate separate PCR products (1) and (2), using an Expand Taq polymerase and a pCR2.1 TOPO-TA cDNA template (100 ng) represented by nucleotide sequence SEQ ID NO: 23. Products (1) and (2) were purified and combined in a third PCR step (ca. 50 ng each) along with B3 and revKappa primers, to generate the modified 6.67.1 kappa light chain V-domain. This modified version contains a Thr/Asn change in CDR1 and an Arg/Gly change in FR2. The resultant PCR product was cloned into pEE12.1 using HindIII/EcoR1 sites and fully sequence verified. The nucleotide sequence for the modified 6.67.1 kappa light chain is found in SEQ ID NO: 61 and the corresponding amino acid sequence in SEQ ID NO: 62. The changes in the nucleotide and amino acid sequences compared with the parent are indicated.

6.77.1 Heavy chain: PCR primer sets VH 3-21 and 6.22.2VH\_CS\* were used to generate a single PCR product using an Expand Taq polymerase and a pCR2.1 TOPO-TA cDNA template (100 ng) represented by nucleotide sequence SEQ ID NO: 29. The PCR products were digested with XbaI, gel purified and cloned into the XbaI site of pEE6.1CH, checking for orientation. The insert was fully sequence verified. The nucleotide sequence for the modified 6.77.1 heavy chain is found in SEQ ID NO: 63 and the corresponding amino acid sequence in SEQ ID NO: 64. The changes in the nucleotide and amino acid sequences compared with the parent are indicated.

6.77.1 kappa light chain: PCR primer sets A2 and 6.77.1\_VK\_R1 (1), 6.77.1\_VK\_VK\_F1 and 6.77.1\_R2 (2), as well as 6.77.1\_VK\_F2 and revKappa (3) were used to generate separate PCR products (1), (2) and (3), using an Expand Taq polymerase and a pCR2.1 TOPO-TA cDNA template (100 ng) represented by nucleotide sequence SEQ ID NO: 31. Products (1), (2) and (3) were purified and, (1) and (2) were combined in a third PCR step (ca. 50 ng each) along with A2 and 6.77.1\_VK\_R2 primers, to generate PCR product (4). PCR product (2) and (3) were combined in a fourth PCR step (ca. 50 ng each) along with 6.77.1\_VK\_F1 and revKappa primers, to generate PCR product (5). PCR products (4) and (5) were purified and combined together (ca. 50 ng each) with primers A2 and JK2 to generate the modified 6.77.1 kappa light chain V-domain. This modified version contains an Asn/Lys change in CDR1, a Ser/Tyr change in FR3 and a Cys/Ser residue change in CDR3 sequence. The resultant PCR product was cloned into pEE12.1 using HindIII/EcoR1 sites and fully sequence verified. The nucleotide sequence for the modified 6.77.1 kappa light chain is found in SEQ ID NO: 65 and the corresponding amino acid sequence in SEQ ID NO: 66. The changes in the nucleotide and amino acid sequences compared with the parent are indicated.

7.26.4 kappa light chain: PCR primer sets 7.26.4\_VK\_F1 and revKappa (1), and A2 and 7.26.4\_VK\_R1 (2) were used to generate separate PCR products (1) and (2), using an Expand Taq polymerase and a pCR2.1 TOPO-TA cDNA template (100 ng) represented by nucleotide sequence SEQ ID NO: 43. Products (1) and (2) were purified and combined in a third PCR step (ca. 50 ng each) along with A2 and revKappa primers, to generate the modified 7.26.4 kappa light chain V-domain. This modified version contains an Asn/Ser change in CDR1. The resultant PCR product was cloned into pEE12.1 using HindIII/EcoR1 sites and fully sequence verified. The nucleotide sequence for the modified 7.26.4 kappa light chain is found in SEQ ID NO: 67 and the corresponding amino acid sequence in SEQ ID NO: 68. The changes in the nucleotide and amino acid sequences compared with the parent are indicated.

A functional eukaryotic expression vector for each of the modified versions of 6.22.2, 6.34.2, 6.67.1, 6.77.1 and 7.26.4, referred to as 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod and 7.26.4-mod, and representing respectively the heavy chain nucleotide sequences SEQ ID NOS: 51, 55, 59, 63 and 41, and corresponding amino acid sequences SEQ ID NOS: 52, 56, 60, 64 and 42, as well as the kappa light chain nucleotide sequences SEQ ID NOS: 53, 57, 61, 65 and 67, and the corresponding amino acid sequences SEQ ID NOS: 54, 58, 62, 66 and 68 were assembled as follows: The heavy chain cDNA inserts corresponding to 6.22.2-mod, 6.34.2-mod, 6.67.1-mod and 6.77.1-mod were excised from the pEE6.1CH vector with NotI/SalI, the parental version of the heavy chains of 7.26.4 was excised from the pEE6.1 vector with NotI/SalI, and the purified fragments were cloned into identical sites into the corresponding pEE12.1 vector contain-



ing the modified versions of the kappa light chain sequences 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod and 7.26.4-mod. The sequences of the vectors were confirmed, and purified amounts used in transient transfections with HEK 293T cells. Briefly,  $9 \times 10^6$  HEK 293T cells, seeded in a T165 flask the day before transfection and washed into Opti-mem, were transiently transfected with vector cDNAs corresponding to 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod and 7.26.4-mod (40  $\mu$ g) using Lipofectamine PLUS (Invitrogen) according to manufacturer's instructions. The cells were incubated for 3 hrs, then the transfection media replaced with DMEM (Invitrogen 21969-035) media containing 10% ultra-low IgG fetal calf serum (Invitrogen 16250-078) and L-Glutamine (50 mL). The media supernatant was harvested 5 days later, filter sterilised and the anti-MAdCAM antibody purified using protein G sepharose affinity chromatography, in a similar manner as to that described above. The amount of antibody recovered (20-100  $\mu$ g) was quantified by a Bradford assay.

The anti-MAdCAM activity of affinity purified antibody corresponding to 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod and 7.26.4-mod was assessed in the MAdCAM-IgG1-Fc fusion assay as described previously. The  $IC_{50}$  values of these anti-MAdCAM antibodies compared with the parental anti-MAdCAM antibodies from which they were derived are presented in Table 13. There was minimal effect of the amino acid substitutions described above on the activity of the modified anti-MAdCAM antibodies compared with their parents was minimal. The antibodies also maintained their binding to CHO cells expressing recombinant human MAdCAM or the cynomolgus/human MAdCAM chimera.

TABLE 13

| Activity of modified versions of anti-MAdCAM antibodies, 6.22.2-mod, 6.34.2-mod, 6.67.1-mod, 6.77.1-mod and 7.26.4-mod compared with their parents. |  |          |
|---|--|----------|
| CLONE   | MAdCAM IgG1 Fc fusion Assay Mean $IC_{50}$ ( $\mu$ g/mL) |          |
|   | Parent   | Modified |
| 6.22.2  | 0.018  | 0.058    |
| 6.34.2  | 0.013  | 0.049    |
| 6.67.1  | 0.013  | 0.037    |
| 6.77.1  | 0.022  | 0.077    |
| 7.26.4  | 0.021  | 0.033    |

## Example VI

Increase in  $\mu_7^+$  Lymphocytes in the Peripheral Circulation by Blocking Anti-MAdCAM Antibodies

An assay was developed to identify and correlate a mechanistic effect of an anti-MAdCAM antibody and its circulating level in blood. An inhibitory anti-MAdCAM antibody should have the effect of inhibiting the recruitment of leukocytes expressing the  $\alpha_4\beta_7$  integrin to the gastrointestinal tract. Classes of  $\alpha_4\beta_7$  integrin-bearing leukocytes should, therefore, be restricted to the peripheral circulation

This was demonstrated with a fully human anti-human MAdCAM mAb 7.16.6, in cynomolgus.

Purified anti-human MAdCAM mAb 7.16.6 (1 mg/kg) or vehicle (20 mM NaAcetate, 0.2 mg/mL polysorbate 80, 45 mg/mL mannitol, and 0.02 mg/mL EDTA at pH 5.5) were assessed in a similar manner by intravenous administration via the saphenous vein to two groups of cynomolgus monkeys

(n=4/group). At day 3 post-dosing blood samples were collected in EDTA tubes by femoral venipuncture. LPAM specific antibodies, which crossreact with the cynomolgus  $\alpha_4\beta_7$  integrin, are not commercially available, so an anti- $\beta_7$  antibody (recognising  $\alpha_4\beta_7$  and  $\alpha_E\beta_7$  integrin) was used instead. Antibodies (30  $\mu$ L), according to the following table, table 15, were added to tubes containing 100  $\mu$ L of cynomolgus blood, mixed by gentle vortexing and incubated for 20-30 mins at 4° C.

TABLE 15

| Antibodies (BD Pharmingen) used in immunophenotyping of cynomolgus blood |                     |
|--|---------------------|
| Catalogue Number   | Antibody or Isotype |
| 555748   | mIgG1, k-FITC       |
| 555844   | mIgG2a, k-PE        |
| 559425   | mIgG1-PerCP         |
| 555751   | mIgG1, k-APC        |
| 555728   | CD 28-FITC          |
| 555945   | $\beta_7$ -PE       |
| 558814   | CD 95-APC           |
| 550631   | CD 4-PerCP          |

To each tube, 1 mL of 1:10 FACSlyse solution (BD # 349202) was added, mixed by gentle vortex and incubated at room temperature for approximately 12 minutes in the dark until red blood cell lysis was complete. Then 2 mL of BD stain buffer (# 554656) was added to each tube, mixed and centrifuged at 250 $\times$ g for 6-7 mins at room temperature. The supernatant was decanted and the pellet resuspended in 3 mL of stain buffer, mixed again and centrifuged at 250 $\times$ g for 6-7 mins at room temperature. Cytifix buffer (BD # 554655), containing w/v paraformaldehyde (100  $\mu$ L) was added to the cell pellets from monkey peripheral blood and mixed thoroughly by low/moderate speed of vortexer. The samples were kept at 4° C. in the dark until they acquired on the FACSCalibur. Just prior to acquisition, PBS (100  $\mu$ L) was added to all tubes immediately before acquisition. The absolute cell numbers of  $CD4^+\beta_7^+CD95^loCD28^+$  (naïve),  $CD4^+\beta_7^+CD95^hiCD28^+$  (central memory),  $CD4^+\beta_7^-CD95^hiCD28^+$  (central memory),  $CD4^+\beta_7^+CD95^hiCD28^-$  (effector memory) were acquired by appropriate gating and quadrant analyses. Other T cell subsets for example,  $CD8^+$  T central memory cell ( $\beta_7^+CD8^+CD28^+CD95^+$ ) and any other leukocytes bearing a MAdCAM ligand, may also be analyzed by this method with the appropriate antibodies. Compared with the vehicle control, anti-MAdCAM mAb 7.16.6 caused an approximate 3 fold increase in the levels of circulating  $CD4^+\beta_7^+CD95^hiCD28^+$  central memory T cells, as shown in FIG. 7. There were no effects on the population of circulating  $CD4^+\beta_7^-CD95^hiCD28^+$  central memory T cells, indicating that the effect of anti-MAdCAM mAb 7.16.6 is specific for gut homing T cells. The effects of anti-MAdCAM mAb 7.16.6, in cynomolgus, on populations of circulating ( $\alpha_4$ ) $\beta_7^+$  lymphocytes indicates that this is a robust surrogate proof of mechanism biomarker, particularly in the context of practical application in a clinical setting.

## Sequences

SEQ ID NO: 1-48 and 51-68 provide nucleotide and amino acid sequences of the heavy and kappa light chains for twelve human anti-MAdCAM antibodies, nucleotide and amino acid sequences of cynomolgus MAdCAM  $\alpha_4\beta_7$  binding domain sequences and nucleotide and amino acid sequences of five modified human anti-MAdCAM antibodies.

SEQ ID NO: 1-48 provide the heavy and kappa light chain nucleotide and amino acid sequences of twelve human mono-



clonal anti-MAdCAM antibodies: 1.7.2 (SEQ ID NO: 1-4), 1.8.2 (SEQ ID NO: 5-8), 6.14.2 (SEQ ID NO: 9-12), 6.22.2 (SEQ ID NO: 13-16), 6.34.2 (SEQ ID NO: 17-20), 6.67.1 (SEQ ID NO: 21-24), 6.73.2 (SEQ ID NO: 25-28), 6.77.1 (SEQ ID NO: 29-32), 7.16.6 (SEQ ID NO: 33-36), 7.20.5 (SEQ ID NO: 37-40), 7.26.4 (SEQ ID NO: 41-44), and 9.8.2 (SEQ ID NO: 45-48).

SEQ ID NO: 49-50 provide the nucleotide and amino acid sequences of a cynomolgus MAdCAM  $\alpha_4\beta_7$  binding domain.

SEQ ID NO: 51-68 provide the heavy and kappa light chain nucleotide and amino acid sequences for the modified monoclonal anti-MAdCAM antibodies: 6.22.2 (SEQ ID NO:

51-54), modified 6.34.2 (SEQ ID NO: 55-58), modified 6.67.1 (SEQ ID NO: 59-62), modified 6.77.1 (SEQ ID NO: 63-66) and the kappa light chain nucleotide and amino acid sequences of modified monoclonal anti-MAdCAM antibody: modified 7.26.4 (SEQ ID NO: 67-68).

SEQ ID NOS: 70-106 and 108-110 provide various primer sequences.

Key:

Signal sequence: underlined lower case

Amino acid changes in modified anti-MAdCAM antibodies sequence compared to parent: underlined upper case

SEQ ID NO. 1

1.7.2 Heavy Chain Nucleotide Sequence

1 atggagtttg ggctgagctg gattttcctt gctgctat ttt taaaaggtgt

51 ccagtgtGAG GTGCAGCTGG TGGAGTCTGG GGGAGGCTTG GTGAAGCCTG

101 GGGGGTCCCT TAGACTCTCC TGTGTAGCCT CTGGATTCAC TTCTACTAAC

151 GCCTGGATGA TCTGGGTCCG CCAGGCTCCA GGAAGGGGC TGGAGTGGGT

201 TGGCCGTATT AAAAGGAAAA CTGATGGTGG GACAACAGAC TACGCTGCAC

251 CCGTGAAAGG CAGATTCACC ATCTCAAGAG ATGATTCAA AACACGCTG

301 TATCTGCAAA TGAACAGCCT GAAAACCGAG GACACAGCCG TGTATTACTG

351 TACCACAGGG GGAGTGGCTG AGGACTACTG GGGCCAGGGA ACCCTGGTCA

401 CCGTCTCCTC AGCCTCCACC AAGGGCCCAT CGGTCTTCCC CCTGGCGCCC

451 TGCTCCAGGA GCACCTCCGA GAGCACAGCG GCCCTGGGCT GCCTGGTCAA

501 GGACTIONTTC CCCGAACCGG TGACGGTGTC GTGGAICTCA GCGCTCTGA

551 CCAGCGGCGT GCACACCTTC CCAGCTGTCC TACAGTCTTC AGGACTCTAC

601 TCCCTCAGCA GCGTGGTGAC CGTGCCCTCC AGCAACTTCG GCACCCAGAC

651 CTACACCTGC AACGTAGATC ACAAGCCCAG CAACACCAAG GTGGACAAGA

701 CAGTTGAGCG CAAATGTTGT GTCGAGTGCC CACCGTGCCC AGCACCACCT

751 GTGGCAGGAC CGTCAGTCTT CCTCTTCCCC CCAAACCCA AGGACACCCT

801 CATGATCTCC CGGACCCCTG AGGTCACGTG CGTGGTGGTG GACGTGAGCC

851 ACGAAGACCC CGAGGTCCAG TTCAACTGGT ACGTGGACGG CGTGGAGGTG

901 CATAATGCCA AGACAAAGCC ACGGGAGGAG CAGTTCAACA GCACGTTCCG

951 TGTGGTCAGC GTCCTCACCG TTGTGCACCA GGACTIONTTC AACGGCAAGG

1001 AGTACAAGTG CAAGGTCTCC AACAAAGGCC TCCCAGCCCC CATCGAGAAA

1051 ACCATCTCCA AAACCAAAGG GCAGCCCCGA GAACCACAGG TGTACACCCT

1101 GCCCCATCC CGGGAGGAGA TGACCAAGAA CCAGGTGAGC CTGACCTGCC

1151 TGGTCAAAGG CTTCTACCCC AGCGACATCG CCGTGGAGTG GGAGAGCAAT

1201 GGGCAGCCGG AGAACAATA CAAGACCACA CCTCCCATGC TGGACTCCGA

1251 CGGCTCCTTC TTCCTCTACA GCAAGCTCAC CGTGGACAAG AGCAGGTGGC

1301 AGCAGGGGAA CGTCTTCTCA TGCTCCGTGA TGCATGAGGC TCTGCACAAC

1351 CACTACACGC AGAAGAGCCT CTCCTGTCT CCGGTAAAT GA

SEQ ID NO. 2

1.7.2 Predicted Heavy Chain Protein Sequence

1 mefglswifl aailkqvqcE VQLVESGGGL VKPGGSLRLS CVASGFTFTN

51 AWMIWVRQAP GKGLEWVGRI KRKTDGGTTD YAAPVKGRFT ISRDDSKNTL

101 YLQMNSLKTE DTAVYYCTTG GVAEDYWGQG TLVTVSSAST KGPSVFLPLAP



- continued

151 CSRSTSESTA ALGCLVKDYF PEPVTVSWNS GALTSGVHTF PAVLQSSGLY  
 201 SLSSVVTVPA SNFGTQTYTC NVDHKPSNTK VDKTVERKCC VECPPCPAPP  
 251 VAGPSVFLFP PKPKDTLMIS RTPEVTCVVV DVSHEDPEVQ FNWYVDGVEV  
 301 HNAKTKPREE QFNSTFRVVS VLTVVHQDWL NGKEYKCKVS NKGLPAPIEK  
 351 TISKTKGQPR EPQVYTLPPS REEMTKNQVS LTCLVKGFYP SDIAVEWESN  
 401 GQPENNYKTT PPM LDSGSF FLYSKLTVDK SRWQQGNVFS CSVMHEALHN  
 451 HYTQKSLSL S PGK

SEQ ID NO. 3

1.7.2 Kappa Light Chain Nucleotide Sequence

1 atgaggtctcc ctgctcagct cctggggctg ctaatgctct gggtctctgg  
 51 atccagtggg GATATTGTGA TGA CT CAGTC TCCACTCTCC CTGCCCGTCA  
 101 CCCCTGGAGA GCCGCCTCC ATCTCCTGCA GGTCTAGTCA GAGCCTCCTG  
 151 CAAAGTAATG GATACA ACTA TTTGGATTGG TACCTGCAGA AGCCAGGGCA  
 201 GTGTCCACAG CTCCTGATCT ATTTGGGTTC TAATCGGGCC TCCGGGGTCC  
 251 CTGACAGGTT CAGTGGCAGT GGATCAGGCA CAGATTTTAC ACTGAAAATC  
 301 AGCAGAGTCC AGGCTGAGGA TGTGGGGT TATTACTGCA TGCAAGCTCT  
 351 ACAA ACTATC ACCTTCGGCC AAGGGACACG ACTGGAGATT AACGAACTG  
 401 TGGCTGCACC ATCTGTCTTC ATCTCCCGC CATCTGATGA GCAGTTGAAA  
 451 TCTGGA ACTG CCTCTGTTGT GTGCCTGCTG AATAACTTCT ATCCAGAGA  
 501 GGCCAAAGTA CAGTGAAGG TGGATAACGC CCTCCAATCG GGTA ACTCCC  
 551 AGGAGAGTGT CACAGAGCAG GACAGCAAGG ACAGCACCTA CAGCCTCAGC  
 601 AGCACCTGA CGCTGAGCAA AGCAGACTAC GAGAAACACA AAGTCTACGC  
 651 CTGCGAAGTC ACCCATCAGG GCCTGAGCTC GCCCGTCACA AAGAGCTTCA  
 701 ACAGGGGAGA GTGTTAGTGA

SEQ ID NO. 4

1.7.2 Predicted Kappa Light Chain Protein Sequence

1 mrlpagllgl lmlwvsqssg DIVMTQSPLS LPVTPGEPAS ISCRSSQSL L  
 51 QSNGYNYLDW YLQKPGQSPQ LLIYLGSNRA SGVPDRFSGS GSGTDFTLKI  
 101 SRVEAEDVGV YYCMQALQTI TFGQTRLEI KRTVAAPSVF IFPPSDEQLK  
 151 SGTASVVCLL NNFYPREAKV QWKVDNALQS GNSQESVTEQ DSKDSTYSLS  
 202 STLTLKADY EKHKVYACEV THQGLSSPVT KSFNRGEC

SEQ ID NO. 5

1.8.2 Heavy Chain Nucleotide Sequence

1 atggagtttg gqctgagctg gattttcett gctgctat tt taaaaggtgt  
 51 ccagtgtgag GTGCAGCTGG TGGAGTCTGG GGGAGGCTTG GTGAAGCCTG  
 101 GGGGTCCCT TAGACTCTCC TGTGTAGTCT CTGGATTAC TTTCACTAAC  
 151 GCCTGGATGA TCTGGTCCG CCAGGCTCCA GGAAGGGGC TGGAGTGGGT  
 201 TGGCCGTATT AAAAGGAAA CTGATGGTGG GACAACAGAC TACGCTGCAC  
 251 CCGTGAAAGG CAGATTCACC ATCTCAAGAG ATGATTCAA AAACACGCTG  
 301 TATCTGCAA TGAACAGCCT GAAAACCGAG GACACAGCCG TGTATTACTG  
 351 TACCACAGGG GGAGTGGCTG AGGACTACTG GGGCCAGGGA ACCCTGGTCA  
 401 CCGTCTCCTC AGCCTCCACC AAGGGCCCAT CCGTCTTCCC CCTGGCGCCC  
 451 TGCTCCAGGA GCACCTCCGA GAGCACAGCG GCCCTGGGCT GCCTGGTCAA  
 501 GGACTACTTC CCCGAACCGG TGACGGTGTC GTGGA ACTCA GCGCTCTGA



- continued

551 CCAGCGGCGT GCACACCTTC CCAGCTGTCC TACAGTCCTC AGGACTCTAC  
601 TCCCTCAGCA GCGTGGTGAC CGTGCCCTCC AGCAACTTCG GCACCCAGAC  
651 CTACACCTGC AACGTAGATC ACAAGCCCAG CAACACCAAG GTGGACAAGA  
701 CAGTTGAGCG CAAATGTTGT GTCGAGTGCC CACCGTGCCC AGCACCACCT  
751 GTGGCAGGAC CGTCAGTCTT CCTCTTCCCC CCAAACCCA AGGACACCCT  
801 CATGATCTCC CGGACCCCTG AGGTCACGTG CGTGGTGGTG GACGTGAGCC  
851 ACGAAGACCC CGAGGTCCAG TTCAACTGGT ACGTGGACGG CGTGGAGGTG  
901 CATAATGCCA AGACAAAGCC ACGGGAGGAG CAGTTCAACA GCACGTTCCG  
951 TGTGGTCAGC GTCCTACCG TTGTGCACCA GACTGGCTG AACGGCAAGG  
1001 AGTACAAGTG CAAGGTCTCC AACAAAGGCC TCCCAGCCCC CATCGAGAAA  
1051 ACCATCTCCA AAACCAAAGG GCAGCCCCGA GAACCACAGG TGTACACCCT  
1101 GCCCCATCC CGGGAGGAGA TGACCAAGAA CCAGGTCAGC CTGACCTGCC  
1151 TGGTCAAAGG CTTCTACCCC AGCGACATCG CCGTGGAGTG GGAGAGCAAT  
1201 GGGCAGCCGG AGAACAACTA CAAGACCACA CCTCCCATGC TGGACTCCGA  
1251 CGGCTCCTTC TTCCTCTACA GCAAGCTCAC CGTGGACAAG AGCAGGTGGC  
1301 AGCAGGGGAA CGTCTTCTCA TGCTCCGTGA TGCATGAGGC TCTGCACAAC  
1351 CACTACACGC AGAAGAGCCT CTCCCTGTCT CCGGGTAAAT GA

SEQ ID NO. 6

1.8.2 Predicted Heavy Chain Protein Sequence

1 mefqlswifl aailkqvqcE VQLVESGGGL VKPGGSLRLS C VVS<sup>G</sup>FTFTN  
51 AQMIQVRQAP GKGLEWVGRI KRKTDGGTTD YAAPVKGRFT ISRRD<sup>S</sup>KNTL  
101 YLQMN<sup>S</sup>LKTE DTAVYYCTTG GVAEDYWGQG TLVTVSSAST KGPSV<sup>F</sup>PLAP  
151 CSRSTSESTA ALGCLVKDYF PEPVTVSWNS GALTSGVHTF PAVLQSSGLY  
201 SLSSVVTVPS SNFGTQTYTC NVDHKPSNTK VDKTVERKCC VECPPCPAPP  
251 VAGPSVFLFP PKPKDTLMIS RTPEVTCVVV DVSHEDPEVQ FNWYVDGVEV  
301 HNAKTKPREE QFNSTFRVVS VLT<sup>V</sup>VHQDWL NGKEYKCKVS NKGLPAPIEK  
351 TISKTKGQPR EPQVYTLPPS REEMTKNQVS LTCLVKGFYP SDIAVEWESN  
401 GQPENNYKTT PPM<sup>L</sup>DS<sup>D</sup>GSF FLYSKLTVDK SEWQ<sup>Q</sup>GNVFS CSVMHEALHN  
451 HYTQKSL<sup>S</sup>LSL PGK

SEQ ID NO. 7

1.8.2 Kappa Light Chain Nucleotide Sequence

1 atgaggctcc ctgctcagct cctggggctg ctaatgctct ggg<sup>t</sup>ctctg<sup>g</sup>  
51 atccagtggg GATATTGTGA TGA<sup>C</sup>TCA<sup>G</sup>TC TCCACTCTCC CTGCCC<sup>G</sup>TCA  
101 CCCCTGGAGA GCCGCCTCC ATCTCCTGCA GGTCTAGTCA GAGCCTCCTG  
151 CAAAGTAATG GATTCAACTA TTTGGATTGG TACCTGCAGA AGCCAGGGCA  
201 GTCTCCACAG CTCCTGATCT ATTTGGGTTT TAATCGGGCC TCCGGGTCC  
251 CTGACAGGTT CAGTGGCAGT GGGTCAGGCA CAGATTTTAC ACTGAAAATC  
301 AGCAGAGTGG AGGCTGAGGA TGTTGGGGTT TATTACTGCA TGCAAGCTCT  
351 ACAAACTATC ACCTTCGGCC AAGGGACACG ACTGGAGATT AAACGAACTG  
401 TGGCTGCACC ATCTGTCTTC ATCTTCCCGC CATCTGATGA GCAGTTGAAA  
451 TCTGGA<sup>A</sup>CTG CCTCTGTTGT GTGCCTGCTG AATAACTTCT ATCCCAGAGA  
501 GGCCAAAGTA CAGTGAAGG TGGATAACGC CCTCCAATCG GGTA<sup>A</sup>CTCCC  
551 AGGAGAGTGT CACAGAGCAG GACAGCAAGG ACAGCACCTA CAGCCTCAGC



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601 AGCACCTGA CGCTGAGCAA AGCAGACTAC GAGAAACACA AAGTCTACGC  
 651 CTGCGAAGTC ACCCATCAGG GCCTGAGCTC GCCCGTCACA AAGAGCTTCA  
 701 ACAGGGGAGA GTGTTAGTGA

SEQ ID NO. 8

1.8.2 Predicted Kappa Light Chain Protein Sequence

1 mrlpagllgl lmlwvsgssg DIVMTQSPLS LPVTPGEPAS ISCRSSQSLL  
 51 QSNGFNYLDW YLQKPGQSPQ LLIYLGSNRA SGVPDEFSGS GSGTDFTLKI  
 101 SRVEAEDVGV YYCMQALQTI TFGQTRLEI KRTVAAPSVF IFPPSDEQLK  
 151 SGTASVVCLL NNFYPREAKV QWKVDNALQS GNSQESVTEQ DSKDSTYSLS  
 202 STLTLISKADY EKHKVYACEV THQGLSSPVT KSFNRGEC

SEQ ID NO. 9

6.14.2 Heavy Chain Nucleotide Sequence

1 atggagtttg gctgagctg gctttttctt gtggctattt taaaaggtgt  
 51 ccagtgtGAG GTGCAGCTGT TGGAGTCTGG GGGAGGCTTG GTACAGCCTG  
 101 GGGGGTCCCT GAGACTCTCC TGTGCAGCCT CTGGACTCAC CTTTACAAT  
 151 TCTGCCATGA CCTGGGTCCG CCAGGCTCCA GGAAGGGGC TGGAGTGGGT  
 201 CTCAACTACT AGTGAAGTG GTGGTACCAC ATACTACGCA GACTCCGTGA  
 251 AGGGCCGGTT CACCATCTCC AGAGACTCTC CCAAGAACAC GCTCTATCTG  
 301 CAAATGAACA GCCTGAGAGC CGAGGACACG GCCGTATATT ACTGTGCGGC  
 351 CCGTGGATAC AGCTATGGTA CGACCCCTA TGAGTACTGG GGCCAGGGAA  
 401 CCCTGGTCAC CGTCTCTCA GCTTCCACCA AGGGCCATC CGTCTTCCC  
 451 CTGGCGCCCT GTTCCAGGAG CACCTCCGAG AGCACAGCCG CCCTGGGCTG  
 501 CCTGGTCAAG GACTACTTCC CCGAACCAGT GACGGTGTCTG TGGAACTCAG  
 551 GCGCCCTGAC CAGCGCGTG CACACCTTCC CGGCTGTCCT ACAGTCCTCA  
 601 GGACTCTACT CCCTCAGCAG CGTGGTGACC GTGCCCTCCA GCAGCTGGG  
 651 CACGAAGACC TACACCTGCA ACGTAGATCA CAAGCCAGC AACACCAAGG  
 701 TGGACAAGAG AGTTGAGTCC AAATATGGTC CCCCATGCCC ATCATGCCA  
 751 GCACCTGAGT TCCTGGGGG ACCATCAGTC TTCCTGTTCC CCCCCAAC  
 801 CAAGGACACT CTCATGATCT CCCGGACCCC TGAGGTCACG TGCCTGGTGG  
 851 TGGACGTGAG CCAGGAAGAC CCCGAGGTCC AGTTCAACTG GTACGTGGAT  
 901 GCGGTGGAGG TGCATAATGC CAAGACAAAG CCGCGGGAGG AGCAGTTCAA  
 951 CAGCACGTAC CGTGTGGTCA GCGTCCTCAC CGTCTGCAC CAGGACTGGC  
 1001 TGAACGGCAA GGAGTACAAG TGCAAGGTCT CCAACAAAGG CCTCCCGTCC  
 1051 TCCATCGAGA AAACCATCTC CAAAGCCAAA GGGCAGCCCC GAGAGCCACA  
 1101 GGTGTACACC CTGCCCCAT CCCAGGAGGA GATGACCAAG AACCAGGTCA  
 1151 GCCTGACCTG CCTGGTCAA GGCTTCTACC CCAGCGACAT CGCCGTGGAG  
 1201 TGGGAGAGCA ATGGGCAGCC GGAGAACAAC TACAAGACCA CGCTCCCGT  
 1251 GCTGGACTCC GACGGCTCCT TCTTCTCTA CAGCAGGCTA ACCGTGGACA  
 1301 AGAGCAGGTG GCAGGAGGG AATGTCTTCT CATGCTCCGT GATGCATGAG  
 1351 GCTCTGCACA ACCACTACAC ACAGAAGAGC CTCTCCCTGT CTCTGGGTAA  
 1401 ATGA



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SEQ ID NO. 10

6.14.2 Predicted Heavy Chain Protein Sequence

1 mefqlwelfl vailkqvqcE VQLLESGGGL VQPGGSLRLS CAASGLTFNN  
 51 SAMTWVRQAP GKGLEWVSTT SGSGGTTYA DSVKGTFTIS RDSPKNTLYL  
 101 QMNSLRAEDT AVYYCAARGY SYGTPYEYW GQGLVTVSS ASTKGPSVFP  
 151 LAPCSRSTSE STAALGCLVK DYFPEPVTVS WNSGALTSGV HTPPAVLQSS  
 201 GLYSLSSVVT VPSSSLGTKT YTCNVDHKPS NTKVDRVES KYGPPCPSCP  
 251 APEFLGGPSV FLFPPKPKDT LMISRTPEVT CVVVDVSQED PEVQFNWYVD  
 301 GVEVHNAKTK PREEQFNSTY RVVSVLTVLH QDWLNGKEYK CKVSNKGLPS  
 351 SIEKTISKAK GQPREPQVYT LPPSQEEMTK NQVSLTCLVK GFYPSDIAVE  
 401 WESNGQPENN YKTPPVLDL DGSFFLYSRL TVKDSRWQEG NVFSCSVMHE  
 451 ALHNHYTQKS LSLSLGK

SEQ ID NO. 11

6.14.2 Kappa Light Chain Nucleotide Sequence

1 atggacatga gggtccccgc tcagctcctg gggtcctgc tactctggt  
 51 ccgaggggccc agatgtGACA TCCAGATGAC CCAGTCTCCA TCCTCCCTGT  
 101 CTGCATCTGT AGGAGACAGA GTCACCATCA CTTGAAGGGC AAGTCGGAGC  
 151 ATTAGCAGCT ATTTAAATTG GTATCAGCAG AAACCAGGGA AAGCCCCTAA  
 201 AGTCCTGATC TTTTTGTGT CCAGTTTGCA AAGTGGGGTC CCATCAAGGT  
 251 TCAGTGGCAG TGGCTCTGGG ACAGATTCA CTCTACCAT CAGCAGTCTG  
 301 CAACCTGAAG ATTTTGCAAC TTACTACTGT CAACAGAATT ACATCCCCC  
 351 TATTACCTTC GGCCAGGGGA CACGACTGGA GATCAGACGA ACTGTGGCTG  
 401 CACCATCTGT CTTTATCTTC CCGCCATCTG ATGAGCAGTT GAAATCTGGA  
 451 ACTGCCTCTG TTGTGTGCCT GCTGAATAAC TTCTATCCA GAGAGGCCAA  
 501 AGTACAGTGG AAGGTGGATA ACGCCCTCCA ATCGGGTAAC TCCCAGGAGA  
 551 GTGTCACAGA GCAGGACAGC AAGGACAGCA CCTACAGCCT CAGCAGCACC  
 601 CTGACGCTGA GCAAAGCAGA CTACGAGAAA CACAAAGTCT ACGCCTGCGA  
 651 AGTCACCCAT CAGGGCCTGA GCTCGCCCGT CACAAAGAGC TTCAACAGGG  
 701 GAGAGTGTTA G

SEQ ID NO. 12

6.14.2 Predicted Kappa Light Chain Protein Sequence

1 mdmrvpagll gllllwlrqa rcDIQMTMSP SLSASVGDV VTITCRASRS  
 51 ISSYLNWYQQ KPGKAPKVLV FVSSLQSGV PSRFSGSGSG TDFTLTISSL  
 101 QPEDFATYYC QQNYIPPITF GQTRLEIRR TRAAPSVFIF PPSREQLKSG  
 151 TASVVCLLNN FYPREAKVQW KVDNALQSGN SQESVTEQDS KDSTYLSST  
 202 LTLISKADYEK HKVYACEVTH QGLWVPVYKS FNRGEC

SEQ ID NO. 13

6.22.2 Heavy Chain Nucleotide Sequence

1 atggagtttg gqctgagctg ggttttcctc ggtgctcttt taagaggtgt  
 51 ccagtgtCAG GTGCAGCTGG TGGAGTCTGG GGGAGGCGTG GTCCAGCCTG  
 101 GGAGGTCCCT GAGACTCTCC TGTGCAGCGT CTGGACACAC CTTAGTAGC  
 151 GATGGCATGC ACTGGGTCCG CCAGGCTCCA GGCAAGGGGC TGGAGTGGGT  
 201 GGCAATTATA TGGTATGATG GAAGTAATAA ATATTATGCA GACTCCGTGA  
 251 AGGGCCGATT CACCATCTCC AGAGACAATT CCAAGAACAC GCTGTATCTG  
 301 CAAATGAACA GCCTGAGAGC CGAGGACACG GCTGTATATT ACTGTGCGAG



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351 AGATCCCGGC TACTATTACG GTATGGACGT CTGGGGCCAA GGGACCACGG  
 401 TCACCGTCTC CTCAGCTTCC ACCAAGGGCC CATCCGTCTT CCCCCTGGCG  
 451 CCCTGCTCCA GGAGCACCTC CGAGAGCACA GCCGCCCTGG GCTGCCTGGT  
 501 CAAGGACTAC TTCCCCGAAC CGGTGACGGT GTCGTGGAAC TCAGGCGCCC  
 551 TGACCAGCGG CGTGCACACC TTCCCGGCTG TCCTACAGTC CTCAGGACTC  
 601 TACTCCCTCA GCAGCGTGGT GACCGTGCCC TCCAGCAGCT TGGGCACGAA  
 651 GACCTACACC TGCAACGTAG ATCACAAGCC CAGCAACACC AAGGTGGACA  
 701 AGAGAGTTGA GTCCAAATAT GGTCCCCCAT GCCCATCATG CCCAGCACCT  
 751 GAGTTCCTGG GGGGACCATC AGTCTTCCTG TTCCCCCAA AACCCAAGGA  
 801 CACTCTCATG ATCTCCCGGA CCCCTGAGGT CACGTGCGTG GTGGTGGACG  
 851 TGAGCCAGGA AGACCCCGAG GTCCAGTTCA ACTGGTACGT GGATGGCGTG  
 901 GAGGTGCATA ATGCCAAGAC AAAGCCGCGG GAGGAGCAGT TCAACAGCAC  
 951 GTACCGTGTG GTCAGCGTCC TCACCGTCCT GCACCAGGAC TGGCTGAACG  
 1001 GCAAGGAGTA CAAGTGCAAG GTCTCCAACA AAGGCCTCCC GTCCTCCATC  
 1051 GAGAAAACCA TCTCCAAAGC CAAAGGGCAG CCCCAGAGC CACAGGTGTA  
 1101 CACCCTGCCC CCATCCCAGG AGGAGATGAC CAAGAACCAG GTCAGCCTGA  
 1151 CCTGCCTGGT CAAAGGCTTC TACCCAGCG ACATCGCCGT GGAGTGGGAG  
 1201 AGCAATGGGC AGCCGGAGAA CAACTACAAG ACCGCGCCTC CCGTGCTGGA  
 1251 CTCCGACGGC TCCTTCTTCC TCTACAGCAG GCTAACCGTG GACAAGAGCA  
 1301 GGTGGCAGGA GGGGAATGTC TTCTCATGCT CCGTGATGCA TGAGGCTCTG  
 1351 CACAACCACT ACACACAGAA GAGCCTCTCC CTGTCTCTGG GTAAATGA

SEQ ID NO. 14

6.22.2 Predicted Heavy Chain Protein Sequence

1 mefqlswvfl vallrqvqcQ VQLVEDGGGV VQPGRSLRLS CAASGHTFSS  
 51 DGMHWVRQAP GKGLEWVAII WYDGSNKYYA DSVKGRFTIS RDNSKNTLYL  
 101 QMNSLRAEDT AVYYCARDPG YYYGMDVWGQ GTTVTVSSAS TKGPSVFPLA  
 151 PCSRSTSEST AALGCLVKDY FPEPVTVSWN SGALTSGVHT FPAVLQSSGL  
 201 YSLSSVVTVP SSSLGTKTYT CNVDHKPSNT KVDKRVESKY GPPCPCPAP  
 251 EFLGGPSVFL FPPKPKDTLM ISRTPEVTCV VVDVSQEDPE VQFNWYVDGV  
 301 EVHNAKTKPR EEQFNSTYRV VSVLTVLHQD WLNKEYKCK VSNKGLPSSI  
 351 EKTISKAKGQ PREPQVYTL PPSQEEMTKNQ VSLTCLVKGF YPSDIAVEWE  
 401 SNGQPENNYK TAPPVLDSDG SFFLYSRLTV DKSRWQEGNV FSCFVMHEAL  
 451 HNHYTQKSL SLSL GK

SEQ ID NO. 15

6.22.2 Kappa Light Chain Nucleotide Sequence

1 atgttgccat cacaactcat tgggtttctg ctgctctggg ttccagcttc  
 51 caggggtGAA ATTGTGCTGA CTCAGTCTCC AGACTTTCAG TCTGTGACTC  
 101 CAAAAGAGAA AGTCACCATC ACCTGCCGGG CCAGTCAGAG AATTGGTAGT  
 151 AGCTTACTACT GGTACCAGCA GAAACCAGAT CAGTCTCCAA AACTCCTCAT  
 201 CAAGTATGCT TCCAGTCTCT TCTCAGGGGT CCCCTCGAGG TTCAGTGGCA  
 251 GTGGATCTGG GACAAATTTT ACCCTCACCA TCAATGGCCT GGAAGCTGAA  
 301 GATGCTGCAA CTTATTACTG TCTCCAGAGT GGTGCTTTAC CGCTCACTTT  
 351 CGGCGGAGGG ACCAAGGTGG AGATCAAACG AACTGTGGCT GCACCATCTG



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401 TCTTCATCTT CCCGCCATCT GATGAGCAGT TGAATCTGG AACTGCCTCT  
 451 GTTGTGTGCC TGCTGAATAA CTTCTATCCC AGAGAGGCCA AAGTACAGTG  
 501 GAAGGTGGAT AACGCCCTCC AATCGGGTAA CTCCAGGAG AGTGTCACAG  
 551 AGCAGGAGAG CAAGGACAGC ACCTACAGCC TCAGCAGCAC CCTGACGCTG  
 601 AGCAAAGCAG ACTACGAGAA ACACAAAGTC TACGCCTGCG AAGTCACCCA  
 651 TCAGGGCCTG AGCTCGCCCG TCACAAAGAG CTTCAACAGG GGAGAGTGTT  
 701 AGTGA

SEQ ID NO. 16

6.22.2 Predicted Kappa Light Chain Protein Sequence

1 mlpsqligfl llwvpasrgE IVLTQSPDFQ SVTPKEKVTI TCRASQRIGS  
 51 SLHWYQKPD QSPKLLIKYA SQSFSGVPSR FSGSGSGTNF TLTINGLEAE  
 101 DAATYYCHQS GRLPLTFGGG TKVEIKRTVA APSVFIFPPS DEQLKSGTAS  
 151 VVCLLNNFYF REAKVQWKVD NALQSGNSQE SVTEQDSKDS TYLSSTLTL  
 201 SKADYEKHKV YACEVTHQGL SSPVTKSFNR GEC

SEQ ID NO. 17

6.34.2 Heavy Chain Nucleotide Sequence

1 atggagtttg ggtgagctg ggttttctc gttgctcttt taagaggtgt  
 51 ccagtgtCAG GTGCAGCTGG TGGAGTCTGG GGGAGGCGTG GTCCAGCCTG  
 101 GGAGGTCCCT GAGACTCTCC TGTGCAGCCT CTGGATTAC CTTCAGTAGC  
 151 TATGGCATGC ACTGGGTCCG CCAGGCTCCA GGCAAGGGGC TGGAGTGGGT  
 201 GGCAGTTATA TCAAATGATG GAAATAATAA ATACTATGCA GACTCCGTGA  
 251 AGGGCCGATT CACCATCTCC AGAGACAATT CCAAAAACAC GCTGTATCTG  
 301 CAAATGAACA GCCTGAGCGC TGAGGACACG GCTGTGTATT ACTGTGCGAG  
 351 AGATAGTACG GCGATAACCT ACTACTACTA CGGAATGGAC GTCTGGGGCC  
 401 AAGGGACCAC GGTACCGTC TCCTCAGCTT CCACCAAGGG CCCATCCGTC  
 451 TTCCCCCTGG CGCCCTGCTC CAGGAGCACC TCCGAGAGCA CAGCCGCCCT  
 501 GGGCTGCCTG GTCAAGGACT ACTTCCCCGA ACCGGTGACG GTGTCGTGGA  
 551 ACTCAGGCGC CCTGACCAGC GGCGTGCACA CCTTCCCGGC TGTCTACAG  
 601 TCCTCAGGAC TCTACTCCCT CAGCAGCGTG GTGACCGTGC CCTCCAGCAG  
 651 CTTGGGCACG AAGACCTACA CCTGCAACGT AGATACAAG CCCAGCAACA  
 701 CCAAGGTGGA CAAGAGAGTT GAGTCCAAAT ATGGTCCCCC ATGCCATCA  
 751 TGCCAGCAC CTGAGTTCTT GGGGGGACCA TCAGTCTTCC TGTCCCCC  
 801 AAAACCCAAG GACACTCTCA TGATCTCCCG GACCCCTGAG GTCACGTGCG  
 851 TGGTGGTGGG CGTGAGCCAG GAAGACCCCG AGGTCCAGTT CAACTGGTAC  
 901 GTGGATGGCG TGGAGGTGCA TAATGCCAAG ACAAAGCCGC GGGAGGAGCA  
 951 GTTCAACAGC ACGTACCGTG TGGTCAGCGT CCTCACCGTC CTGCACCACC  
 1001 ACTGGCTGAA CGGCAAGGAG TACAAGTGCA AGGTCTCCA CAAAGGCCTC  
 1051 CCGTCTCCA TCGAGAAAAC CATCTCCAA GCCAAAGGGC AGCCCCGAGA  
 1101 GCCACAGGTG TACACCCTGC CCCCATCCCA GGAGGAGATG ACCAAGAACC  
 1151 AGGTCAGCCT GACCTGCCTG GTCAAAGGCT TCTACCCAG CGACATCGCC  
 1201 GTGGAGTGGG AGAGCAATGG ACAGCCGGAG AACAACTACA AGACCACGCC  
 1251 TCCCGTGCTG GACTCCGACG GCTCCTTCTT CCTCTACAGC AGGCTAACCG  
 1301 TGGACAAGAG CAGGTGGCAG GAGGGGAATG TCTTCTCATG CTCCGTGATG



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1351 CATGAGGCTC TGCACAACCA CTACACACAG AAGAGCCTCT CCCTGTCTCT  
 1401 GGGTAAATGA

SEQ ID NO. 18

6.34.2 Predicted Heavy Chain Protein Sequence

1 mefqlswvfl vallrqvqcQ VQLVESGGGV VQPGRSLRLS CAASGFTFSS  
 51 YGMHWVRQAP GKGLEWVAVI SNDGNNKYA DSVKGRFTIS RDNSKNTLYL  
 101 QMNSLSAEDT AVYYCARDST AITYYYYGMD VWGQGTTVTV SSASTKGPSV  
 151 FPLAPCSRST SESTAALGCL VKDYFPEPVT VSWNSGALTS GVHTFPAVLQ  
 201 SSGLYSLSSV VTPVSSSLGT KTYTCNVNDHK PSNTKVDKRV ESKYGPPCPS  
 251 CPAPEFLGGP SVFLFPPKPK DTLMISRTPV VTCVVVDVSQ EDPEVQFNWY  
 301 VDGVEVHNAK TKPREEQFNS TYRVVSVLTV LHQDWLNGKE YKCKVSNKGL  
 351 PSSIEKTISK AKGQPREPQV YTLPPSQEEM TKNQVSLTCL VKGFYPSDIA  
 401 VEWESNGQPE NNYKTTPPVL DSDGSFFLYS RLTVDKSRWQ EGNVFSQSV  
 451 HEALHNHYTQ KSLSLSLGLK

SEQ ID NO. 19

6.34.2 Kappa Light Chain Nucleotide Sequence

1 atggacatga gggccccgc tcagctcctg gggctcctgc tactctggct  
 51 ccgaggtgcc agatgtGACA TCCAGATGAC CCAGTCTCCA TCCTCCCTGT  
 101 CTGCATCTGT CGGAGACAGA GTCACCATCA CTGCGCGGC AAGTCAGAAT  
 151 ATTAGTAGCT ATTTAAATTG GTTTCAGCAG AAACCAGGGA AAGCCCCTAA  
 201 GCTCCTGATC TATGCTGCAT CCGGTTTGAA GCGTGGGGTC CCATCACGGT  
 251 TCAGTGGTAG TGGATCTGGG ACAGATTTCA CTCTCACCAT CAGGACTCTG  
 301 CAACCTGATG ATTTTGCAAC TTACTCCTGT CACCAGAGTT ACAGTCTCCC  
 351 ATTCACTTTC GGCCCTGGGA CCAAAGTGA TATCAAACGA ACTGTGGCTG  
 401 CACCATCTGT CTTTCATCTC CCGCCATCTG ATGAGCAGTT GAAATCTGGA  
 451 ACTGCCTCTG TTGTGTGCCT GCTGAATAAC TTCTATCCCA GAGAGGCCAA  
 501 AGTACAGTGG AAGGTGGATA ACGCCCTCCA ATCGGGTAAC TCCAGGAGA  
 551 GTGTACAGA GCAGGACAGC AAGGACAGCA CCTACAGCCT CAGCAGCACC  
 601 CTGACGCTGA GCAAAGCAGA CTACGAGAAA CACAAAGTCT ACGCCTGCGA  
 651 AGTCACCCAT CAGGGCCTGA GCTCGCCCGT CACAAAGAGC TTCAACAGGG  
 701 GAGAGTGTTA GTGA

SEQ ID NO. 20

6.34.2 Predicted Kappa Light Chain Protein Sequence

1 mdmrvpaql l gllllwlrqa rcDIQMTQSP SLSASVGR VTITCRASQ  
 51 ISSYLNWFQQ KPGKAPKLLI YAASGLKRGV PSRFSGSGSG TDFLTIRTLL  
 101 QPDDFATYSC HQSYSLPFTF GPGTKVDIKR TVAAPSVFTF PPSDEQLKSG  
 151 TASVVCLLNN FYPREAKVQW KVDNALQSGN SQESVTEQDS KDSTYLSST  
 201 LTLKADYK HKVYACEVTH QGLSSPVTKS FNRGEC

SEQ ID NO. 21

6.67.1 Heavy Chain Nucleotide Sequence

1 atgaaacacc tqtggttctt cctcctgctg qtggcagctc ccagatgggt  
 51 cctgtccCAG GTGCAGCTGC AGGAGTCGGG CCCAGGACTG GTGAAGCCTT  
 101 CGGAGACCCT GTCCCTCACC TGCACTGTCT CTGGTGACTC CATCAGTAGT  
 151 AACTATTGGA GCTGGATCCG GCAGCCCGCC GGAAGGGAC TGGAGTGGAT  
 201 TGGGCGTATC TATACCAGTG GGGGCACCAA CTCCAACCCC TCCCTCAGGG



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251 GTCGAGTCAC CATTTTAGCA GACACGTCCA AGAACCAGTT CTCTCTGAAA  
301 CTGAGTTCTG TGACCGCCGC GGACACGGCC GTGTATTACT GTGCGAGAGA  
351 TCGTATTACT ATAATTCGGG GACTTATTCC ATCCTTCTTT GACTACTGGG  
401 GCCAGGGAAC CCTGGTCACC GTCTCCTCAG CTTCCACCAA GGGCCCATCC  
451 GTCTTCCCCC TGGCGCCCTG CTCCAGGAGC ACCTCCGAGA GCACAGCCGC  
501 CCTGGGCTGC CTGGTCAAGG ACTACTTCCC CGAACCGGTG ACGGTGTCGT  
551 GGAATCAGG CGAAATGACC AGCGGCGTGC ACACCTTCCC GGCTGTCTTA  
601 CAGTCCTCAG GACTCTACTC CCTCAGCAGC GTGGTGACCG TGCCCTCCAG  
651 CAGCTTGGGC ACGAAGACCT ACACCTGCAA CGTAGATCAC AAGCCCAGCA  
701 ACACCAAGGT GGACAAGAGA GTTGAGTCCA AATATGGTCC CCCATGCCCA  
751 TCATGCCCAG CACCTGAGTT CCTGGGGGGA CCATCAGTCT TCCTGTTCCT  
801 CCCAAAACCC AAGGACACTC TCATGATCTC CCGGACCCCT GAGGTCACGT  
851 GCGTGGTGGT GGACGTGAGC CAGGAAGACC CCGAGGTCCA GTTCAACTGG  
901 TACGTGGATG GCGTGGAGGT GCATAATGCC AAGACAAAGC CGCGGGAGGA  
951 GCAGTTCAAC AGCACGTACC GTGTGGTTCAG CGTCCTCACC GTCCTGCACC  
1001 AGGACTGGCT GAACGGCAAG GAGTACAAGT GCAAGGTCTC CAACAAAGGC  
1051 CTCCCGTCTT CCATCGAGAA AACCATCTCC AAAGCCAAAG GGCAGCCCCG  
1101 AGAGCCACAG GTGTACACCC TGCCCCCATC CCAGGAGGAG ATGACCAAGA  
1151 ACCAGGTCAG CCTGACCTGC CTGGTCAAAG GCTTCTACCC CAGCGACATC  
1201 GCCGTGGAGT GGGAGAGCAA TGGGCAGCCG GAGAACAAC TACAAGACCAC  
1251 GCCTCCCGTG CTGGACTCCG ACGGCTCCTT CTTCTCTAC AGCAGGCTAA  
1301 CCGTGGACAA GAGCAGGTGG CAGGAGGGGA ATGTCTTCTC ATGCTCCGTG  
1351 ATGCATGAGG CTCTGCACAA CCACTACACA CAGAAGAGCC TCTCCCTGTC  
1401 TCTGGGTAAA TGA

SEQ ID NO. 22

6.67.1 Predicted Heavy Chain Protein Sequence

1 mkhlwfflll vaaprwlslq VQLQEDGPGI VKPSETLSLT CTVSGDISS  
51 NYWSWIRQPA GKLEWIGRI YTSGGTNSNP SLRGRVITLA DTSKNQFSLK  
101 LSSVTAADTA VYCARDRIT IIRGLIPSFF DYWGQGLVT VSSASTKGPS  
151 VFPLAPCSRS TSESTAALGC LVKDYFPEPV TVSWNSGALT SGVHTFPAVL  
201 QSSGLYSLSS VVTVPSSSLG TKTYTCNVDH KPSNTKVDKR VESKYGPPCP  
251 SCPAPEFLGG PSVFLFPPKP KDTLMISRTP EVTCVVVDVS QEDPEVQFNW  
301 YVDGVEVHNA KTKPREEQFN STYRVVSVLT VLHQDWLNGK EYCKVSNKG  
351 LPSSIEKTIS KAKQPREPQ VYTLPPSQEE MTKNQVSLTC LVKGFYPSDI  
401 AVEWESNGQP ENNYKTPPV LDSDGSFFLY SRTLVDKSRW QEGNVFSCSV  
451 MHEALHNHYT QKSLSLSLGK

SEQ ID NO. 23

6.67.1 Kappa Light Chain Nucleotide Sequence

1 atggtggtgc agaccaggt cttcatttct ctggtgctct gqatctctgg  
51 tgctacggg GACATCGTGA TGACCCAGTC TCCAGACTCC CTGGCTGTGT  
101 CTCTGGGCGA GAGGGCCACC ATCAACTGCA AGTCCAGCCA GAGTGTTTTA  
151 TACAGCTCCA ACAATAAGAC CTAATTAGCT TGGTACCAAC AGAAACCAAG  
201 ACAGCCTCCT AAATTGCTCA TTTACTGGGC ATCTATACGG GAATATGGGG



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251 TCCCTGACCG ATTCAGTGGC AGCGGGTCTG GGACAGATTT CACTCTCACC  
 301 ATCAGCAGCC TGCAAGCTGA AGATGTGGCA GTTTATTTCT GTCAACAATA  
 351 TTATAGTATT CCTCCCCTCA CTTTCGGCGG AGGGACCAAG GTGGAGATCA  
 401 AACGAACTGT GGCTGCACCA TCTGTCTTCA TCTTCCCGCC ATCTGATGAG  
 451 CAGTTGAAAT CTGGAAGTGC CTCTGTTGTG TGCCTGCTGA ATAACTTCTA  
 501 TCCCAGAGAG GCCAAAGTAC AGTGGGAAGGT GGATAACGCC CTCCAATCGG  
 551 GTAACCTCCA GGAGAGTGTC ACAGAGCAGG ACAGCAAGGA CAGCACCTAC  
 601 AGCCTCAGCA GCACCCTGAC GCTGAGCAA GCAGACTACG AGAAACACAA  
 651 AGTCTACGCC TCGGAAGTCA CCCATCAGGG CCTGAGCTCG CCCGTCACAA  
 701 AGAGCTTCAA CAGGGGAGAG TGTTAGTGA

SEQ ID NO. 24

6.67.1 Predicted Kappa Light Chain Protein Sequence

1 mvlqtqvfis lllwisfayg DIVMTQSPDS LAVSLGERAT INCKSSQSVL  
 51 YSSNNKTYLA WYQQKPRQPP KLLIYWASIR EYGVPRDFSG SGSSTDFTLT  
 101 ISSLQAEDVA VYFCQQYYSI PPLTFGGGTK VEIKRTVAAP SVFIFPPSDE  
 151 QLKSGTASVV CLLNFPYPRE AKVQWKVDNA LQSGNSQESV TEQDSKDYTY  
 201 SLSSTLTLSK ADYEKHKVYA CEVTHQGLSS PVTKSFNRGE C

SEQ ID NO. 25

6.73.2 Heavy Chain Nucleotide Sequence

1 atggagtttg gctgagctg gctttttctt gtggctat tttaaaaggtgt  
 51 ccagtgtGAG GTGCAGCTGT TGGAGTCTGG GGGAGACTTG GTCCAGCCTG  
 101 GGGGGTCCCT GAGACTCTCC TGTGCAGCCT CTGGATTCAC CTTTAGAAGT  
 151 TATGCCATGA ACTGGTCCG ACAGGCTCCA GGAAGGGGC TGGAGTGGGT  
 201 CTCAGTTATT AGTGGTCGTG GTGGTACTAC ATACTACGCA GACTCCGTGA  
 251 AGGGCCGGTT CACCATCTCC AGAGACAATT CCAAGAACAC GCTGTATCTG  
 301 CAAATGAACA GCCTGAGAGC CGAGGACGCG GCCGTATATT ACTGTGCGAA  
 351 GATAGCAGTG GCTGGAGAGG GGCTCTACTA CTACTACGGT ATGGACGTCT  
 401 GGGGCCAAGG GACCACGGTC ACCGTCTCCT CAGCTTCCAC CAAGGGCCCA  
 451 TCCGTCTTCC CCCTGGCGCC CTGCTCCAGG AGCACCTCCG AGAACACAGC  
 501 CGCCCTGGGC TGCCTGGTCA AGGACTACTT CCCCGAACCG GTGACGGTGT  
 551 CGTGGAAGTC AGGCGCCCTG ACCAGCGGCG TGCACACCTT CCCGGCTGTC  
 601 CTACAGTCCT CAGGACTCTA CTCCCTCAGC AGCGTGGTGA CCGTGCCCTC  
 651 TAGCAGTCCT CAGGACTCTA CTCCCTCAGC AGCGTGGTGA CCGTGCCCTC  
 701 GCAACACCAA GGTGACAAG AGAGTTGAGT CCAAATATGG TCCCCATGC  
 751 CCATCATGCC CAGCACCTGA GTTCTGGGG GGACCATCAG TCTTCTGTT  
 801 CCCCCAAA CCAAGGACA CTCTCATGAT CTCCCGGACC CCTGAGGTCA  
 851 CGTGCGTGGT GGTGACGTG AGCCAGGAAG ACCCCGAGGT CCAGTTCAAC  
 901 TGGTACGTGG ATGGCGTGA GGTGCATAAT GCCAAGACAA AGCCGCGGA  
 951 GGAGCAGTTC AACAGCACGT ACCGTGTGGT CAGCGTCCTC ACCGTCCTGC  
 1001 ACCAGGACTG GCTGAACGGC AAGGAGTACA AGTGCAAGGT CTCCAACAAA  
 1051 GGCTCCCGT CCTCCATCGA GAAAACCATC TCAAAGCCA AAGGGCAGCC  
 1101 CCGAGAGCCA CAGGTGTACA CCCTGCCCC ATCCCAGGAG GAGATGACCA  
 1151 AGAACCAGGT CAGCCTGACC TGCTGGTCA AAGGCTTCTA CCCAGCGAC



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1201 ATCGCCGTGG AGTGGGAGAG CAATGGGCAG CCGGAGAACA ACTACAAGAC  
 1251 CACGCCTCCC GTGCTGGACT CCGACGGCTC CTTCTTCCTC TACAGCAGGC  
 1301 TAACCGTGGG CAAGAGCAGG TGGCAGGAGG GGAATGTCTT CTCATGCTCC  
 1351 GTGATGCATG AGGCTCTGCA CAACCACTAC ACACAGAAGA GCCTCTCCCT  
 1401 GTCTCTGGGT AAATGATAG

SEQ ID NO. 26

6.73.2 Predicted Heavy Chain Protein Sequence

1 mefglswlfl valkqvqcE VQLLESGGDL VQPGGSLRLS CAASGFTFRS  
 51 YAMNWRQAP GKLEWVSVI SGRGGTTYA DSVKGRFTIS RDNSKNTLYL  
 101 QMNSLRAEDA AVYYCAKIAV AGEGLYYYYG MDVWQGTTV TVSSASTKGP  
 151 SVFPLAPCSR STSENTAALG CLVKDYFPEP VTVSWNSGAL TSGVHTFPAV  
 201 LQSSGLYLSL SVVTVPSSSL GTKTYTCNVD HKPSNTKVVDK RVESKYGPPC  
 251 PSCPAPFLG GPSVFLFPPK PKDTLMISRT PEVTCVVVDV SQEDPEVQFN  
 301 WYVDGVEVHN AKTKPREEQF NSTYRVVSVL TVLHQDWLNG KEYKCKVSNK  
 351 GLPSSIEKTI SKAKQPREP QVYTLPPSQE EMTKWQVSLT CLVKGFYPSD  
 401 IAVEWESNGQ PENNYKTPP VLDSDGSFLL YSRLTVDKSR WQEGNVFSCS  
 451 VMHEALHNHY TQKSLSLSLG K

SEQ ID NO. 27

6.73.2 Kappa Light Chain Nucleotide Sequence

1 atggacatga gggccccgc tcagctcctg gggctcctgc tactctgqct  
 51 ccgaggtgcc agatgtGACA TCCAGATGAC CCAGTCTCCA TCCTCCCTGT  
 101 CTGCATCTGT AGGTGACAGA GTCACCTTCA CTTGCCGGGC AAGTCAGAAC  
 151 ATTACCAACT ATTTAAATTG GTATCAGCAG AAACCAGGGA AGGCCCTAA  
 201 GCTCCTGATC TATGCTGCGT CCAGTTTGCC AAGAGGGGTC CCATCAAGGT  
 251 TCCGTGGCAG TGGATCTGGG ACAGATTTCA CTCTCACCAT CAGCAGTCTG  
 301 CAACCTGAAG ATTTTGCAAC TTACTACTGT CAACAGAGTT ACAGTAATCC  
 351 TCCGGAGTGC GGTTTTGGCC AGGGGACCAC GCTGGATATC AACGAAGT  
 401 TGGCTGCACC ATCTGTCTTC ATCTTCCCGC CATCTGATGA GCAGTTGAAA  
 451 TCTGGAAGT CCTCTGTTGT GTGCCTGCTG AATAACTTCT ATCCAGAGA  
 501 GGCCAAAGTA CAGTGAAGG TGGATAACGC CCTCCAATCG GGTAAGTCCC  
 551 AGGAGAGTGT CACAGAGCAG GACAGCAAGG ACAGCACCTA CAGCCTCAGC  
 601 AGCACCTGA CGCTGAGCAA AGCACACTAC GAGAAACACA AAGTCTACGC  
 651 CTGCGAAGTC ACCCATCAGG GCCTGAGCTC GCCCGTCACA AAGAGCTTCA  
 701 ACAGGGGAGA GTGTTAGTGA

SEQ ID NO. 28

6.73.2 Predicted Kappa Light Chain Protein Sequence

1 mdmrvpagll gllllwlrgrcDIQMTQSP SLSALVGDR VTFTCRASQN  
 51 ITNYLNWYQQ KPGKAPKLLI YAASSLPRGV PSRFRGSGSG TDFTLTISSL  
 101 QPEDFATYYC QQSYSNPPEC GFGQGTTLDI KRTVAAPSVF IFPPSDEQLK  
 151 SGTASVVCLL NNFYPREAKV QWKVDNALQS GNSQESVTEQ DSKSSTYLSL  
 201 STLTLKADY EKHKVIYACEV THQGLSSPVT KSFNRGEC

SEQ ID NO. 29

6.77.1 Heavy Chain Nucleotide Sequence

1 atggaactgg ggtccgctg ggttttcctt gttgctatth tagaaggtgt  
 51 ccagtgtGAG GTGCAGCTGG TGGAGTCTGG GGGAGGCCTG GTCAAGCCTG



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101 GGGGGTCCCT GAGACTCTCC TGTGCAGCCT CTGGATTCAC CTTCAGTAGC  
 151 TATAGCATGA ACTGGGTCCG CCAGGCTCCA GGAAGGGGC TGGAGTGGGT  
 201 CTCATCCATT AGTAGTAGTA GTAGTTACAT ATACTACGCA GACTCAGTGA  
 251 AGGGCCGATT CACCATCTCC AGAGACAACG CCAAGAACTC ACTGTATCTG  
 301 CAAATGAACA GCCTGAGAGC CGAGGACACG GCTGTGTATT ACTGTGCGAG  
 351 AGATGGGTAT AGCAGTGGCT GGTCCACTA CTACTACTAC GGTATGGACG  
 401 TCTGGGGCCA AGGGACCACG GTCACCGTCT CCTCAGCTTC CACCAAGGGC  
 451 CCATCCGTCT TCCCCCTGGC GCCCTGCTCC AGGAGCACCT CCGAGAGCAC  
 501 AGCCGCCCTG GGCTGCCTGG TCAAGGACTA CTTCCCCGAA CCGGTGACGG  
 551 TGTCGTGGAA CTCAGGCGCC CTGACCAGCG GCGTGCACAC CTTCCCCGCT  
 601 GTCCTACAGT CCTCAGGACT CTACTCCCTC AGCAGCGTGG TGACCGTGCC  
 651 CTCCAGCAGC TTGGGCACGA AGACCTACAC CTGCAACGTA GATCACAAGC  
 701 CCAGCAACAC CAAGGTGGAC AAGAGAGTTG AGTCCAAATA TGGTCCCCCA  
 751 TGCCCATCAT GCCCAGCACC TGAGTTCCTG GGGGGACCAT CAGTCTTCCT  
 801 GTTCCCCCA AAACCCAAGG AACTCTCAT GATCTCCCGG ACCCCTGAGG  
 851 TCACGTGCGT GGTGGTGGAC GTGAGCCAGG AAGACCCCGA GGTCCAGTTC  
 901 AACTGGTACG TGGATGGCGT GGAGGTGCAT AATGCCAAGA CAAAGCCGCG  
 951 GGAGGAGCAG TTCAACAGCA CGTACCGTGT GGTGAGCGTC CTCACCGTCC  
 1001 TGCACCAGGA CTGGCTGAAC GGCAAGGAGT ACAAGTGCAA GGTCTCCAAC  
 1051 AAAGGCCTCC CGTCTCCAT CGAGAAAACC ATCTCCAAAG CCAAAGGCA  
 1101 GCCCCGAGAG CCACAGGTGT ACACCCTGCC CCCATCCCAG GAGGAGATGA  
 1151 CCAAGAACCA GGTGAGCCTG ACCTGCCTGG TCAAAGGCTT CTACCCAGC  
 1201 GACATCGCCG TGGAGTGGGA GAGCAATGGG CAGCCGGACA ACAACTACAA  
 1251 GACCACGCCT CCCGTGCTGG ACTCCGACGG CTCCTTCTTC CTCTACAGCA  
 1301 GGCTAACCGT GGACAAGAGC AGGTGGCAGG AGGGGAATGT CTTTTCACGC  
 1351 TCCGTGATGC ATGAGGCTCT GCACAACCAC TACACACAGA AGAGCCTCTC  
 1401 CCTGTCTCTG GGTAATGAT AGGAATTCTG ATGA

SEQ ID NO. 30

6.77.1 Predicted Heavy Chain Protein Sequence

1 melqlrwwfl vaileqvqcE VQLVESGGGL VKPGGSLRLS CAASGFTFSS  
 51 YSMNWRQAP GKLEWVSSI SSSSYIYYA DSVKGRFTIS RDNAKNSLYL  
 101 QMNSLRAEDT AVYYCARDGY SSGWSYYYYY GMDVWGQGT VTVSSASTKG  
 151 PSVFPLAPCS RSTSESTAAL GCLVKDYFPE PVTVSWNSGA LTVSGVHTFPA  
 201 VLQSSGLYSL SSVVTVPSSS LGTKYTCNV DHKPSNTKVD KRVESKYGPP  
 251 CPSCPAPEFL GGPSVFLFPP KPKDTLMISR TPEVTCVVVD VSQEDPEVQF  
 301 MWYVDGVEVH NAKTKPREEQ FNSTYRVVSV LTVLHQDWLN GKEYKCKVSN  
 351 KGLPSSIEKT ISKAKQPRE PQVYTLPPSQ EEMTKNQVSL TCLVKGFYPS  
 401 DIAVEWESNG QPENNYKTP PVLDSGDSFF LYSRLTVDKS RWQEGNVFSR  
 451 SVMHEALHNH YTQKSLSLSL GK

SEQ ID NO. 31

6.77.1 Kappa Light Chain Nucleotide Sequence

1 atgaggetcc ctgctcagct cctggggctg ctaatgctct ggatacctgg  
 51 atccagtqca GATATTGTGA TGACCAGAC TCCACTCTCT CTGTCCGTCA



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101 CTCCTGGACA GCCGGCCTCC ATCTCCTGCA ACTCTAGTCA GAGCCTCCTG  
 151 CTTAGTGATG GAAAGACCTA TTTGAATTGG TACCTGCAGA AGCCCGGCCA  
 201 GCCTCCACAG CTCCTGATCT ATGAAGTTTC CAACCGGTTT TCTGGAGTGC  
 251 CAGACAGGTT CAGTGGCAGC GGGTCAGGGA CAGATTTTAC ACTGAAAATC  
 301 AGCCGGGTGG AGGCTGAGGA TGTGGGGTT TATTCTGCA TGCAAAGTAT  
 351 ACAGCTTATG TGCACTTTTG GCCAGGGGAC CAAGCTGGAG ATCAAACGAA  
 401 CTGTGGCTGC ACCATCTGTC TTCATCTTCC CGCCATCTGA TGAGCAGTTG  
 451 AAATCTGGAA CTGCCTCTGT TGTGTGCCTG CTGAATAACT TCTATCCCAG  
 501 AGAGGCCAAA GTACAGTGGG AGGTGGATAA CGCCCTCAA TCGGGTAACT  
 551 CCCAGGAGAG GTTCACAGAG CAGGACAGCA AGGACAGCAC CTACAGCCTC  
 601 AGCAGCACCC TGACGCTGAG CAAAGCAGAC TACGAGAAAC ACAAAGTCTA  
 651 CGCCTGCGAA GTCACCCATC AGGGCCTGAG CTCGCCCGTC ACAAAGAGCT  
 701 TCAACAGGGG AGAGTGTTAG TGA

SEQ ID NO. 32

6.77.1 Predicted Kappa Light Chain Protein Sequence

1 mrlpaqlql lmlwipgssa DIVMTQTPLS LSVTPGQPAS ISCNSSQSLL  
 51 LSDGKTYLWV YLQKPGPPQ LLIYEVSNRF SGVPDRFSGS GSGTDFTLKI  
 101 SRVEAEDVGV YSCMQSIQLM CSFGQGTKLE IKRTVAAPSV FIFPPSDEQL  
 151 KSGTASVVCL LNNFYPREK VQWKVDNALQ SGNSQESVTE QDSKDYSL  
 201 SSTLTLKAD YEKHKVYACE VTHQGLSSPV TKSFNREGC

SEQ ID NO. 33

7.16.6 Heavy Chain Nucleotide Sequence

1 atggactgga cctggagcat ccttttcttg gtggcagcag caacaggtgc  
 51 ccactccCAG GTTCAGCTGG TGCAGTCTGG AGCTGAGGTG AAGAAGCCTG  
 101 GGGCCTCAGT GAAGGTCTCC TGCAAGGCTT CTGGTTACAC CTTTACCAGC  
 151 TATGGTATCA ACTGGGTGCG ACAGGCCCTT GGACAAGGGC TTGAGTGGAT  
 201 GGGATGGATC AGCGTTTACA GTGGTAACAC AAACATATGCA CAGAAGGTCC  
 251 AGGGCAGAGT CACCATGACC GCAGACACAT CCACGAGCAC AGCCTACATG  
 301 GACCTGAGGA GCCTGAGATC TGACGACACG GCCGTGTATT ACTGTGCGAG  
 351 AGAGGGTAGC AGCTCGTCCG GAGACTACTA TTACGGTATG GACGTCTGGG  
 401 GCCAAGGGAC CACGGTCACC GTCTCCTCAG CCTCCACCAA GGGCCCATCG  
 451 GTCTTCCCCC TGGCGCCCTG CTCCAGGAGC ACCTCCGAGA GCACAGCGGC  
 501 CCTGGGCTGC CTGGTCAAGG ACTACTTCCC CGAACCGGTG ACGGTGTCTG  
 551 GGAACCTCAGG AGCTCTGACC AGCGGCGTGC ACACCTTCCC AGCTGTCTTA  
 601 CAGTCTCAG GACTCTACTC CCTCAGCAGC GTGGTGACCG TGCCCTCCAG  
 651 CAACTTCGGC ACCCAGACCT ACACCTGCAA CGTAGATCAC AAGCCAGCA  
 701 ACACCAAGGT GGACAAGACA GTTGAGCGCA AATGTTGTGT CGAGTGCCCA  
 751 CCGTGCCCAG CACCACCTGT GGCAGGACCG TCAGTCTTCC TCTTCCCCC  
 801 AAAACCCAAG GACACCCTCA TGATCTCCCG GACCCCTGAG GTCACGTGCG  
 851 TGGTGGTGGG CGTGAGCCAC GAAGACCCCG AGGTCCAGTT CAACTGGTAC  
 901 GTGGACGGCG TGGAGGTGCA TAATGCCAAG ACAAAGCCAC GGGAGGAGCA  
 951 GTTCAACAGA ACGTTCCTGT TGGTCAGCGT CCTCACCGTT GTGCACCAGG  
 1001 ACTGGCTGAA CGGCAAGGAG TACAAGTGCA AGGTCTCCAA CAAAGGCCTC



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1051 CCAGCCCCCA TCGAGAAAAC CATCTCCAAA ACCAAAGGGC AGCCCCGAGA  
 1101 ACCACAGGTG TACACCCTGC CCCCATCCCG GGAGGAGATG ACCAAGAACC  
 1151 AGGTCAGCCT GACCTGCCTG GTCAAAGGCT TCTACCCCAG CGACATCGCC  
 1201 GTGGAGTGGG AGAGCAATGG GCAGCCGGAG AACAACTACA AGACCACACC  
 1251 TCCCATGCTG GACTCCGACG GCTCCTTCTT CCTCTACAGC AAGCTCACCG  
 1301 TGGACAAGAG CAGGTGGCAG CAGGGGAACG TCTTCTCATG CTCCGTGATG  
 1351 CATGAGGCTC TGCACAACCA CTACACGAG AAGAGCCTCT CCCTGTCTCC  
 1401 GGGTAAATGA

SEQ ID NO. 34

7.16.6 Predicted Heavy Chain Protein Sequence

1 mdwtwsilfl vaaatgahsQ VQLVQSGAEV KKPASVKVS CKASGYTFTS  
 51 YGINWVRQAP GQGLEWVGWI SVYSGNTNYA QKVQGRVTMT ADTSTSTAYM  
 101 DLRLRSDDT AVYYCAREGS SSSGDYYYGM DWVQGTTVT VSSASTKGPS  
 151 VFPLAPCSRS TSESTAALGC LVDKYFPEPV TVSWNSGALT SGVHTFPAVL  
 201 QSSGLYSLSS VVTVPSSNFG TQTYTCNVDH KPSNTKVDKT VERKCCVECP  
 251 PCPAPPVAGP SVFLFPPKPK DTLMISRTPE VTCVVVDVSH EDPEVQFNWY  
 301 VDGVEVHNAK TKPREEQFNS TFRVSVLTV VHQDWLNGKE YKCKVSNKGL  
 351 PAPIEKTISK TKGQPREPQV YTLPPSREEM TKNQVSLTCL VKGFYPSDIA  
 401 VEWESNGQPE NNYKTTPML DSDGSFFLYS KLTVDKSRWQ QGNVFSCSVM  
 451 HEALHNHYTQ KSLSLSPGK

SEQ ID NO. 35

7.16.6 Kappa Light Chain Nucleotide Sequence

1 atgagqctcc ctgctcagct cctgggqctg ctaatgctct ggatacctgg  
 51 atccattqca GATATTGTGA TGACCCAGAC TCCACTCTCT CTGTCCGTCA  
 101 CCCCTGGACA GCCGCCTCC ATCTCCTGCA AGTCTAGTCA GAGCCTCCTG  
 151 CATACTGATG GAACGACCTA TTTGTATTGG TACCTGCAGA AGCCAGGCCA  
 201 GCCTCCACAG CTCCTGATCT ATGAAGTTC CAACCGGTTT TCTGGAGTGC  
 251 CAGATAGGTT CAGTGGCAGC GGGTCAGGGA CAGATTTTAC ACTGAAAATC  
 301 AGCCGGGTGG AGGCTGAGGA TGTGGGATT TATTACTGCA TGCAAATAT  
 351 ACAGCTTCCG TGGACGTTG GCCAAGGGAC CAAGGTGGAA ATCAAACGAA  
 401 CTGTGGCTGC ACCATCTGTC TTCATCTTCC CGCCATCTGA TGAGCAGTTG  
 451 AAATCTGGAA CTGCCTCTGT TGTGTGCCTG CTGAATAACT TCTATCCCAG  
 501 AGAGGCCAAA GTACAGTGGA AGGTGGATAA CGCCCTCAA TCGGGTAACT  
 551 CCCAGGAGAG TGTACAGAG CAGGACAGCA AGGACAGCAC CTACAGCCTC  
 601 AGCAGCACCC TGACGCTGAG CAAAGCAGAC TACGAGAAAC ACAAAGTCTA  
 651 CGCCTGCGAA GTCACCCATC AGGGCCTGAG CTCGCCCGTC ACAAAGAGCT  
 701 TCAACAGGGG AGAGTGTTAG TGA

SEQ ID NO. 36

7.16.6 Kappa Light Chain Protein Sequence

1 mrlpaqlql lmlwipgssa DIVMTQTPLS LSVTPGQPAS ISCKSSQSLL  
 51 HTDGTTYLYW YLQKPGQPPQ LLIYEVSNRF SGVPDRFSGS GSGTDFTLKI  
 101 SRVEAEDVGI YYCMQNIQLP WTFGQGTKVE IKRTVAAPSV FIFPPSDEQL  
 151 KSGTASVVCL LNNFYPREAK VQWKNDNALQ SGNSQESVTE QDSKDSTYSL  
 201 SSTLTLSKAD YEKHKVYACE VTHQGLSSPV TKSFNREGC



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SEQ ID NO. 37

7.20.5 Heavy Chain Nucleotide Sequence

1 atgaaacacc tqtggttctt cctcctgctg gtggcagctc ccagatgggt  
 51 cctgtcccCAG GTGCAGCTGC AGGAGTCGGG CCCAGGACTG GTGAAGCCTT  
 101 CGGAGACCCT GTCCCTCACC TGCACTGTCT CTGGTAGCTC CATCAGTAGT  
 151 TACCACTGGA ACTGGATCCG GCAGCCCGCC GGAAGGGAC TGGAGTGGAT  
 201 TGGGCGTATC TATACCAGTG GGAGCACCAA CTACAACCCC TCCCTCAAGA  
 251 GTCGAGTCAC CATGTCTACTA GACACGTCCA AGAACCAGTT CTCCCTGAAG  
 301 CTGAGCTCTG TGACCGCCGC GGACACGGCC GTGTATTACT GTGCGAGAGA  
 351 GGGGGTCAGG TATTACTATG CTTCGGGGAG TTATTACTAC GGTCTGGACG  
 401 TCTGGGGCCA AGGGACCACG GTCACCGTCT CCTCAGCCTC CACCAAGGGC  
 451 CCATCGGTCT TCCCCCTGGC GCCCTGCTCC AGGAGCACCT CCGAGAGCAC  
 501 AGCGGCCCTG GGCTGCCTGG TCAAGGACTA ATTCCCCGAA CCGGTGACGG  
 551 TGTCGTGGAA CTCAGGCGCT CTGACCAGCG GCGTGCACAC CTCCCAGCT  
 601 GTCCTACAGT CCTCAGGACT CTACTCCCTC AGCAGCGTGG TGACCGTGCC  
 651 CTCCAGCAAC TTCGGCACCC AGACCTACAC GTGCAACGTA GATCACAAGC  
 701 CCAGCAACAC CAAGGTGGAC AAGACAGTTG AGCGCAAATG TTGTGTCGAG  
 751 TGCCCACCGT GCCCAGCACC ACCTGTGGCA GGACCGTCAG TCTTCCTCTT  
 801 CCCCCAAAA AAACCGGACA CCCTCATGAT CTCCCGGACC CCTGAGGTCA  
 851 CGTGCCTGGT GGTGGACGTG AGCCACGAAG ACCCCGAGGT CCAGTTCAAC  
 901 TGGTACGTGG ACGGCGTGGG GGTGCATAAT GCCAAGACAA AGCCACGGGA  
 951 GGAGCAGTTC AACAGCACGT TCCGTGTGGT CAGCGTCCTC ACCGTTGTGC  
 1001 ACCAGGACTG GCTGAACGGC AAGGAGTACA AGTGCAAGGT CTCCAACAAA  
 1051 GGCCTCCCAG CCCCATCGA GAAAACCATC TCCAAAACCA AAGGCAGCC  
 1101 CCGAGAACCA CAGGTGTACA CCCTGCCCCC ATCCCGGGAG GAGATGACCA  
 1151 AGAACCAGGT CAGCCTGACC TGCCCTGGTCA AAGGCTTCTA CCCAGCGAC  
 1201 ATCGCCGTGG AGTGGGAGAG CAATGGGAG CCGGAGAACA ACTACAAGAC  
 1251 CACACCTCCC ATGCTGGACT CCGACGGCTC CTTCTTCTC TACAGCAAGC  
 1301 TCACCGTGGG CAAGAGCAGG TGGCAGCAGG GGAACGTCTT CTCATGCTCC  
 1351 GTGATGCATG AGGCTCTGCA CAACCACTAC ACGCAGAAGA GCCTCTCCCT  
 1401 GTCTCCGGGT AAATGA

SEQ ID NO. 38

7.20.5 Predicted Heavy Chain Protein Sequence

1 mkhlwfflll vaaprwlsQ VQLQESGPGI VKPSETLSLT CTVSGSSISS  
 51 YHWNWIRQPA GKLEWIGRI YTSNSTNYNP SLKSRVTMSL DTSKNQFSLK  
 101 LSSVTAADTA VYVCAREGVR YYYASGSYYY GLDVWGQGT VTVSSASTKG  
 151 PSVFPLAPCS RSTSESTAAL GCLVKDYFPE PVTVSWNSGA LTVSGVHTFPA  
 201 VLQSSGLYSL SSVVTVPSN FGTQTYTCNV DHKPSNTKVD KTVKCCVE  
 251 CPPCPAPPVA GPSVFLFPPK PKDTLMISRT PEVTCVVVDV SHEDPEVQFN  
 301 WYVDGVEVHN AKTKPREEQF NSTGRVSVL TVVHQDWLNG KEYKCKVANK  
 351 GLPAPIEKTI SKTKGQPREP QVYTLPPSRE EMTKNQVSLT CLVKGFYPSD  
 401 IAVEWESNGQ PENNYKYYP MLDSGDFFL YSKLTVDKSR WQQGNVFCSS  
 451 VMHEALHNHY TQKSLSLSPG K



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SEQ ID NO. 39

7.20.5 Kappa Light Chain Nucleotide Sequence

1 atgagqctcc ctgctcagct cctggggctg ctaatqctct gqgtctctgg  
 51 atccagtggg GATATTGTGA TGACTCAGTC TCCACTCTCC CTGCCCCTCA  
 101 CCCCTGGAGA GCCGGCCTCC ATCTCCTGCA GGTCTAGTCA GAGCCTCCTG  
 151 CATGGTAATG GATACAATA TTTGGATTGG TACCTGCAGA AGCCAGGGCA  
 201 GTCTCCACAG CTCCTGATCT ATTTGGGTTT TAATCGGGCC TCCGGGGTCC  
 251 CTGACAGGTT CAGTGGCAGT GGATCAGGCA CAGATTTTAC ACTGAAAATC  
 301 AGCAGAGTGG AGGCTGAGGA TGTGGGGTT TATTACTGCA TGCAAGCTCT  
 351 ACAAACTCTC ACTTTCGGCG GAGGGACCAA GGTGGAGATC AACGAACTG  
 401 TGGCTGCACC ATCTGTCTTC ATCTTCCCGC CATCTGATGA GCAGTTGAAA  
 451 TCTGGAAGTG CCTCTGTTGT GTGCCTGCTG AATAACTTCT ATCCCAGAGA  
 501 GGCCAAAGTA CAGTGAAGG TGGATAACGC CCTCCAATCG GGTAACCTCC  
 551 AGGAGAGTGT CACAGAGCAG GACAGCAAGG ACAGCACCTA CAGCCTCAGC  
 601 AGCACCTGA CGCTGAGCAA AGCAGACTAC GAGAAACACA AAGTCTACGC  
 651 CTGCGAAGTC ACCCATCAGG GCCTGAGCTC GCCCGTCACA AAGAGCTTCA  
 701 ACAGGGGAGA GTGTTAGTGA

SEQ ID NO. 40

7.20.5 Predicted Kappa Light Chain Protein Sequence

1 mrlpaqlql lmlwvsqssq DIVMTQSPLS LPVTPGEPAS ISCRSSQSLI  
 51 HGNHNYLDW YLQKPGQSPQ LLIYLGSNRA SGVPDRFSGS GSGTDFTLKI  
 101 SRVEAEDVGV YYCMQALQTL TFGGGTKVEI KRTVAAPSVF IFPPSDEQLK  
 151 SGTASVCLL NNFYPREAKV QWKVDNALQS GNSQESVTEQ DSKDSTYSLI  
 201 STLTLKADY EKHKVYACEV THQGLSSPVT KSFNRGEC

SEQ ID NO. 41

7.26.4 Heavy Chain Nucleotide Sequence

1 atggactgga cctggagcat ccttttcttg gtggcagcag caacaggtgc  
 51 ccactccCAG GTTCAGCTGG TGCAGTCTGG AGCTGAGGTG AAGAAGCCTG  
 101 GGGCCTCAGT GAAGGTCTCC TGCAGGCTT CTGGTTACAC CTTTACCAGC  
 151 TATGGTATCG ACTGGGTGCG ACAGGCCCTT GGACAAGGGC TTGAGTGGAT  
 201 GGGATGGATC AGCGTTTACA GTGGTAACAC AACTATGCA CAGAAGCTCC  
 251 AGGGCAGAGT CACCATGTCC ACAGACACAT CCACGAGCAC AGCCTACATG  
 301 GAGCTGAGGA GCCTGAGATC TGACGACACG GCCGTGTATT ACTGTGCGAG  
 351 AGAGGGTAGC AGCTCGTCCG GAGACTACTA CTACGGTATG GACGTCTGGG  
 401 GCCAAGGGAC CACGGTCACC GTCTCCTCAG CCTCCACCAA GGGCCCATCG  
 451 GTCTTCCCCC TGGCGCCCTG CTCCAGGAGC ACCTCCGAGA GCACAGCGGC  
 501 CCTGGGCTGC CTGGTCAAGG ACTACTTCCC CGAACCGGTG ACGGTGTCGT  
 551 GGAACCTCAGG CGCTCTGACC AGCGGCGTGC ACACCTTCCC AGCTGTCTTA  
 601 CAGTCCTCAG GACTCTACTC CCTCAGCAGC GTGGTGACCG TGCCCTCCAG  
 651 CAACTTCGGC ACCCAGACCT ACACCTGCAA CGTAGATCAC AAGCCCAGCA  
 701 ACACCAAGGT GGACAAGACA GTTGAAGGCA AATGTTGTGT CGAGTGCCCA  
 751 CCGTGCCAG CACCACCTGT GGCAGGACCG TCAGTCTTCC TCTTCCCCC  
 801 AAAACCCAAG GACACCCTCA TGATCTCCCG GACCCCTGAG GTCACGTGCG  
 851 TGGTGGTGGG CGTGAGCCAC GAAGACCCCG AGGTCCAGTT CAACTGGTAC



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901 GTGGACGGCG TGGAGGTGCA TAATGCCAAG ACAAAGCCAC GGGAGGAGCA  
 951 GTTCAACAGC ACGTTCCGTG TGGTCAGCGT CCTCACCGTT GTGCACCAGG  
 1001 ACTGGCTGAA CGGCAAGGAG TACAAGTGCA AGGTCTCCAA CAAAGGCCTC  
 1051 CCAGCCCCCA TTGAGAAAAC CATCTCCAAA ACCAPAGGGC AGCCCCGAGA  
 1101 ACCACAGGTG TACACCCTGC CCCCATCCCG GGAGGAGATG ACCAAGAACC  
 1151 AGGTCAGCCT GACCTGCCTG GTCAAAGGCT TCTACCCAG CGACATCGCC  
 1201 GTGGAGTGGG AGAGCAATGG GCAGCCGGAG AACAACTACA AGACCACACC  
 1251 TCCCATGCTG GACTCCGACG GCTCCTTCTT CCTCTACAGC AAGCTCACCG  
 1301 TGGACAAGAG CAGGTGGCAG CAGGGGAACG TCTTCTCATG CTCCGTGATG  
 1351 CATGAGGCTC TGCACAACCA CTACACGCAG AAGAGCCTCT CCCTGTCTCC  
 1402 GGGTAAATGA

SEQ ID NO. 42

7.26.4 Predicted Heavy Chain Protein Sequence

1 mdwtvsilfl vaaatgahsQ VQLVQSGAEV KKPGASVKVS CEASGYTFTS  
 51 YGIDWVRQAP GQGLEWMGWI SVYSGNTNYA QKLQGRVTME TDTSTSTAYM  
 101 ELRSLRSDDT AVYYCAREGS SSSGDYYYGM DVWGQGTTVT VSSASTKGPS  
 151 VFPLAPCSRS TSESTAALGC LVKDYFPEPV TVAWNSGALT SGVHTFPAVL  
 201 QSSGLYLSLS VVTVPSSNFG TQTYTCNVDH KPANTKVDKT VERKCCVACP  
 251 PCPAPPVAGP SVFLFPPKPK DTLMISRTPV VTCVVVDVSH EDPEVQFNWY  
 301 VDGVEVHNAK TKPREEQFNS TFRVSVLTV VHQDWLNGKE YKCKVSNKGL  
 351 PAPIEKTISK TKGQPREPOV YTLPPSREEM TKNQVSLTCK VKGFYPSDIA  
 401 VEWESNGQPE NNYKTPPML DSDGSFFLYS KLTVDKSRWQ QGNVFSCSVM  
 451 HEALHNHYTQ KSLSLSPGK

SEQ ID NO. 43

7.26.4 Kappa Light Chain Nucleotide Sequence

1 atgagqctcc ctgctcagct cctgggqctg ctaatgctct ggatacctgg  
 51 atccagtgcg GATATTGTGA TGACCCAGAC TCCACTCTCT CTGTCCGTCA  
 101 CCCCTGGACA GCCGCCTCC ATCTCCTGCA AGTCTAATCA GAGCCTCCTG  
 151 TATAGTGATG GAAAGACCTA TTTGTTTTGG TACCTGCAGA AGCCAGGCCA  
 201 GCCTCCACAG CTCCTGATCT ATGAAGTTTC CAACCGATTC TCTGGAGTGC  
 251 CAGATAGGTT CAGTGGCAGC GGGTCAGGGA CAGATTTTAC ACTGAAAATC  
 301 AGCCGGGTGG AGGCTGAGGA TGTGGGGTT TATTACTGCA TGCAAAGTAT  
 351 ACAGCTTCCG TGGACGTTCC GCCAAGGGAC CAAGGTGGAA ATCAAACGAA  
 401 CTGTGGCTGC ACCATCTGTC TTCATCTTCC CGCCATCTGA TGAGCAGTTG  
 451 AAATCTGGAA CTGCCTCTGT TGTGTGCCTG CTGAATAACT TCTATCCCAG  
 501 AGAGGCCAAA GTACAGTGA AGGTGGATAA CGCCCTCCAA TCGGGTAACT  
 551 CCCAGGAGAG TGTCACAGAG CAGGACAGCA AGGACAGCAC CTACAGCCTC  
 601 AGCAGCACCC TGACGCTGAG CAAAGCAGAC TACGAGAAAC ACAAAGCTA  
 651 CGCCTGCGAA GTCACCCATC AGGGCCTGAG CTCGCCCGTC ACAAAGAGCT  
 701 TCAACAGGGG AGAGTGTTAG TGA

SEQ ID NO. 44

7.26.4 Predicted Kappa Light Chain Protein Sequence

1 mrlpaqlqlgl lmlwipgssa DIVMTQTPLS LSVTPGQPAS ISCKNQSLI  
 51 YSDGKTYLFW YLQKPGQPPQ LLIYEVSNRV SGVPDRFSGS GSGTDFTLKI



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101 SRVEAEDVGV YYCMQSIQLP WTFGQGTKVE IKRTVAAPSV FIFPPSDEQL  
 151 KSGTASVVCL LNNFYBREAK VQWKVDNALQ SGNSQESVTE QDSKDSTYSL  
 201 SSTLTLSKAD YEKHKVYACE VTHQGLSSPV TKSFNRGEC

SEQ ID NO. 45

9.8.2 Heavy Chain Nucleotide Sequence

1 atggagtttg ggctgagctg ggttttcctc gttgctcttt taagaggtgt  
 51 ccagtgtCAG GTGCAGCTGG TGGAGTCTGG GGGAGGCGTG GTCCAGCCTG  
 101 GGAGGTCCCT GAGACTCTCC TGTGCAGCGT CTGGATTCAC CTCAGTAGC  
 151 TATGGCATGC ACTGGGTCCG CCAGGCTCCA GGCAAGGGGC TGGAGTGGGT  
 201 GGCAGTTATA TGGTATGATG GAAGTAATGA ATACTATGCA GACTCCGTGA  
 251 AGGGCCGATT CACCATCTCC AGAGACAATT CCAAGAACAC GCTGTATCTG  
 301 CAAATGAACA GCCTGAGAGC CGAGGACACG GCTGTGTATT ACTGTGCGAG  
 351 GGGGGCGTAC CACTTTGCCT ACTGGGGCCA GGAACCCCTG GTCACCGTCT  
 401 CCTCAGCTTC CACCAAGGGC CCATCCGTCT TCCCCCTGGC GCCCTGCTCC  
 451 AGGAGCACCT CCGAGAGCAC AGCCGCCCTG GGCTGCCTGG TCAAGGACTA  
 501 CTTCCCCGAA CCGGTGACGG TGTCTGGGAA CTCAGGCGCC CTGACCAGCG  
 551 GCGTGCACAC CTTCCCGGCT GTCCTACAGT CCTCAGGACT CTACTIONCTC  
 601 AGCAGCGTGG TGACCGTGCC CTCCAGCAGC TTGGGCACGA AGACCTACAC  
 651 CTGCAACGTA GATCACAAGC CCAGCAACAC CAAGGTGGAC AAGAGAGTTG  
 701 AGTCCAAATA TGGTCCCCCA TGCCCATCAT GCCCAGCACC TGAGTTCTCTG  
 751 GGGGGACCAT CAGTCTTCTT GTTCCCCCA AAACCAAGG AACTCTCAT  
 801 GATCTCCCGG ACCCTGAGG TCACGTGCGT GGTGGTGGAC GTGAGCCAGG  
 851 AAGACCCCGA GGTCCAGTTC AACTGGTACG TGGATGGCGT GGAGGTGCAT  
 901 AATGCCAAGA CAAAGCCGCG GGAGGAGCAG TTCAACAGCA CGTACCGTGT  
 951 GGTCAGCGTC CTCACCGTCC TGCACCAGGA CTGGCTGAAC GGCAAGGAGT  
 1001 ACAAGTGCAA GGTCTCCAAC AAAGGCCTCC CGTCCTCCAT CGAGAAAACC  
 1051 ATCTCAAAG CCAAAGGGCA GCCCCGAGAG CCACAGGTGT ACACCCTGCC  
 1101 CCCATCCCAG GAGGAGATGA CCAAGAACCA GGTCAGCCTG ACCTGCCTGG  
 1151 TCAAAGGCTT CTACCCAGC GACATCGCCG TGGAGTGGGA GAGCAATGGG  
 1201 CAGCCGGAGA ACAACTACAA GACCACGCCT CCCGTGCTGG ACTCCGACGG  
 1251 CTCCTTCTTC CTCTACAGCA GGCTAACCGT GGACAAGAGC AGGTGGCAGG  
 1301 AGGGGAATGT CTTCTCATGC TCCGTGATGC ATGAGGCTCT GCACAACCAC  
 1351 TACACACAGA AGAGCCTCTC CCTGTCTCTG GGTAATGA

SEQ ID NO. 46

9.8.2 Predicted Heavy Chain Protein Sequence

1 mefglswvfl vallrgvgcQ VQLVESGGGV VQPGRSLRLS CAASGFTFSS  
 51 YGMHWVRQAP GKLEWVAVI WYDGSNEYVA DSVKGRFTIS RDNSKNTLYL  
 101 QMNSLRAEDT AVYYCARGAY HFAYWGQGTL VTVSSASTKG PSVFPLAPCS  
 151 RSTSESTAAL GCLVKDYFPE PVTVSWNSGA LTSGVHTFPA VLQSSGLYSL  
 201 SSVVTVPSSS LGTKYTCNV DHKPSNTKVD KRVESKYGPP CPSCPAPEFL  
 251 GGPSVFLFPP KPKDTLMISR TPEVTCVVVD VSQEDPEVQF NWYVDGVEVH  
 301 NAKTKPREEQ FNSTYRVVSV LTVLHQDWLN GKEYKCKVSN KGLPSSIEKT  
 351 ISKAKGQPRE PQVYTLPPSQ EEMTKNQVSL TCLVKGFYPS DIAVEWESHG



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401 QPENNYKTP PVLSDSGSFF LYSRLTVDKS RWQEGNVFSC SVMHEALHNNH  
451 YTQKSLSLSL GK

SEQ ID NO. 47

9.8.2 Kappa Light Chain Nucleotide Sequence

1 atggacatga gqgtccctgc tcagctcctg gqgctcctgc tgctctgqct  
51 ctcagtcgca ggtgccagat gtGACATCCA GATGACCCAG TCTCCATCCT  
101 CCCTGTCTGC ATCTGTAGGA GACAGAGTCA CCATCACTTG CCAGGCGAGT  
151 CAGGACATTA GCAACTATTT AAATTGGTAT CAGCAGAAAC CAGGGAAAGC  
201 CCCTAAGCTC CTGATCTACG ATGCATCAA TTTGGAAACA GGGGTCCCAT  
251 CAAGGTTTCA TGGAAGTGGG TCTGGGACAG ATTTTACTTT CACCATCAGC  
301 AGCCTGCAGC CTGAAGATAT TGCAACATAT TCCTGTCAAC ACTCTGATAA  
351 TCTCTCGATC ACCTTCGGCC AGGCGACACG ACTCCAGATT AACGAACTG  
401 TGGCTGCACC ATCTGTCTTC ATCTTCCCGC CATCTGAGGA GCAGTTGAAA  
451 TCTGGAAGT CCTCTGTTGT GTGCCTGCTG AATAACTTCT ACCCCAGAGA  
501 GGCCAAAGTA CAGTGAAGG TGGATAACGC CCTCCAATCG GGTAAGTCCC  
551 AGGAGAGTGT CACAGAGCAG GACAGCAAGG ACAGCACCTA CAGCCTCAGC  
601 AGCACCTGA CGCTGAGCAA AGCAGACTAC GAGAAACACA AAGTCTACGC  
651 CTGCGAAGTC ACCCATCAGG GCCTGAGCTC GCCCCTCACA AAGAGCTTCA  
701 ACAGGGGAGA GTGTTAGTGA

SEQ ID NO. 48

9.8.2 Predicted Kappa Light Chain Protein Sequence

1 mdmrvpaql l gllllwlsva garcDIQMTQ SPSSLSASVG DRVTITCQAS  
51 QDISNYLNWY QQKPGKAPKL LIYDASNLET GVPSRFSGSG SGTDFFTIS  
101 SLQPEDIATY SCQHSNLSI TFGQTRLEI KRTVAAPSVF IFPPSDEQLK  
151 SGTASVVCLL NNFYPREAKV QWKVDNALQS GNSQESVTEQ DSKDSTYSLS  
201 STLTLKADY EKHKVYACEV THQGLSSPVT KSFNRGEC

SEQ ID NO. 49

Nucleotide Sequence of cynomolgus MAdCAM  $\alpha 4\beta 7$  binding domain

1 ATGGATCGGG GCCTGGCCCT CCTGCTGGCG GGGCTTCTGG GGCTCCTCCA  
51 GCCGGGCTGC GGCCAGTCCC TCCAGGTGAA GCCCCTGCAG GTGGAGCCCC  
101 CGGAGCCGGT GGTGGCCGTG GCCCTGGGCG CCTCTCGCCA GCTCACCTGC  
151 CGCCTGGACT GCGCGGACGG CGGGGCCACG GTGCAGTGGC GGGGCTGGA  
201 CACCAGCCTG GCGCGGTGC AGTCGGACGC GGGCCGCAGC GTCCTACCG  
251 TGCACAACGC CTCGCTGTCG GCGGCCGGGA CCCGTGTGTG CGTGGGCTCC  
301 TGGGGGGGCC GCACCTTCCA GCACACCGTG CGGCTCCTTG TGTACGCTT  
351 CCCGGACCAG CTGACCATCT CCCCAGCAGC CCTGGTGCCT GGTGACCCGG  
401 AGGTGGCCTG TACGGCTCAC AAAGTCACGC CTGTGGACCC CAATGCGCTC  
451 TCCTTCTCCC TGCTCCTGGG GGCAACGGAA CTGGAGGGGG CCCAGGCTCT  
501 GGGCCCGGAG GTGGAGGAGG AGGAGGAGCC CCAGGAGGAG GAGGACGTGC  
551 TGTTCAAGGT GACAGAGCGC TGGCGGCTGC CGACCCTGGC AACCCCTGTC  
601 CTGCCCAGCG TCTACTGCCA GGCCACGATG AGGCTGCCTG GCTTGGAGCT  
651 CAGCCACCGC CAGGCCATCC CGGTCCTGCA C



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SEQ ID NO. 50

Amino acid sequence of cynomolgus MadCAM  $\alpha 4\beta 7$  binding domain

1 MDRGLALLLA GLLGLLQPGC GQSLQVKPLQ VEPPEPVVAV ALGASRQLTC  
 51 RLDCADGGAT VQWRGLDTSL GAVQSDAGRS VLTVRNASLS AAGTRVCVGS  
 101 CGGRTFQHTV RLLVYAFPDQ LTISPAALVP GDPEVACTAH KVTPVDPNAL  
 151 SFSLLLGDQE LEGAQLGPE VEEEEEPQEE EDVLFRTVTER WRLPTLATPV  
 201 LPALYCQATM RLPGLELSHR QAIPVLH

SEQ ID NO. 51

Modified 6.22.2 Heavy Chain Nucleotide Sequence

1 atggagtttg gctgagctg ggttttcctc gttgctcttt taagaggtgt  
 51 ccagtgtCAG GTGCAGCTGG TGGAGTCTGG GGGAGGCGTG GTCCAGCCTG  
 101 GGAGGTCCCT GAGACTCTCC TGTGCAGCGT CTGGATTAC CTTAGTAGC  
 151 GATGGCATGC ACTGGGTCCG CCAGGCTCCA GGCAAGGGGC TGGAGTGGGT  
 201 GGCAATTATA TGGTATGATG GAAGTAATAA ATATTATGCA GACTCCGTGA  
 251 AGGGCCGATT CACCATCTCC AGAGACAATT CCAAGAACAC GCTGTATCTG  
 301 CAAATGAACA GCCTGAGAGC CGAGGACACG GCTGTATATT ACTGTGCGAG  
 351 AGATCCCGGC TACTATTACG GTATGGACGT CTGGGGCCAA GGGACCACGG  
 401 TCACCGTCTC CTCAGCTTCC ACCAAGGGCC CATCCGTCTT CCCCTGGCG  
 451 CCCTGCTCTA GAAGCACCTC CGAGAGCACA GCGGCCCTGG GCTGCCTGGT  
 501 CAAGGACTAC TTCCCGAAC CGGTGACGGT GTCGTGGAAC TCAGGCGCTC  
 551 TGACCAGCGG CGTGCACACC TTCCAGCTG TCCTACAGTC CTCAGGACTC  
 601 TACTCCCTCA GCAGCGTGGT GACCGTGCC TCCAGCAACT TCGGCACCCA  
 651 GACCTACACC TGCAACGTAG ATCACAAGCC CAGCAACACC AAGGTGGACA  
 701 AGACAGTTGA GCGCAAATGT TGTGTCGAGT GCCCACCGTG CCCAGCACCA  
 751 CCTGTGGCAG GACCGTCAGT CTTCTCTTC CCCCCAAAAC CCAAGGACAC  
 801 CCTCATGATC TCCCGGACCC CTGAGGTCAC GTGCGTGGTG GTGGACGTGA  
 851 GCCACGAAGA CCCCAGGTC CAGTTCAACT GGTACGTGGA CGGCGTGGAG  
 901 GTGCATAATG CCAAGACAAA GCCACGGGAG GAGCAGTTCA ACAGCACGTT  
 951 CCGTGTGGTC AGCGTCTCA CCGTGTGCA CCAGGACTGG CTGAACGGCA  
 1001 AGGAGTACAA GTGCAAGGTC TCCAACAAAG GCCTCCAGC CCCCATCGAG  
 1051 AAAACCATCT CAAAACCAA AGGGCAGCCC CGAGAACCAC AGGTGTACAC  
 1101 CCTGCCCCCA TCCCGGAGG AGATGACCAA GAACCAGGTC AGCCTGACCT  
 1151 GCCTGGTCAA AGGCTTCTAC CCCAGCGACA TCGCCGTGGA GTGGGAGAGC  
 1201 AATGGGCAGC CGGAGAACAA CTACAAGACC ACACCTCCA TGCTGGACTC  
 1251 CGACGGCTCC TTCTTCTCT ACAGCAAGCT CACCGTGGAC AAGAGCAGGT  
 1301 GGCAGCAGGG GAACGTCTT TCATGCTCCG TGATGCATGA GGCTCTGCAC  
 1351 AACCACTACA CGCAGAAGAG CCTCTCCCTG TCTCCGGGTA AATGATAG

SEQ ID NO. 52

Modified 6.22.2 Heavy Chain Amino Acid Sequence

1 mefqlswvfl vallrqvqcQ VQLVESGGGV VQGRSLRLS CAASGFTFSS  
 51 DGMHWVRQAP GKLEWVAII WYDGSNKYYA DSVKGRFTTS RDNSKNTLYL  
 101 QMNSLRAEDT AVYYCARDPG YYYGMDVWGQ GTTVTVSSAS TKPGSVFPLA  
 151 PCSRSTSEST AALGCLVKDY FPEPVTVSWN SGALTSGVHT FPAVLQSSGL  
 201 YSLSSVVTVP SSNFGTQTYT CNVDHKPSNT KVDKTVKRC CVECPCPAP



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251 PVAGPSVFLF PPKPKDTLMI SRTPEVTCVV VDVSHEDPEV QFNWYVDGVE  
 301 VHANKTKPRE EQFNSTFRVV SVLTVVHQDW LNGKEYKCKV SNKGLPAPIE  
 351 KTISKTKGQP REPQVYTLPP SREEMTKNQV SLTCLVKGFY PSDIAVEWES  
 401 NGQPENNYKT TPPMLDSGDS FFLYSKLTVD KSRWQOQNVF SCSVMHEALH  
 451 NBYTQKSLSL SPGK

SEQ ID NO. 53

Modified 6.22.2 Kappa Light Chain Nucleotide Sequence

1 atgttgccat cacaactcat tgggtttctg ctgctctggg ttccagcttc  
 51 caggggtGAA ATTGTGCTGA CTCAGTCTCC AGACTTTCAG TCTGTGACTC  
 101 CAAAAGAGAA AGTCACCATC ACCTGCCGGG CCAGTCAGAG AATTGGTAGT  
 151 AGCTTACACT GGTACCAGCA GAAACCAGAT CAGTCTCAA AACTCCTCAT  
 201 CAAGTATGCT TCCAGTCCT TCTCAGGGGT CCCCTCGAGG TTCAGTGGCA  
 251 GTGGATCTGG GACAGATTC ACCCTCACCA TCAATAGCCT GGAAGCTGAA  
 301 GATGCTGCAA CTTATTACTG TCATCAGAGT GGTGTTTTAC CGCTCACTTT  
 351 CGGCGGAGGG ACCAAGGTGG AGATCAAACG AACTGTGGCT GCACCATCTG  
 401 TCTTCATCTT CCCGCCATCT GATGAGCAGT TGAAATCTGG AACTGCCTCT  
 451 GTTGTGTGCC TGCTGAATAA CTTCTATCCC AGAGAGGCCA AAGTACAGTG  
 501 GAAGGTGGAT AACGCCCTCC AATCGGGTAA CTCCAGGAG AGTGTACACAG  
 551 AGCAGGACAG CAAGGACAGC ACCTACAGCC TCAGCAGCAG CCTGACGCTG  
 601 AGCAAAGCAG ACTACGAGAA ACACAAAGTC TACGCCTGCG AAGTCACCCA  
 651 TCAGGGCCTG AGCTCGCCCG TCACAAAGAG CTTCAACAGG GGAGAGTGTT  
 701 AGTGA

SEQ ID NO. 54

Modified 6.22.2 Kappa Light Chain Amino Acid Sequence

1 mlpsqligfl llwvpasrgE IVLTQSPDFQ SVTPKEKVTI TCRASQRIGS  
 51 SLHWYQKPD QSPKLLIKYA SQSFSGVPSR FSGSGSGTDF TLTINSLEAE  
 101 DAATYYCHQS GRLPLTFGGG TKVEIKRTVA APSVFIFPPS DEQLKSGTAS  
 151 VVCLLNNFYF REAKVQWKVD NALQSGNSQE SVTEQDSKDS TYSLSSTLTL  
 201 SKADYEKHKV YACEVTHQGL SSPVTKSFNR GEC

SEQ ID NO. 55

Modified 6.34.2 Heavy Chain Nucleotide Sequence

1 atggagtttg gqctgagctg ggttttctc qttgctcttt taagaggtgt  
 51 ccagtgctCAG GTGCAGCTGG TGGAGTCTGG GGGAGGCGTG GTCCAGCCTG  
 101 GGAGGTCCCT GAGACTCTCC TGTGCAGCCT CTGGATTCAC CTTCAGTAGC  
 151 TATGGCATGC ACTGGGTCCG CCAGGCTCCA GGCAAGGGGC TGGAGTGGGT  
 201 GGCAGTTATA TCAAATGATG GAAATAATAA ATACTATGCA GACTCCGTGA  
 251 AGGGCCGATT CACCATCTCC AGAGACAATT CCAAAAACAC GCTGTATCTG  
 301 CAAATGAACA GCCTGCGCGC TGAGGACACG GCTGTGTATT ACTGTGCGAG  
 351 AGATAGTACG GCGATAACCT ACTACTACTA CGGAATGGAC GTCTGGGGCC  
 401 AAGGGACCAC GGTACCGTC TCCTCAGCTT CCACCAAGGG CCCATCCGTC  
 451 TTCCCCCTGG CGCCCTGCTC TAGAAGCACC TCCGAGAGCA CAGCGGCCCT  
 501 GGGCTGCCTG GTCAAGGACT ACTTCCCCGA ACCGGTGACG GTGTCGTGGA  
 551 ACTCAGGCGC TCTGACCAGC GCGTGCACA CCTTCCAGC TGTCTACAG  
 601 TCCTCAGGAC TCTACTCCCT CAGCAGCGTG GTGACCGTGC CCTCCAGCAA



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651 CTTCGGCACC CAGACCTACA CCTGCAACGT AGATCACAAG CCCAGCAACA  
 701 CCAAGGTGGA CAAGACAGTT GAGCGCAAAT GTTGTGTCGA GTGCCACCG  
 751 TGCCCAGCAC CACCTGTGGC AGGACCGTCA GTCTTCCTCT TCCCCCAA  
 801 ACCCAAGGAC ACCCTCATGA TCTCCCGGAC CCCTGAGGTC ACGTGCCTGG  
 851 TGGTGGACGT GAGCCACGAA GACCCCGAGG TCCAGTTCAA CTGGTACGTG  
 901 GACGGCGTGG AGGTGCATAA TGCCAAGACA AAGCCACGGG AGGAGCAGTT  
 951 CAACAGCACG TTCCTGTGG TCAGCGTCCT CACCGTTGTG CACCAGGACT  
 1001 GGCTGAACGG CAAGGAGTAC AAGTGCAAGG TCTCCAACAA AGGCCTCCCA  
 1051 GCCCCATCG AGAAAACCAT CTCCAAAACC AAAGGGCAGC CCCGAGAACC  
 1101 ACAGGTGTAC ACCCTGCCCC CATCCCGGGA GGAGATGACC AAGAACCAGG  
 1151 TCAGCCTGAC CTGCCTGGTC AAAGGCTTCT ACCCCAGCGA CATCGCCGTG  
 1201 GAGTGGGAGA GCAATGGGCA GCCGGAGAAC AACTACAAGA CCACACCTCC  
 1251 CATGCTGGAC TCCGACGGCT CTTCTTCCT CTACAGCAAG CTCACCGTGG  
 1301 ACAAGAGCAG GTGGCAGCAG GGAACGTCT TCTCATGCTC CGTGATGCAT  
 1351 GAGGCTCTGC ACAACCACTA CACGCAGAAG AGCCTCTCCC TGTCTCCGGG  
 1401 TAAATGATAG

SEQ ID NO. 56

Modified 6.34.2 Heavy Chain Amino Acid Sequence

1 mefqlswvfl vallrqvqcQ VQLVESGGGV VQPGSLRLS CAASGFTFSS  
 51 YGMHWVRQAP GKLEWVAVI SNDGNKYA DSVKGRFTIS RDNSKNTLYL  
 101 QMNSLRAEDT AVYYCARDST AITYYYGMD VWGQTTTVTV SSASTKGPSV  
 151 FPLAPCSRST SESTAALGCL VKDYFPEPVT VSWNSGALTS GVHTFPAVLQ  
 201 SSGLYSLSSV VTPSSNFGT QTYTCNVDHK PSNTKVDKTV ERKCCVECPP  
 251 CPAPPVAGPS VFLFPPKPKD TLMISRTPEV TCVVVDVSHE DPEVQFNWYV  
 301 DGVEVHNAKT KPREEQFNST FRVSVLTVV HQDWLNGKEY KNKVSNGKLP  
 351 APIEKTISKI KGQPREPOVY TLPPSREEMT KNQVSLTCLV KGFYPSDIAV  
 401 EWESNGQPEN NYKTPPMLD SDGSFFLYSK LTVDKSRWQQ GNVFSCSVMH  
 451 EALHNHYTQK SLSLSPGK

SEQ ID NO. 57

Modified 6.34.2 Kappa Light Chain Nucleotide Sequence

1 atggacatga gqgtccccgc tcagctcctg gqgtcctgc tactctgqct  
 51 ccgaggtgcc agatgtGACA TCCAGATGAC CCAGTCTCCA TCCTCCCTGT  
 101 CTGCATCTGT CGGAGACAGA GTCACCATCA CTTGCCGGGC AAGTCAGAGT  
 151 ATTAGTAGCT ATTTAAATTG GTATCAGCAG AAACCAGGGA AAGCCCCTAA  
 201 GCTCCTGATC TATGCTGCAT CCGGTTTGAA GCGTGGGGTC CCATCACGGT  
 251 TCAGTGGTAG TGGATCTGGG ACAGATTTC A CTCTACCAT CAGTCTCTG  
 301 CAACCTGAGG ATTTTGCAAC TTACTACTGT CACCAGAGTT ACAGTCTCCC  
 351 ATTCACCTTC GGCCCTGGGA CCAAAGTGA TATCAAACGA ACTGTGGCTG  
 401 CACCATCTGT CTTTATCTTC CCGCCATCTG ATGAGCAGTT GAAATCTGGA  
 451 ACTGCCTCTG TTGTGTGCCT GCTGAATAAC TTCTATCCA GAGAGGCCAA  
 501 AGTACAGTGG AAGGTGGATA ACGCCCTCCA ATCGGGTAAC TAAAAGGAGA  
 551 GTGTCACAGA GCAGGACAGC AAGGACAGCA CCTACAGCCT CAGCAGCACC  
 601 CTGACGCTGA GCAAAGCAGA CTACGAGAAA CACAAAGTCT ACGCCTGCGA



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651 AGTCACCCAT CAGGGCCTGA GCTCGCCCGT CACAAAGAGC TTCAACAGGG  
701 GAGAGTGTTA GTGA

SEQ ID NO. 58

Modified 6.34.2 Kappa Light Chain Amino Acid Sequence

1 mdmrvpaql1 qlllslrga rcDIQMTQSP SLSASVGDV VTITCRASQS  
51 ISSYLNWYQQ KPGKAPKLLI YAASGLKRGV PSRFSGSGSG TDFTLTISSL  
101 QPEDFATYYC HQSYSLPFTF GPGTKVKIKR TVAAPSVFIF PPSDEQLKSG  
151 TASVVCLLNN FYPREAKVQW KVDNALQSGN SQESVTEQDS KDSTYLSLST  
201 LTLKADYK HKVYACEVTH QGLSSPVTKS FNRGEC

SEQ ID NO. 59

Modified 6.67.1 Heavy Chain Nucleotide Sequence

1 atgaaacacc tqtggttctt cctcctgctg gtggcagctc ccagatgggt  
51 cctgtccCAG GTGCAGCTGA AGGAGTCGGG CCCAGGACTG GTGAAGCCTT  
101 CGGAGACCCT GTCCCTCACC TGCACTGTCT CTGGTACTC CATCAGTAGT  
151 AACTATTGGA GCTGGATCCG GCAGCCCGCC GGAAGGGAC TGGAGTGGAT  
201 TGGGCGTATC TATACCAGTG GGGGCACCAA CTCCAACCCC TCCCTCAGGG  
251 GTCGAGTCAC CATGTCAGTA GACACGTCCA AGAACAGTT CTCTCTGAAA  
301 CTGAGTTCTG TGACCGCCGC GGACACGGC GTGTATTACT GTGCGAGAGA  
351 TCGTATTACT ATAATTCGGG GACTTATTC ATCCTTCTTT GACTACTGGG  
401 GCCAGGGAAC CCTGGTCACC GTCTCCTCAG CTTCCACCAA GGGCCCATCC  
451 GTCTTCCCC TGGCGCCCTG CTCTAGAAGC ACCTCCGAGA GCACAGCGGC  
501 CCTGGGCTGC CTGGTCAAGG ACTACTTCCC CGAACCGGTG ACGGTGTCGT  
551 GGAAGTCAGG CGCTCTGACC AGCGGCGTGC ACACCTTCCC AGCTGTCTTA  
601 CAGTCCTCAG GACTCTACTC CCTACGCAGC GTGGTGACCG TGCCCTCCAG  
651 CAACTTCGGC ACCCAGACCT ACACCTGCAA CGTAGATCAC AAGCCAGCA  
701 ACACCAAGGT GGACAAGACA GTTGAGCGCA AATGTTGTGT CGAGTGCCCA  
751 CCGTGCCCAG CACCACCTGT GGCAGGACCG TCAGTCTTCC TCTTCCCCC  
801 AAAACCCAAG GACACCCTCA TGATCTCCCG GACCCCTGAG GTCACGTGCG  
851 TGGTGGTGGG CGTGAGCCAC GAAGACCCCG AGGTCCAGTT CAACTGGTAC  
901 GTGACGCGCG TGGAGGTGCA TAATGCCAAG ACAAAGCCAC GGGAGGAGCA  
951 GTTCAACAGC ACGTTCCTGT TGGTCAGCGT CCTCACCGTT GTGCACCAGG  
1001 ACTGGCTGAA CGGCAAGGAG TACAAGTGCA AGGTCTCAA CAAAGGCCTC  
1051 CCAGCCCCCA TCGAGAAAAC CATCTCCAAA ACCAAAGGGC AGCCCCGAGA  
1101 ACCACAGGTG TACACCCTGC CCCCATCCCG GGAGGAGATG ACCAAGAACC  
1151 AGGTCAGCCT GACCTGCCTG GTCAAAGGCT TCTACCCAG CGACATCGCC  
1201 GTGGAGTGGG AGAGCAATGG GCAGCCGGAG AACAACTACA AGACCACACC  
1251 TCCCATGCTG GACTCCGACG GCTCCTTCTT CCTCTACAGC AAGCTCACCG  
1301 TGGACAAGAG CAGGTGGCAG CAGGGGAACG TCTTCTCATG CTCCGTGATG  
1351 CATGAGGCTC TGCACAACCA CTACACGCAG AAGAGCCTCT CCCTGTCTCC  
1401 GGGTAAATGA TAG

SEQ ID NO. 60

Modified 6.67.1 Heavy Chain Amino Acid Sequence

1 mkhllwfflll vaaprwlslQ VQLQESGPGV VKPSETLSLT CTVSGDSISS  
51 NYWSWIRQPA GKLEWIGRI YTSGGTNSNP SLRGRVTMSV DTSKNQFSLK



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101 LSSVTAADTA VYYCARDRIT IIRGLIPSPF DYWGQGLVTV VSSASTKGPS  
 151 VFPLAPCSRS TSESTAALGC LVKDYFPEPV TVSWNSGALT SGVHTFPAVL  
 201 QSSGLYSLSS VVTVPSNFG TQTYTCNVDH KPSNTKVDKT VERKCCVECP  
 251 PCPAPPVAGP SVFLFPPKPK DTLMISRTPE VTCVVVDVSH EDPEVQFNWY  
 301 VDGVEVHNAK TKPREEQFNS TFRVSVLTV VHQDWLNGKE YKNKVS NKGL  
 351 PAPIEKTISK TKGQPREQOV YTLPPSREEM TKNQVSLTCL VKGFYPSDIA  
 401 VEWESNGQPE NNYKTTPPML DSDGSFFLYS KLTVDKSRWQ QGNVFS CSVM  
 451 HEALHNHYTQ KSLSLSPGK

SEQ ID NO. 61

Modified 6.67.1 Kappa Light Chain Nucleotide Sequence

1 atggtggtgc agaccaggt cttcattct ctggtgctct qgatctctgg  
 51 tgctacggg GACATCGTGA TGACCCAGTC TCCAGACTCC CTGGCTGTGT  
 101 CTCTGGGCGA GAGGCCACC ATCAACTGCA AGTCCAGCCA GAGTGTTTTA  
 151 TACAGCTCCA ACAATAAGAA CTA CTACTAGCT TGGTACCAAC AGAAACCAGG  
 201 ACAGCCTCCT AAATTGCTCA TTTACTGGGC ATCTATACGG GAATATGGGG  
 251 TCCCTGACCG ATTCAGTGGC AGCGGGTCTG GGACAGATTT CACTCTCACC  
 301 ATCAGCAGCC TGCAGGCTGA AGATGTGGCA GTTTATTTCT GTCAACAATA  
 351 TTATAGTATT CCTCCCCTCA CTTTCGGCGG AGGGACCAAG GTGGAGATCA  
 401 AACGAACTGT GGCTGCACCA TCTGTCTTCA TCTTCCCGCC ATCTGATGAG  
 451 CAGTTGAAAT CTGGAAGTGC CTCTGTTGTG TGCTGCTGA ATA ACTTCTA  
 501 TCCCAGAGAG GCCAAAGTAC AGTGGAAGGT GGATAACGCC CTCCAATCGG  
 551 GTA ACTCCA GGAGAGTGTC ACAGAGCAGG ACAGCAAGGA CAGCACCTAC  
 601 AGCCTCAGCA GCACCCTGAC GCTGAGCAAA GCAGACTACG AGAAACACAA  
 651 AGTCTACGCC TCGAAGTCA CCCATCAGGG CCTGAGCTCG CCCGTCACAA  
 701 AGAGCTTCAA CAGGGGAGAG TGTTAGTGA

SEQ ID NO. 62

Modified 6.67.1 Kappa Light Chain Amino Acid Sequence

1 mvlgtqvfis lllwisgayg DIVMTQSPDS LAVSLGERAT INCKSSQSVL  
 51 YSSNNKNYLA WYQQKPGQPP KLLIYWASIR EYGVPRDFSG SGS GTDFLT  
 101 ISSLQAEDVA VFYFQQYYSI PPLTFGGGTK VEIKRTVAAP SVFIFPPSDE  
 151 QLKSGTASVV CLLNFPYPRE AKVQWKVDNA LQSGNSQESV TEQSKDSTY  
 201 SLSSTLTLSK ADYEKHKVYA CEVTHQGLSS PVTKSFNRGE C

SEQ ID NO. 63

Modified 6.77.1 Heavy Chain Nucleotide Sequence

1 atggaactgg ggctccgctg ggttttcctt gttgctattt tagaagggtg  
 51 ccagtgtgag GTGCAGCTGG TGGAGTCTGG GGGAGGCCTG GTCAAGCCTG  
 101 GGGGTCCCT GAGACTCTCC TGTGCAGCCT CTGGATTAC CTT CAGTAGC  
 151 TATAGCATGA ACTGGTCCG CCAGGCTCCA GGAAGGGGC TGGAGTGGGT  
 201 CTCATCCATT AGTAGTAGTA GTAGTTACAT ATACTACGCA GACTCAGTGA  
 251 AGGGCCGATT CACCATCTCC AGAGACAACG CCAAGAACTC ACTGTATCTG  
 301 CAAATGAACA GCCTGAGAGC CGAGGACACG GCTGTGTATT ACTGTGCGAG  
 351 AGATGGGTAT AGCAGTGGCT GGTCCACTA CTACTACTAC GGTATGGACG  
 401 TCTGGGGCCA AGGGACCACG GTCACCGTCT CCTCAGCTTC CACCAAGGGC  
 451 CCATCCGTCT TCCCCTGGC GCCCTGCTCT AGAAGCACCT CCGAGAGCAC



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501 AGCGGCCCTG GGCTGCCTGG TCAAGGACTA CTTCCCCGAA CCGGTGACGG  
 551 TGTCGTGGAA CTCAGGCGCT CTGACCAGCG GCGTGCACAC CTCCCAGCT  
 601 GTCCTACAGT CCTCAGGACT CTACTCCCTC AGCAGCGTGG TGACCGTGCC  
 651 CTCCAGCAAC TTCGGCACCC AGACCTACAC CTGCAACGTA GATCACAAGC  
 701 CCAGCAACAC CAAGGTGGAC AAGACAGTTG AGCGCAAATG TTGTGTCGAG  
 751 TGCCCACCGR GCCCAGCACC ACCTGTGGCA GGACCGTCAG TCTTCTCTT  
 801 CCCCCAAAA CCAAGGACA CCCTCATGAT CTCCCGGACC CCTGAGGTCA  
 851 CGTGCCTGGT GGTGGACGTG AGCCACGAAG ACCCCGAGGT CCAGTTCAAC  
 901 TGGTACGTGG ACGGCGTGA GGTGCATAAT GCCAAGACAA AGCCACGGGA  
 951 GGAGCAGTTC AACAGCACGT TCCGTGTGGT CAGCGTCCTC ACCGTTGTGC  
 1001 ACCAGGACTG GCTGAACGGC AAGGAGTACA AGTGCAAGGT CTCCAACAAA  
 1051 GGCCTCCCAG CCCCATCGA GAAAACCATC TCCAAAACCA AAGGCAGCC  
 1101 CCGAGAACCA CAGGTGTACA CCCTGCCCCC ATCCCGGGAG GAGATGACCA  
 1151 AGAACCAGGT CAGCCTGACC TGCTTGGTCA AAGGCTTCTA CCCAGCGAC  
 1201 ATCGCCGTGG AGTGGGAGAG CAATGGGCAG CCGGAGAACA ACTACAAGAC  
 1251 CACACCTCCC ATGCTGGACT CGGACGGCTC CTTCTTCTC TACAGCAAGC  
 1301 TCACCGTGGG CAAGAGCAGG TGGCAGCAGG GGAACGTCTT CTCATGCTCC  
 1351 GTGATGCATG AGGCTCTGCA CAACCACTAC ACGCAGAAGA GCCTCTCCCT  
 1401 GTCTCCGGGT AAATGATAG

SEQ ID NO. 64

Modified 6.77.1 Heavy Chain Protein Sequence

1 melqlrwwfl vaileqvqe VQLVESGGGL VKPGGSLRLS CAASGFTFSS  
 51 YSMNWVRQAP GKGLEWVSSI SSSSSYIYYA DSVKGRFTIS RDNAKNSLYL  
 101 QMNSLRAEDT AVYYCARDGY SSGWSYYYYY GMDVWGQGT VTVSSASTKG  
 151 PSVFPLAPCS RSTSESTAAL GCLVKDYFPE PVTVSWNSGA LTSGVHTFPA  
 201 VLQSSGLYSL SSVVTVPSSN FGTQTYTCNV DHKPSNTKVD KTVRKCCE  
 251 CPPCPAPPVA GPSVFLFPPK PKDTLMISRT PEVTCVVVDV SHEDPEVQFN  
 301 WYVDGVEVHN AKTKPREEQF NSTFRVSVL TVVHQDWLNG KEYKKNVSNK  
 351 GLPAPIEKTI SKTKGQPREP QVYTLPPSRE EMTKNQVSLT CLVKGFPYSD  
 401 IAVEWESNGQ PENNYKTPP MLDSDGFFL YSKLTVDKSR WQQGNVFCSS  
 451 VMHEALHNHY TQKSLSLSPG K

SEQ ID NO. 65

Modified 6.77.1 Kappa Light Chain Nucleotide Sequence

1 atgaggctcc ctgctcagct cctggggctg ctaatgctct ggatacctgg  
 51 atccagtqca GATATTGTGA TGACCCAGAC TCCACTCTCT CTGTCCGTCA  
 101 CTCCTGGACA GCCGGCCTCC ATCTCCTGCA AGTCTAGTCA GAGCCTCCTG  
 151 CTTAGTGATG GAAAGACCTA TTTGAATTGG TACCTGCAGA AGCCCGCCA  
 201 GCCTCCACAG CTCCTGATCT ATGAAGTTTC CAACCGGTTT TCTGGAGTGC  
 251 CAGACAGGTT CAGTGGCAGC GGGTCAGGGA CAGATTTTAC ACTGAAAATC  
 301 AGCCGGGTGG AGGCTGAGGA TGTGGGGTT TATTACTGCA TGCAAAGTAT  
 351 ACAGCTTATG TGCACTTTTG GCCAGGGGAC CAAGCTGGAG ATCAAACGAA  
 401 CTGTGGCTGA ACCATCTGTC TTCATCTTCC CGCCATCTGA TGAGCAGTTG



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451 AAATCTGGAA CTGCCTCTGT TGTGTGCCTG CTGAATAACT TCTATCCCAG  
 501 AGAGGCCAAA GTACAGTGGA AGGTGGATAA CGAAATCCAA TCGGGTAACT  
 551 CCCAGGAGAG TGTCACAGAG CAGGACAGCA AGGACAGCAC CTACAGCCTC  
 601 AGCAGCACCC TGACGCTGAG CAAAGCAGAC TACGAGAAAC ACAAAGTCTA  
 651 CGCCTGCGAA GTCACCCATC AGGGCCTGAG CTCGCCCGTC ACAAAGAGCT  
 701 TCAACAGGGG AGAGTGTTAG TGA

SEQ ID NO. 66

Modified 6.77.1 Kappa Light Chain Amino Acid Sequence

1 mrlpaqlql lmlwipgssa DIVMTQTPLS LSVTPGQPAS ISCKSSQSLL  
 51 LSDGKTYLNW YLQKPGOPPQ LLIYEVSNRFSGVPDRFSGS GSGTDFTLKI  
 101 SRVEAEDVGV YSCKQSIQLM SSFGQGTKLE IKRTVAAPSV FIFPPSDEQL  
 151 KSGTASVVCL LNNFYPREAK VQWKVDNALQ SGNSQESVTE QDSKDSTYSL  
 201 SSTLTLSKAD YEKHKVYACE VTHQGLSSPV TKSFNRGEC

SEQ ID NO. 67

Modified 7.26.4 Kappa Light Chain Nucleotide Sequence

1 atgaggctcc ctgctcagct cctggggctg ctaatgctct ggatacctgg  
 51 atccagtgcg GATATTGTGA TGACCCAGAC TCCACTCTCT CTGTCCGTCA  
 101 CCCCTGGACA GCCGCCTCC ATCTCCTGCA AGTCTAGTCA GAGCCTCCTG  
 151 TATAGTGATG GAAAGACCTA TTTGTTTTGG TACCTGCAGA AGCCAGGCCA  
 201 GCCTCCACAG CTCCTGATCT ATGAAGTTC CAACCGATTC TCTGGAGTGC  
 251 CAGATAGGTT CAGTGGCAGC GGGTCAGGGA CAGATTTTAC ACTGAAAATC  
 301 AGCCGGGTGG AGGCTGAGGA TGTGGGGT TATTACTGCA TGCAAAGTAT  
 351 ACAGCTTCCG TGGACGTTCCGCCAAGGGAC CAAGGTGGAA ATCAAACGAA  
 401 CTGTGGCTGC ACCATCTGTC TTCATCTTCC CGCCATCTGA TGAGCAGTTG  
 451 AAATCTGGAA CTGCCTCTGT TGTGTGCCTG CTGAATAACT TCTATCCCAG  
 501 AGAGGCCAAA GTACAGTGGA AGGTGGATAA CGCCCTCCAA TCGGGTAACT  
 551 CCCAGGAGAG TGTCACAGAG CAGGACAGCA AGGACAGCAC CTACAGCCTC  
 601 AGCAGCACCC TGACGCTGAG CAAAGCAGAC TACGAGAAAC ACAAAGTCTA  
 651 CGCCTGCGAA GTCACCCATC AGGGCCTGAG CTCGCCCGTC ACAAAGAGCT  
 701 TCAACAGGGG AGAGTGTTAG TGA

SEQ ID NO. 68

Modified 7.26.4 Kappa Light Chain Amino Acid Sequence

1 mrlpaqlql lmlwipgssa DIVMTQTPLS LSVTPGQPAS ISCKSSQSLL  
 51 YSDGKTYLFW YLQKPGOPPQ LLIYEVSNRFSGVPDRFSGS GSGTDFTLKI  
 101 SRVEAEDVGV YYCMQSIQLP WTFGQGTKVE IKRTVAAPSV FIFPPSDEQL  
 151 KSGTASVVCL LNNFYPREAK VQWKVDNALQ SGNSQESVTE QDSKDSTYSL  
 201 SSTLTLSKAD YEKHKVYACE VTHQGLSSPV TKWFNRGEC

## SEQUENCE LISTING

&lt;160&gt; NUMBER OF SEQ ID NOS: 147

&lt;210&gt; SEQ ID NO 1

&lt;211&gt; LENGTH: 1392

&lt;212&gt; TYPE: DNA

&lt;213&gt; ORGANISM: Homo sapiens



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&lt;400&gt; SEQUENCE: 1

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atggagtttg ggctgagctg gattttcctt gctgctatth taaaaggtgt ccagtgtgag    60
gtgcagctgg tggagtctgg gggaggcttg gtgaagcctg gggggtcctc tagactctcc    120
tgtgtagcct ctggattcac tttcactaac gcttgatga tctgggtccg ccaggctcca    180
gggaaggggc tggagtgggt tggccgtatt aaaaggaaaa ctgatgggtg gacaacagac    240
tacgctgcac ccgtgaaagg cagattcacc atctcaagag atgattcaaa aaacacgctg    300
tatctgcaaa tgaacagcct gaaaaccgag gacacagccg tgtattactg taccacaggg    360
ggagtggctg aggactactg gggccagggg accctgggtc cegtctctc agcctccacc    420
aagggcccat cggctctccc cctggcgccc tgetccagga gcacctccga gagcacagcg    480
gccctgggct gcctgggtcaa ggactacttc cccgaaccgg tgacgggtgc gtggaactca    540
ggcgctctga ccagcggcgt gcacaccttc ccagctgtcc tacagtctc aggactctac    600
tcctcagca gcgtggtgac cgtgccctcc agcaacttcg gcacccagac ctacacctgc    660
aacgtagatc acaagcccag caacaccaag gtggacaaga cagttgagcg caaatggtgt    720
gtcgagtgcc caccgtgccc agcaccacct gtggcaggac cgtcagtctt cctcttcccc    780
ccaaaacca aggacaccct catgatctcc cggacccctg aggtcacgtg cgtgggtggtg    840
gacgtgagcc acgaagaccc cgaggtccag ttcaactggt acgtggacgg cgtggaggtg    900
cataatgcca agacaaagcc acgggaggag cagttcaaca gcacgttccg tgtggtcagc    960
gtcctcaccg ttgtgcacca ggactggctg aacggcaagg agtacaagtg caaggtctcc   1020
aacaaggcc tcccagcccc catcgagaaa accatctcca aaaccaagg gcagccccga   1080
gaaccacagg tgtacaccct gccccatcc cgggaggaga tgaccaagaa ccaggtcagc   1140
ctgacctgcc tgggtcaaagg cttctacccc agcgacatcg ccgtggagtg ggagagcaat   1200
gggcagccgg agaacaacta caagaccaca cctcccatgc tggactccga cggctccttc   1260
ttcctctaca gcaagctcac cgtggacaag agcaggtggc agcaggggaa cgtcttctca   1320
tgctccgtga tgcattgagc tctgcacaac cactacacgc agaagagcct ctccctgtct   1380
ccgggtaaat ga                                                              1392

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&lt;210&gt; SEQ ID NO 2

&lt;211&gt; LENGTH: 463

&lt;212&gt; TYPE: PRT

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 2

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Met Glu Phe Gly Leu Ser Trp Ile Phe Leu Ala Ala Ile Leu Lys Gly
  1           5           10           15
Val Gln Cys Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Lys
  20           25           30
Pro Gly Gly Ser Leu Arg Leu Ser Cys Val Ala Ser Gly Phe Thr Phe
  35           40           45
Thr Asn Ala Trp Met Ile Trp Val Arg Gln Ala Pro Gly Lys Gly Leu
  50           55           60
Glu Trp Val Gly Arg Ile Lys Arg Lys Thr Asp Gly Gly Thr Thr Asp
  65           70           75           80
Tyr Ala Ala Pro Val Lys Gly Arg Phe Thr Ile Ser Arg Asp Asp Ser
  85           90           95
Lys Asn Thr Leu Tyr Leu Gln Met Asn Ser Leu Lys Thr Glu Asp Thr
  100          105          110

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|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Ala | Val | Tyr | Tyr | Cys | Thr | Thr | Gly | Gly | Val | Ala | Glu | Asp | Tyr | Trp | Gly |
|     |     | 115 |     |     |     |     | 120 |     |     |     |     | 125 |     |     |     |
| Gln | Gly | Thr | Leu | Val | Thr | Val | Ser | Ser | Ala | Ser | Thr | Lys | Gly | Pro | Ser |
|     | 130 |     |     |     |     | 135 |     |     |     |     | 140 |     |     |     |     |
| Val | Phe | Pro | Leu | Ala | Pro | Cys | Ser | Arg | Ser | Thr | Ser | Glu | Ser | Thr | Ala |
| 145 |     |     |     |     | 150 |     |     |     |     | 155 |     |     |     |     | 160 |
| Ala | Leu | Gly | Cys | Leu | Val | Lys | Asp | Tyr | Phe | Pro | Glu | Pro | Val | Thr | Val |
|     |     |     |     | 165 |     |     |     |     | 170 |     |     |     |     | 175 |     |
| Ser | Trp | Asn | Ser | Gly | Ala | Leu | Thr | Ser | Gly | Val | His | Thr | Phe | Pro | Ala |
|     |     |     | 180 |     |     |     |     | 185 |     |     |     |     | 190 |     |     |
| Val | Leu | Gln | Ser | Ser | Gly | Leu | Tyr | Ser | Leu | Ser | Ser | Val | Val | Thr | Val |
|     |     | 195 |     |     |     |     | 200 |     |     |     |     | 205 |     |     |     |
| Pro | Ser | Ser | Asn | Phe | Gly | Thr | Gln | Thr | Tyr | Thr | Cys | Asn | Val | Asp | His |
|     | 210 |     |     |     |     | 215 |     |     |     |     | 220 |     |     |     |     |
| Lys | Pro | Ser | Asn | Thr | Lys | Val | Asp | Lys | Thr | Val | Glu | Arg | Lys | Cys | Cys |
| 225 |     |     |     |     | 230 |     |     |     |     | 235 |     |     |     |     | 240 |
| Val | Glu | Cys | Pro | Pro | Cys | Pro | Ala | Pro | Pro | Val | Ala | Gly | Pro | Ser | Val |
|     |     |     |     | 245 |     |     |     |     | 250 |     |     |     |     | 255 |     |
| Phe | Leu | Phe | Pro | Pro | Lys | Pro | Lys | Asp | Thr | Leu | Met | Ile | Ser | Arg | Thr |
|     |     |     | 260 |     |     |     |     | 265 |     |     |     |     |     | 270 |     |
| Pro | Glu | Val | Thr | Cys | Val | Val | Val | Asp | Val | Ser | His | Glu | Asp | Pro | Glu |
|     |     | 275 |     |     |     |     | 280 |     |     |     |     | 285 |     |     |     |
| Val | Gln | Phe | Asn | Trp | Tyr | Val | Asp | Gly | Val | Glu | Val | His | Asn | Ala | Lys |
|     | 290 |     |     |     |     | 295 |     |     |     | 300 |     |     |     |     |     |
| Thr | Lys | Pro | Arg | Glu | Glu | Gln | Phe | Asn | Ser | Thr | Phe | Arg | Val | Val | Ser |
| 305 |     |     |     |     | 310 |     |     |     |     | 315 |     |     |     |     | 320 |
| Val | Leu | Thr | Val | Val | His | Gln | Asp | Trp | Leu | Asn | Gly | Lys | Glu | Tyr | Lys |
|     |     |     |     | 325 |     |     |     |     | 330 |     |     |     |     | 335 |     |
| Cys | Lys | Val | Ser | Asn | Lys | Gly | Leu | Pro | Ala | Pro | Ile | Glu | Lys | Thr | Ile |
|     |     |     | 340 |     |     |     |     | 345 |     |     |     |     | 350 |     |     |
| Ser | Lys | Thr | Lys | Gly | Gln | Pro | Arg | Glu | Pro | Gln | Val | Tyr | Thr | Leu | Pro |
|     |     | 355 |     |     |     |     | 360 |     |     |     |     | 365 |     |     |     |
| Pro | Ser | Arg | Glu | Glu | Met | Thr | Lys | Asn | Gln | Val | Ser | Leu | Thr | Cys | Leu |
|     |     | 370 |     |     |     | 375 |     |     |     |     | 380 |     |     |     |     |
| Val | Lys | Gly | Phe | Tyr | Pro | Ser | Asp | Ile | Ala | Val | Glu | Trp | Glu | Ser | Asn |
| 385 |     |     |     |     | 390 |     |     |     |     | 395 |     |     |     |     | 400 |
| Gly | Gln | Pro | Glu | Asn | Asn | Tyr | Lys | Thr | Thr | Pro | Pro | Met | Leu | Asp | Ser |
|     |     |     |     | 405 |     |     |     |     | 410 |     |     |     |     | 415 |     |
| Asp | Gly | Ser | Phe | Phe | Leu | Tyr | Ser | Lys | Leu | Thr | Val | Asp | Lys | Ser | Arg |
|     |     |     | 420 |     |     |     |     | 425 |     |     |     |     | 430 |     |     |
| Trp | Gln | Gln | Gly | Asn | Val | Phe | Ser | Cys | Ser | Val | Met | His | Glu | Ala | Leu |
|     |     | 435 |     |     |     |     | 440 |     |     |     |     | 445 |     |     |     |
| His | Asn | His | Tyr | Thr | Gln | Lys | Ser | Leu | Ser | Leu | Ser | Pro | Gly | Lys |     |
|     | 450 |     |     |     |     | 455 |     |     |     |     | 460 |     |     |     |     |

&lt;210&gt; SEQ ID NO 3

&lt;211&gt; LENGTH: 720

&lt;212&gt; TYPE: DNA

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 3

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gatattgtga tgactcagtc tccactctcc ctgcccgtca cccctggaga gccggcctcc 120

atctctgca ggtctagtca gagcctcctg caaagtaatg gatacaacta tttggattgg 180



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tacctgcaga agccagggca gtctccacag ctctgatct atttgggttc taatcgggcc 240
tccgggggtcc ctgacaggtt cagtggcagt ggatcaggca cagattttac actgaaaatc 300
agcagagtgg aggctgagga tgttgggggtt tattactgca tgcaagctct acaaactatc 360
accttcgggc aaggacacg actggagatt aaacgaactg tggetgcacc atctgtcttc 420
atcttcccgc catctgatga gcagttgaaa tctggaactg cctctgttgt gtgectgctg 480
aataacttct atcccagaga ggccaaagta cagtggaagg tggataacgc cctccaatcg 540
ggtaactccc aggagagtgt cacagagcag gacagcaagg acagcaccta cagcctcagc 600
agcacctga cgctgagcaa agcagactac gagaacaca aagtctacgc ctgcgaagtc 660
acccatcagg gcctgagctc gcccgtcaca aagagcttca acaggggaga gtgttagtga 720

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<210> SEQ ID NO 4
<211> LENGTH: 238
<212> TYPE: PRT
<213> ORGANISM: Homo sapiens

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<400> SEQUENCE: 4

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

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<210> SEQ ID NO 5
<211> LENGTH: 1392
<212> TYPE: DNA
<213> ORGANISM: Homo sapiens

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<400> SEQUENCE: 5

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tgtgtagtct ctggattcac tttcactaac gcctggatga tctgggtccg ccaggctcca    180
gggaaggggc tggagtgggt tggccgtatt aaaaggaaaa ctgatgggtg gacaacagac    240
tacgctgcac ccgtgaaagg cagattcacc atctcaagag atgattcaaa aaacacgctg    300
tatctgcaaa tgaacagcct gaaaaccgag gacacagccg tgtattactg taccacaggg    360
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gccctgggct gcctgggtcaa ggactacttc cccgaaccgg tgacgggtgc gtggaactca    540
ggcgctctga ccagcggcgt gcacaccttc ccagctgtcc tacagtctct aggactctac    600
tcctcagca gcgtggtgac cgtgccctcc agcaacttcg gcaccagac ctacacctgc    660
aacgtagatc acaagcccag caacaccaag gtggacaaga cagttgagcg caaatgttgt    720
gtcgagtgcc caccgtgcc agcaccacct gtggcaggac cgtcagtctt cctcttcccc    780
ccaaaacca aggacacct catgatctcc cggaccctcg aggtcacgtg cgtgggtggtg    840
gacgtgagcc acgaagacc cgaggtccag ttcaactggt acgtggacgg cgtggaggtg    900
cataatgcca agacaaagcc acgggaggag cagttcaaca gcacgttccg tgtggtcagc    960
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aacaaggcc tcccagcccc catcgagaaa accatctcca aaaccaaagg gcagccccga   1080
gaaccacagg tgtacacct gccccatcc cgggaggaga tgaccaagaa ccaggtcagc   1140
ctgacctgcc tgggtcaaagg cttctacccc agcgacatcg ccgtggagtg ggagagcaat   1200
gggcagccgg agaacaacta caagaccaca cctcccatgc tggactccga cggctccttc   1260
ttcctctaca gcaagctcac cgtggacaag agcaggtggc agcaggggaa cgtcttctca   1320
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&lt;210&gt; SEQ ID NO 6

&lt;211&gt; LENGTH: 463

&lt;212&gt; TYPE: PRT

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 6

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Met Glu Phe Gly Leu Ser Trp Ile Phe Leu Ala Ala Ile Leu Lys Gly
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Val Gln Cys Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Lys
             20             25             30
Pro Gly Gly Ser Leu Arg Leu Ser Cys Val Val Ser Gly Phe Thr Phe
             35             40             45
Thr Asn Ala Trp Met Ile Trp Val Arg Gln Ala Pro Gly Lys Gly Leu
             50             55             60
Glu Trp Val Gly Arg Ile Lys Arg Lys Thr Asp Gly Gly Thr Thr Asp
             65             70             75             80
Tyr Ala Ala Pro Val Lys Gly Arg Phe Thr Ile Ser Arg Asp Asp Ser
             85             90             95
Lys Asn Thr Leu Tyr Leu Gln Met Asn Ser Leu Lys Thr Glu Asp Thr
             100            105            110
Ala Val Tyr Tyr Cys Thr Thr Gly Gly Val Ala Glu Asp Tyr Trp Gly

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| 115 |     |     | 120 |     |     | 125 |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Gln | Gly | Thr | Leu | Val | Thr | Val | Ser | Ser | Ala | Ser | Thr | Lys | Gly | Pro | Ser |
|     | 130 |     |     |     | 135 |     |     |     |     |     | 140 |     |     |     |     |
| Val | Phe | Pro | Leu | Ala | Pro | Cys | Ser | Arg | Ser | Thr | Ser | Glu | Ser | Thr | Ala |
|     | 145 |     |     |     | 150 |     |     |     |     |     | 155 |     |     |     | 160 |
| Ala | Leu | Gly | Cys | Leu | Val | Lys | Asp | Tyr | Phe | Pro | Glu | Pro | Val | Thr | Val |
|     |     |     |     | 165 |     |     |     |     |     | 170 |     |     |     |     | 175 |
| Ser | Trp | Asn | Ser | Gly | Ala | Leu | Thr | Ser | Gly | Val | His | Thr | Phe | Pro | Ala |
|     |     |     |     | 180 |     |     |     |     |     | 185 |     |     |     | 190 |     |
| Val | Leu | Gln | Ser | Ser | Gly | Leu | Tyr | Ser | Leu | Ser | Ser | Val | Val | Thr | Val |
|     |     | 195 |     |     |     |     | 200 |     |     |     |     |     | 205 |     |     |
| Pro | Ser | Ser | Asn | Phe | Gly | Thr | Gln | Thr | Tyr | Thr | Cys | Asn | Val | Asp | His |
|     |     | 210 |     |     |     |     | 215 |     |     |     |     |     | 220 |     |     |
| Lys | Pro | Ser | Asn | Thr | Lys | Val | Asp | Lys | Thr | Val | Glu | Arg | Lys | Cys | Cys |
|     |     |     |     |     | 230 |     |     |     |     | 235 |     |     |     |     | 240 |
| Val | Glu | Cys | Pro | Pro | Cys | Pro | Ala | Pro | Pro | Val | Ala | Gly | Pro | Ser | Val |
|     |     |     |     |     | 245 |     |     |     |     | 250 |     |     |     |     | 255 |
| Phe | Leu | Phe | Pro | Pro | Lys | Pro | Lys | Asp | Thr | Leu | Met | Ile | Ser | Arg | Thr |
|     |     |     |     |     | 260 |     |     |     |     | 265 |     |     |     | 270 |     |
| Pro | Glu | Val | Thr | Cys | Val | Val | Val | Asp | Val | Ser | His | Glu | Asp | Pro | Glu |
|     |     | 275 |     |     |     |     |     | 280 |     |     |     |     | 285 |     |     |
| Val | Gln | Phe | Asn | Trp | Tyr | Val | Asp | Gly | Val | Glu | Val | His | Asn | Ala | Lys |
|     |     | 290 |     |     |     |     | 295 |     |     |     | 300 |     |     |     |     |
| Thr | Lys | Pro | Arg | Glu | Glu | Gln | Phe | Asn | Ser | Thr | Phe | Arg | Val | Val | Ser |
|     |     |     |     |     | 310 |     |     |     |     |     | 315 |     |     |     | 320 |
| Val | Leu | Thr | Val | Val | His | Gln | Asp | Trp | Leu | Asn | Gly | Lys | Glu | Tyr | Lys |
|     |     |     |     |     | 325 |     |     |     |     | 330 |     |     |     |     | 335 |
| Cys | Lys | Val | Ser | Asn | Lys | Gly | Leu | Pro | Ala | Pro | Ile | Glu | Lys | Thr | Ile |
|     |     |     |     |     | 340 |     |     |     |     | 345 |     |     |     | 350 |     |
| Ser | Lys | Thr | Lys | Gly | Gln | Pro | Arg | Glu | Pro | Gln | Val | Tyr | Thr | Leu | Pro |
|     |     | 355 |     |     |     |     |     | 360 |     |     |     |     |     | 365 |     |
| Pro | Ser | Arg | Glu | Glu | Met | Thr | Lys | Asn | Gln | Val | Ser | Leu | Thr | Cys | Leu |
|     |     | 370 |     |     |     |     |     | 375 |     |     |     |     |     | 380 |     |
| Val | Lys | Gly | Phe | Tyr | Pro | Ser | Asp | Ile | Ala | Val | Glu | Trp | Glu | Ser | Asn |
|     |     |     |     |     | 390 |     |     |     |     |     | 395 |     |     |     | 400 |
| Gly | Gln | Pro | Glu | Asn | Asn | Tyr | Lys | Thr | Thr | Pro | Pro | Met | Leu | Asp | Ser |
|     |     |     |     |     | 405 |     |     |     |     | 410 |     |     |     |     | 415 |
| Asp | Gly | Ser | Phe | Phe | Leu | Tyr | Ser | Lys | Leu | Thr | Val | Asp | Lys | Ser | Arg |
|     |     |     |     |     | 420 |     |     |     |     | 425 |     |     |     | 430 |     |
| Trp | Gln | Gln | Gly | Asn | Val | Phe | Ser | Cys | Ser | Val | Met | His | Glu | Ala | Leu |
|     |     |     |     |     | 435 |     |     | 440 |     |     |     |     |     | 445 |     |
| His | Asn | His | Tyr | Thr | Gln | Lys | Ser | Leu | Ser | Leu | Ser | Pro | Gly | Lys |     |
|     |     |     |     |     | 450 |     |     | 455 |     |     |     |     |     | 460 |     |

&lt;210&gt; SEQ ID NO 7

&lt;211&gt; LENGTH: 720

&lt;212&gt; TYPE: DNA

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 7

atgaggctcc ctgctcagct cctggggctg ctaatgctct gggctctctgg atccagtggg 60

gatattgtga tgactcagtc tccactctcc ctgcccgtca ccctggaga gccggcctcc 120

atctcctgca ggtctagtca gagcctcctg caaagtaatg gattcaacta tttggattgg 180



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tacctgcaga agccagggca gtctccacag ctctgatct atttgggttc taatcgggcc 240
tccgggggtcc ctgacaggtt cagtggcagt gggtcaggca cagattttac actgaaaatc 300
agcagagtgg aggctgagga tgttgggggtt tattactgca tgcaagctct acaaactatc 360
accttcggcc aaggacacg actggagatt aaacgaactg tggctgcacc atctgtcttc 420
atcttccccg catctgatga gcagttgaaa tctggaactg cctctgttgt gtgctgctg 480
aataacttct atcccagaga ggccaaagta cagtggaagg tggataacgc cctccaatcg 540
ggtaactccc aggagagtgt cacagagcag gacagcaagg acagcaccta cagcctcagc 600
agcaccctga cgctgagcaa agcagactac gagaacaca aagtctacgc ctgcgaagtc 660
acccatcagg gectgagctc gcccgtcaca aagagcttca acaggggaga gtgtagtga 720

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<210> SEQ ID NO 8
<211> LENGTH: 238
<212> TYPE: PRT
<213> ORGANISM: Homo sapiens

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<400> SEQUENCE: 8

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```

Met Arg Leu Pro Ala Gln Leu Leu Gly Leu Leu Met Leu Trp Val Ser
  1           5           10          15
Gly Ser Ser Gly Asp Ile Val Met Thr Gln Ser Pro Leu Ser Leu Pro
          20          25          30
Val Thr Pro Gly Glu Pro Ala Ser Ile Ser Cys Arg Ser Ser Gln Ser
          35          40          45
Leu Leu Gln Ser Asn Gly Phe Asn Tyr Leu Asp Trp Tyr Leu Gln Lys
          50          55          60
Pro Gly Gln Ser Pro Gln Leu Leu Ile Tyr Leu Gly Ser Asn Arg Ala
          65          70          75          80
Ser Gly Val Pro Asp Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe
          85          90          95
Thr Leu Lys Ile Ser Arg Val Glu Ala Glu Asp Val Gly Val Tyr Tyr
          100         105         110
Cys Met Gln Ala Leu Gln Thr Ile Thr Phe Gly Gln Gly Thr Arg Leu
          115         120         125
Glu Ile Lys Arg Thr Val Ala Ala Pro Ser Val Phe Ile Phe Pro Pro
          130         135         140
Ser Asp Glu Gln Leu Lys Ser Gly Thr Ala Ser Val Val Cys Leu Leu
          145         150         155         160
Asn Asn Phe Tyr Pro Arg Glu Ala Lys Val Gln Trp Lys Val Asp Asn
          165         170         175
Ala Leu Gln Ser Gly Asn Ser Gln Glu Ser Val Thr Glu Gln Asp Ser
          180         185         190
Lys Asp Ser Thr Tyr Ser Leu Ser Ser Thr Leu Thr Leu Ser Lys Ala
          195         200         205
Asp Tyr Glu Lys His Lys Val Tyr Ala Cys Glu Val Thr His Gln Gly
          210         215         220
Leu Ser Ser Pro Val Thr Lys Ser Phe Asn Arg Gly Glu Cys
          225         230         235

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<210> SEQ ID NO 9
<211> LENGTH: 1404
<212> TYPE: DNA
<213> ORGANISM: Homo sapiens

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<400> SEQUENCE: 9

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atggagtttg ggctgagctg gctttttctt gtggctatth taaaaggtgt ccagtgtgag 60
gtgcagctgt tggagtctgg gggaggcttg gtacagcctg gggggtcctt gagactctcc 120
tgtgcagcct ctggactcac ctttaacaat tctgccatga cctgggtccg ccaggctcca 180
gggaaggggc tggagtgggt ctcaactact agtggaaagt gtggtaccac atactacgca 240
gactccgtga agggccggtt caccatctcc agagactctc ccaagaacac gctctatctg 300
caaatgaaca gcctgagagc cgaggacacg gccgtatatt actgtgcggc ccgtggatac 360
agctatggta cgacccctta tgagtactgg gggcagggaa ccttgggtcac cgtctctca 420
gcttccacca agggcccatc cgtcttcccc ctggcgcctt gttccaggag cacctccgag 480
agcacagccg ccttgggttg cctgggtcaag gactacttcc ccgaaccggt gacgggtgctg 540
tggaaactcag ggcacctgac cagcggcgtg cacaccttcc cggctgtcct acagtctca 600
ggactctact cctcagcag cgtgggtgacc gtgccttcca gcagcttggg cacgaagacc 660
tacacctgca acgtagatca caagcccagc aacaccaagg tggacaagag agttgagtcc 720
aaatatggtc ccccatgccc atcatgccc gcacctgagt tcttgggggg accatcagtc 780
ttctgttcc ccccaaaacc caaggacact ctcatgatct cccggacccc tgaggtcacg 840
tgcgtgggtg tggacgtgag ccaggaagac cccgaggtcc agttcaactg gtacgtggat 900
ggcgtggagg tgcataatgc caagacaaag ccgcgggagg agcagttcaa cagcacgtac 960
cgtgtgggtca gcgtcctcac cgtcctgcac caggactggc tgaacggcaa ggagtacaag 1020
tgcaaggtct ccaacaaagg cctcccgtcc tccatcgaga aaacctctc caaagccaaa 1080
gggcagcccc gagagccaca ggtgtacacc ctgccccat cccaggagga gatgaccaag 1140
aaccaggtca gcctgacctg cctgggtcaaa ggcttctacc ccagcgacat cgccgtggag 1200
tgggagagca atgggcagcc ggagaacaac tacaagacca cgctcccgt gctggactcc 1260
gacggctcct tcttctctca cagcaggcta accgtggaca agagcagggt gcaggagggg 1320
aatgtcttct catgctccgt gatgcatgag gctctgcaca accactacac acagaagagc 1380
ctctccctgt ctctgggtaa atga 1404

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&lt;210&gt; SEQ ID NO 10

&lt;211&gt; LENGTH: 467

&lt;212&gt; TYPE: PRT

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 10

```

Met Glu Phe Gly Leu Ser Trp Leu Phe Leu Val Ala Ile Leu Lys Gly
 1           5           10           15
Val Gln Cys Glu Val Gln Leu Leu Glu Ser Gly Gly Gly Leu Val Gln
 20           25           30
Pro Gly Gly Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Leu Thr Phe
 35           40           45
Asn Asn Ser Ala Met Thr Trp Val Arg Gln Ala Pro Gly Lys Gly Leu
 50           55           60
Glu Trp Val Ser Thr Thr Ser Gly Ser Gly Gly Thr Thr Tyr Tyr Ala
 65           70           75           80
Asp Ser Val Lys Gly Arg Phe Thr Ile Ser Arg Asp Ser Pro Lys Asn
 85           90           95
Thr Leu Tyr Leu Gln Met Asn Ser Leu Arg Ala Glu Asp Thr Ala Val
 100          105          110
Tyr Tyr Cys Ala Ala Arg Gly Tyr Ser Tyr Gly Thr Thr Pro Tyr Glu
 115          120          125

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Tyr Trp Gly Gln Gly Thr Leu Val Thr Val Ser Ser Ala Ser Thr Lys  
 130 135 140  
 Gly Pro Ser Val Phe Pro Leu Ala Pro Cys Ser Arg Ser Thr Ser Glu  
 145 150 155 160  
 Ser Thr Ala Ala Leu Gly Cys Leu Val Lys Asp Tyr Phe Pro Glu Pro  
 165 170 175  
 Val Thr Val Ser Trp Asn Ser Gly Ala Leu Thr Ser Gly Val His Thr  
 180 185 190  
 Phe Pro Ala Val Leu Gln Ser Ser Gly Leu Tyr Ser Leu Ser Ser Val  
 195 200 205  
 Val Thr Val Pro Ser Ser Ser Leu Gly Thr Lys Thr Tyr Thr Cys Asn  
 210 215 220  
 Val Asp His Lys Pro Ser Asn Thr Lys Val Asp Lys Arg Val Glu Ser  
 225 230 235 240  
 Lys Tyr Gly Pro Pro Cys Pro Ser Cys Pro Ala Pro Glu Phe Leu Gly  
 245 250 255  
 Gly Pro Ser Val Phe Leu Phe Pro Pro Lys Pro Lys Asp Thr Leu Met  
 260 265 270  
 Ile Ser Arg Thr Pro Glu Val Thr Cys Val Val Val Asp Val Ser Gln  
 275 280 285  
 Glu Asp Pro Glu Val Gln Phe Asn Trp Tyr Val Asp Gly Val Glu Val  
 290 295 300  
 His Asn Ala Lys Thr Lys Pro Arg Glu Glu Gln Phe Asn Ser Thr Tyr  
 305 310 315 320  
 Arg Val Val Ser Val Leu Thr Val Leu His Gln Asp Trp Leu Asn Gly  
 325 330 335  
 Lys Glu Tyr Lys Cys Lys Val Ser Asn Lys Gly Leu Pro Ser Ser Ile  
 340 345 350  
 Glu Lys Thr Ile Ser Lys Ala Lys Gly Gln Pro Arg Glu Pro Gln Val  
 355 360 365  
 Tyr Thr Leu Pro Pro Ser Gln Glu Glu Met Thr Lys Asn Gln Val Ser  
 370 375 380  
 Leu Thr Cys Leu Val Lys Gly Phe Tyr Pro Ser Asp Ile Ala Val Glu  
 385 390 395 400  
 Trp Glu Ser Asn Gly Gln Pro Glu Asn Asn Tyr Lys Thr Thr Pro Pro  
 405 410 415  
 Val Leu Asp Ser Asp Gly Ser Phe Phe Leu Tyr Ser Arg Leu Thr Val  
 420 425 430  
 Asp Lys Ser Arg Trp Gln Glu Gly Asn Val Phe Ser Cys Ser Val Met  
 435 440 445  
 His Glu Ala Leu His Asn His Tyr Thr Gln Lys Ser Leu Ser Leu Ser  
 450 455 460  
 Leu Gly Lys  
 465

<210> SEQ ID NO 11  
 <211> LENGTH: 711  
 <212> TYPE: DNA  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 11

atggacatga gggtecccg ctcagctcctg gggetcctgc tactctgget ccgagggggcc 60

agatgtgaca tccagatgac ccagtcctcca tcctccctgt ctgcatctgt aggagacaga 120



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gtcaccatca cttgccgggc aagtcgggagc attagcagct atttaaattg gtatcagcag 180
aaaccagggga aagcccctaa agtcctgatc ttttttgtgt ccagtttgca aagtgggggc 240
ccatcaaggt tcagtggcag tggctctggg acagatttca ctctcaccat cagcagtctg 300
caacctgaag attttgcaac ttactactgt caacagaatt acattcccc tattaccttc 360
ggccagggga cagcactgga gatcagacga actgtggctg caccatctgt cttcatcttc 420
ccgccatctg atgagcagtt gaaatctgga actgcctctg ttgtgtgcct gctgaataac 480
ttctatccca gagaggccaa agtacagtgg aaggaggata acgccctcca atcgggtaac 540
tcccaggaga gtgtcacaga gcaggacagc aaggacagca cctacagcct cagcagcacc 600
ctgacgctga gcaaagcaga ctacgagaaa cacaaagtct acgcctgcga agtcacccat 660
cagggcctga gctcggccgt cacaaagagc ttcaacaggg gagagtgtta g 711

```

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<210> SEQ ID NO 12
<211> LENGTH: 236
<212> TYPE: PRT
<213> ORGANISM: Homo sapiens

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<400> SEQUENCE: 12

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```

Met Asp Met Arg Val Pro Ala Gln Leu Leu Gly Leu Leu Leu Leu Trp
 1           5           10          15
Leu Arg Gly Ala Arg Cys Asp Ile Gln Met Thr Gln Ser Pro Ser Ser
          20           25           30
Leu Ser Ala Ser Val Gly Asp Arg Val Thr Ile Thr Cys Arg Ala Ser
          35           40           45
Arg Ser Ile Ser Ser Tyr Leu Asn Trp Tyr Gln Gln Lys Pro Gly Lys
          50           55           60
Ala Pro Lys Val Leu Ile Phe Phe Val Ser Ser Leu Gln Ser Gly Val
          65           70           75           80
Pro Ser Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr
          85           90           95
Ile Ser Ser Leu Gln Pro Glu Asp Phe Ala Thr Tyr Tyr Cys Gln Gln
          100          105          110
Asn Tyr Ile Pro Pro Ile Thr Phe Gly Gln Gly Thr Arg Leu Glu Ile
          115          120          125
Arg Arg Thr Val Ala Ala Pro Ser Val Phe Ile Phe Pro Pro Ser Asp
          130          135          140
Glu Gln Leu Lys Ser Gly Thr Ala Ser Val Val Cys Leu Leu Asn Asn
          145          150          155          160
Phe Tyr Pro Arg Glu Ala Lys Val Gln Trp Lys Val Asp Asn Ala Leu
          165          170          175
Gln Ser Gly Asn Ser Gln Glu Ser Val Thr Glu Gln Asp Ser Lys Asp
          180          185          190
Ser Thr Tyr Ser Leu Ser Ser Thr Leu Thr Leu Ser Lys Ala Asp Tyr
          195          200          205
Glu Lys His Lys Val Tyr Ala Cys Glu Val Thr His Gln Gly Leu Ser
          210          215          220
Ser Pro Val Thr Lys Ser Phe Asn Arg Gly Glu Cys
          225          230          235

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<210> SEQ ID NO 13
<211> LENGTH: 1398
<212> TYPE: DNA
<213> ORGANISM: Homo sapiens

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&lt;400&gt; SEQUENCE: 13

```

atggagtttg ggctgagctg ggttttcctc gttgctcttt taagaggtgt ccagtgtcag    60
gtgcagctgg tggagtctgg gggagggcgtg gtccagcctg ggaggtccct gagactctcc    120
tgtgcagcgt ctggacacac cttcagtagc gatggcatgc actgggtccg ccaggctcca    180
ggcaaggggc tggagtgggt ggcaattata tggatgatg gaagtaataa atattatgca    240
gactccgtga agggccgatt caccatctcc agagacaatt ccaagaacac gctgtatctg    300
caaatgaaca gcctgagagc cgaggacacg gctgtatatt actgtgcgag agatcccggc    360
tactattacg gtatggacgt ctggggccaa gggaccacgg tcaccgtctc ctcagcttcc    420
accaagggcc catccgtctt ccccctggcg cctgctcca ggagcacctc cgagagcaca    480
gccgccctgg gctgcctggt caaggactac ttccccgaac cggtgacggt gtcgtggaac    540
tcaggcgccc tgaccagcgg cgtgcacacc ttcccggctg tcctacagtc ctcaggactc    600
tactccctca gcagcgtggt gaccgtgccc tccagcagct tgggcacgaa gacctacacc    660
tgcaacgtag atcacaagcc cagcaacacc aagggtggaca agagagttga gtccaaatat    720
ggtcccccat gcccatcatg cccagcacct gaggttcctgg ggggaccatc agtcttctctg    780
ttcccccaa aaccaagga cactctcatg atctcccgga cccctgaggt cacgtgcgtg    840
gtggtggacg tgagccagga agaccccgag gtccagttca actggtacgt ggatggcgtg    900
gaggtgcata atgccaagac aaagccgagg gaggagcagt tcaacagcac gtaccgtgtg    960
gtcagcgtcc tcaccgtcct gcaccaggac tggctgaacg gcaaggagta caagtgcaag   1020
gtctccaaca aaggcctccc gtcctccatc gagaaaacca tctccaaagc caaagggcag   1080
ccccgagagc cacaggtgta caccctgccc ccatcccagg aggagatgac caagaaccag   1140
gtcagcctga cctgcctggt caaaggcttc taccacagcg acatcgccgt ggagtgggag   1200
agcaatgggc agccggagaa caactacaag accgcgcctc ccgtgctgga ctccgacggc   1260
tccttcttcc tctacagcag gctaaccgtg gacaagagca ggtggcagga ggggaatgct   1320
ttctcatgct ccgtgatgca tgaggctctg cacaaccact acacacagaa gagcctctcc   1380
ctgtctctgg gtaaatga                                     1398

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&lt;210&gt; SEQ ID NO 14

&lt;211&gt; LENGTH: 465

&lt;212&gt; TYPE: PRT

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 14

```

Met Glu Phe Gly Leu Ser Trp Val Phe Leu Val Ala Leu Leu Arg Gly
  1             5             10             15
Val Gln Cys Gln Val Gln Leu Val Glu Ser Gly Gly Gly Val Val Gln
  20             25             30
Pro Gly Arg Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly His Thr Phe
  35             40             45
Ser Ser Asp Gly Met His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu
  50             55             60
Glu Trp Val Ala Ile Ile Trp Tyr Asp Gly Ser Asn Lys Tyr Tyr Ala
  65             70             75             80
Asp Ser Val Lys Gly Arg Phe Thr Ile Ser Arg Asp Asn Ser Lys Asn
  85             90             95
Thr Leu Tyr Leu Gln Met Asn Ser Leu Arg Ala Glu Asp Thr Ala Val
 100             105             110

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Tyr Tyr Cys Ala Arg Asp Pro Gly Tyr Tyr Tyr Gly Met Asp Val Trp  
           115                                  120                  125  
  
 Gly Gln Gly Thr Thr Val Thr Val Ser Ser Ala Ser Thr Lys Gly Pro  
       130                                  135                  140  
  
 Ser Val Phe Pro Leu Ala Pro Cys Ser Arg Ser Thr Ser Glu Ser Thr  
 145                                  150                  155                  160  
  
 Ala Ala Leu Gly Cys Leu Val Lys Asp Tyr Phe Pro Glu Pro Val Thr  
                                   165                  170                  175  
  
 Val Ser Trp Asn Ser Gly Ala Leu Thr Ser Gly Val His Thr Phe Pro  
                                   180                  185                  190  
  
 Ala Val Leu Gln Ser Ser Gly Leu Tyr Ser Leu Ser Ser Val Val Thr  
                                   195                  200                  205  
  
 Val Pro Ser Ser Ser Leu Gly Thr Lys Thr Tyr Thr Cys Asn Val Asp  
       210                                  215                  220  
  
 His Lys Pro Ser Asn Thr Lys Val Asp Lys Arg Val Glu Ser Lys Tyr  
 225                                  230                  235                  240  
  
 Gly Pro Pro Cys Pro Ser Cys Pro Ala Pro Glu Phe Leu Gly Gly Pro  
                                   245                  250                  255  
  
 Ser Val Phe Leu Phe Pro Pro Lys Pro Lys Asp Thr Leu Met Ile Ser  
                                   260                  265                  270  
  
 Arg Thr Pro Glu Val Thr Cys Val Val Val Asp Val Ser Gln Glu Asp  
                                   275                  280                  285  
  
 Pro Glu Val Gln Phe Asn Trp Tyr Val Asp Gly Val Glu Val His Asn  
       290                                  295                  300  
  
 Ala Lys Thr Lys Pro Arg Glu Glu Gln Phe Asn Ser Thr Tyr Arg Val  
 305                                  310                  315                  320  
  
 Val Ser Val Leu Thr Val Leu His Gln Asp Trp Leu Asn Gly Lys Glu  
                                   325                  330                  335  
  
 Tyr Lys Cys Lys Val Ser Asn Lys Gly Leu Pro Ser Ser Ile Glu Lys  
                                   340                  345                  350  
  
 Thr Ile Ser Lys Ala Lys Gly Gln Pro Arg Glu Pro Gln Val Tyr Thr  
       355                                  360                  365  
  
 Leu Pro Pro Ser Gln Glu Glu Met Thr Lys Asn Gln Val Ser Leu Thr  
       370                                  375                  380  
  
 Cys Leu Val Lys Gly Phe Tyr Pro Ser Asp Ile Ala Val Glu Trp Glu  
 385                                  390                  395                  400  
  
 Ser Asn Gly Gln Pro Glu Asn Asn Tyr Lys Thr Ala Pro Pro Val Leu  
                                   405                  410                  415  
  
 Asp Ser Asp Gly Ser Phe Phe Leu Tyr Ser Arg Leu Thr Val Asp Lys  
                                   420                  425                  430  
  
 Ser Arg Trp Gln Glu Gly Asn Val Phe Ser Cys Ser Val Met His Glu  
                                   435                  440                  445  
  
 Ala Leu His Asn His Tyr Thr Gln Lys Ser Leu Ser Leu Ser Leu Gly  
       450                                  455                  460  
  
 Lys  
 465

&lt;210&gt; SEQ ID NO 15

&lt;211&gt; LENGTH: 705

&lt;212&gt; TYPE: DNA

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 15

atggttgcac cacaactcat tgggtttctg ctgctctggg ttccagcttc caggggtgaa 60



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attgtgctga ctcagtctcc agactttcag tctgtgactc caaaagagaa agtcaccatc 120
acctgccggg ccagtcagag aattggtagt agcttacct ggtaccagca gaaaccagat 180
cagtctccaa aactcctcat caagtatgct tcccagtcc tctcaggggt ccctcgagg 240
ttcagtggca gtggatctgg gacaaatttc accctacca tcaatggcct ggaagctgaa 300
gatgctgcaa cttattactg tcatcagagt ggtcgtttac cgctcacttt cggcggaggg 360
accaaggtgg agatcaaacg aactgtggct gcaccatctg tcttcatctt ccgccatct 420
gatgagcagt tgaaatctgg aactgcctct gttgtgtgcc tgctgaataa cttctatccc 480
agagaggcca aagtacagtg gaaggtggat aacgccctcc aatcgggtaa ctcccaggag 540
agtgtcacag agcaggacag caaggacagc acctacagcc tcagcagcac cctgacgctg 600
agcaaagcag actacgagaa acacaaagtc tacgctgcg aagtcacca tcagggcctg 660
agctcgcccg tcacaaagag cttcaacagg ggagagtgtt agtga 705

```

```

<210> SEQ ID NO 16
<211> LENGTH: 233
<212> TYPE: PRT
<213> ORGANISM: Homo sapiens

```

```

<400> SEQUENCE: 16

```

```

Met Leu Pro Ser Gln Leu Ile Gly Phe Leu Leu Leu Trp Val Pro Ala
 1           5           10           15
Ser Arg Gly Glu Ile Val Leu Thr Gln Ser Pro Asp Phe Gln Ser Val
          20           25           30
Thr Pro Lys Glu Lys Val Thr Ile Thr Cys Arg Ala Ser Gln Arg Ile
          35           40           45
Gly Ser Ser Leu His Trp Tyr Gln Gln Lys Pro Asp Gln Ser Pro Lys
          50           55           60
Leu Leu Ile Lys Tyr Ala Ser Gln Ser Phe Ser Gly Val Pro Ser Arg
          65           70           75           80
Phe Ser Gly Ser Gly Ser Gly Thr Asn Phe Thr Leu Thr Ile Asn Gly
          85           90           95
Leu Glu Ala Glu Asp Ala Ala Thr Tyr Tyr Cys His Gln Ser Gly Arg
          100          105          110
Leu Pro Leu Thr Phe Gly Gly Gly Thr Lys Val Glu Ile Lys Arg Thr
          115          120          125
Val Ala Ala Pro Ser Val Phe Ile Phe Pro Pro Ser Asp Glu Gln Leu
          130          135          140
Lys Ser Gly Thr Ala Ser Val Val Cys Leu Leu Asn Asn Phe Tyr Pro
          145          150          155          160
Arg Glu Ala Lys Val Gln Trp Lys Val Asp Asn Ala Leu Gln Ser Gly
          165          170          175
Asn Ser Gln Glu Ser Val Thr Glu Gln Asp Ser Lys Asp Ser Thr Tyr
          180          185          190
Ser Leu Ser Ser Thr Leu Thr Leu Ser Lys Ala Asp Tyr Glu Lys His
          195          200          205
Lys Val Tyr Ala Cys Glu Val Thr His Gln Gly Leu Ser Ser Pro Val
          210          215          220
Thr Lys Ser Phe Asn Arg Gly Glu Cys
          225          230

```

```

<210> SEQ ID NO 17
<211> LENGTH: 1410
<212> TYPE: DNA

```

-continued

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 17

```

atggagtttg ggctgagctg ggttttctc gttgctcttt taagaggtgt ccagtgtcag    60
gtgcagctgg tggagtctgg gggaggcgtg gtccagcctg ggaggtcctt gagactctcc    120
tgtgcagcct ctggattcac cttcagtagc tatggcatgc actgggtccg ccaggctcca    180
ggcaaggggc tggagtgggt ggcagttata tcaaatgatg gaaataataa atactatgca    240
gactccgtga agggccgatt caccatctcc agagacaatt ccaaaaacac gctgtatctg    300
caaatgaaca gcctgagcgc tgaggacacg gctgtgtatt actgtgagag agatagtacg    360
gcgataacct actactacta cggaatggac gtctggggcc aagggaccac ggtcaccgtc    420
tcctcagctt ccaccaaggg cccatccgtc ttccccctgg cgccctgctc caggagcacc    480
tccgagagca cagccgccct gggctgcctg gtcaaggact acttccccga accggtgacg    540
gtgtcgtgga actcaggcgc cctgaccagc ggctgcaca cttccccggc tgtctacag    600
tcctcaggac tctactcctt cagcagcgtg gtgaccgtgc cctccagcag cttgggcacg    660
aagacctaca cctgcaacgt agatcacaag cccagcaaca ccaaggtgga caagagagtt    720
gagtccaaat atggtcccc atgccatca tgcccagcac ctgagttcct ggggggacca    780
tcagtcttcc tgttcccccc aaaacccaag gacactctca tgatctcccc gaccctgag    840
gtcacgtgcg tgggtgtgga cgtgagccag gaagacccc aggtccagtt caactggtac    900
gtggatggcg tggaggtgca taatgccaa acaaagccgc gggaggagca gttcaacagc    960
acgtaccgtg tggtcagcgt cctcaccgtc ctgaccagc actggctgaa cggcaaggag   1020
tacaagtgca aggtctcaa caaaggcctc ccgtcctcca tcgagaaaac catctccaaa   1080
gccaaagggc agccccgaga gccacaggtg tacaccctgc ccccatccca ggaggagatg   1140
accaagaacc aggtcagcct gacctgcctg gtcaaaggct tctaccccag cgacatcgcc   1200
gtggagtggg agagcaatgg acagccggag aacaactaca agaccacgcc tcccgtgctg   1260
gactccgacg gctccttctt cctctacagc aggtaaccg tggacaagag cagggtggcag   1320
gaggggaatg tcttctcatg ctccgtgatg catgaggctc tgcacaacca ctacacacag   1380
aagagcctct ccctgtctct gggtaaatga                                     1410

```

&lt;210&gt; SEQ ID NO 18

&lt;211&gt; LENGTH: 469

&lt;212&gt; TYPE: PRT

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 18

```

Met Glu Phe Gly Leu Ser Trp Val Phe Leu Val Ala Leu Leu Arg Gly
 1             5             10            15
Val Gln Cys Gln Val Gln Leu Val Glu Ser Gly Gly Gly Val Val Gln
 20            25            30
Pro Gly Arg Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe
 35            40            45
Ser Ser Tyr Gly Met His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu
 50            55            60
Glu Trp Val Ala Val Ile Ser Asn Asp Gly Asn Asn Lys Tyr Tyr Ala
 65            70            75            80
Asp Ser Val Lys Gly Arg Phe Thr Ile Ser Arg Asp Asn Ser Lys Asn
 85            90            95
Thr Leu Tyr Leu Gln Met Asn Ser Leu Ser Ala Glu Asp Thr Ala Val

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-continued

| 100 |     |     |     |     | 105 |     |     |     |     | 110 |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Tyr | Tyr | Cys | Ala | Arg | Asp | Ser | Thr | Ala | Ile | Thr | Tyr | Tyr | Tyr | Tyr | Gly |
|     |     | 115 |     |     |     |     | 120 |     |     |     |     | 125 |     |     |     |
| Met | Asp | Val | Trp | Gly | Gln | Gly | Thr | Thr | Val | Thr | Val | Ser | Ser | Ala | Ser |
|     | 130 |     |     |     |     | 135 |     |     |     |     | 140 |     |     |     |     |
| Thr | Lys | Gly | Pro | Ser | Val | Phe | Pro | Leu | Ala | Pro | Cys | Ser | Arg | Ser | Thr |
| 145 |     |     |     |     | 150 |     |     |     |     | 155 |     |     |     |     | 160 |
| Ser | Glu | Ser | Thr | Ala | Ala | Leu | Gly | Cys | Leu | Val | Lys | Asp | Tyr | Phe | Pro |
|     |     |     |     | 165 |     |     |     |     | 170 |     |     |     |     | 175 |     |
| Glu | Pro | Val | Thr | Val | Ser | Trp | Asn | Ser | Gly | Ala | Leu | Thr | Ser | Gly | Val |
|     |     |     | 180 |     |     |     |     | 185 |     |     |     |     | 190 |     |     |
| His | Thr | Phe | Pro | Ala | Val | Leu | Gln | Ser | Ser | Gly | Leu | Tyr | Ser | Leu | Ser |
|     |     | 195 |     |     |     |     | 200 |     |     |     |     | 205 |     |     |     |
| Ser | Val | Val | Thr | Val | Pro | Ser | Ser | Ser | Leu | Gly | Thr | Lys | Thr | Tyr | Thr |
|     | 210 |     |     |     |     | 215 |     |     |     |     | 220 |     |     |     |     |
| Cys | Asn | Val | Asp | His | Lys | Pro | Ser | Asn | Thr | Lys | Val | Asp | Lys | Arg | Val |
| 225 |     |     |     |     | 230 |     |     |     |     | 235 |     |     |     |     | 240 |
| Glu | Ser | Lys | Tyr | Gly | Pro | Pro | Cys | Pro | Ser | Cys | Pro | Ala | Pro | Glu | Phe |
|     |     |     |     | 245 |     |     |     |     | 250 |     |     |     |     | 255 |     |
| Leu | Gly | Gly | Pro | Ser | Val | Phe | Leu | Phe | Pro | Pro | Lys | Pro | Lys | Asp | Thr |
|     |     |     | 260 |     |     |     |     | 265 |     |     |     |     | 270 |     |     |
| Leu | Met | Ile | Ser | Arg | Thr | Pro | Glu | Val | Thr | Cys | Val | Val | Val | Asp | Val |
|     |     | 275 |     |     |     |     | 280 |     |     |     |     | 285 |     |     |     |
| Ser | Gln | Glu | Asp | Pro | Glu | Val | Gln | Phe | Asn | Trp | Tyr | Val | Asp | Gly | Val |
|     | 290 |     |     |     |     | 295 |     |     |     |     | 300 |     |     |     |     |
| Glu | Val | His | Asn | Ala | Lys | Thr | Lys | Pro | Arg | Glu | Glu | Gln | Phe | Asn | Ser |
| 305 |     |     |     |     | 310 |     |     |     |     | 315 |     |     |     |     | 320 |
| Thr | Tyr | Arg | Val | Val | Ser | Val | Leu | Thr | Val | Leu | His | Gln | Asp | Trp | Leu |
|     |     |     |     | 325 |     |     |     |     | 330 |     |     |     |     | 335 |     |
| Asn | Gly | Lys | Glu | Tyr | Lys | Cys | Lys | Val | Ser | Asn | Lys | Gly | Leu | Pro | Ser |
|     |     |     | 340 |     |     |     |     | 345 |     |     |     |     | 350 |     |     |
| Ser | Ile | Glu | Lys | Thr | Ile | Ser | Lys | Ala | Lys | Gly | Gln | Pro | Arg | Glu | Pro |
|     |     | 355 |     |     |     |     | 360 |     |     |     |     | 365 |     |     |     |
| Gln | Val | Tyr | Thr | Leu | Pro | Pro | Ser | Gln | Glu | Glu | Met | Thr | Lys | Asn | Gln |
|     | 370 |     |     |     |     | 375 |     |     |     |     | 380 |     |     |     |     |
| Val | Ser | Leu | Thr | Cys | Leu | Val | Lys | Gly | Phe | Tyr | Pro | Ser | Asp | Ile | Ala |
| 385 |     |     |     |     | 390 |     |     |     |     | 395 |     |     |     |     | 400 |
| Val | Glu | Trp | Glu | Ser | Asn | Gly | Gln | Pro | Glu | Asn | Asn | Tyr | Lys | Thr | Thr |
|     |     |     |     | 405 |     |     |     |     | 410 |     |     |     |     | 415 |     |
| Pro | Pro | Val | Leu | Asp | Ser | Asp | Gly | Ser | Phe | Phe | Leu | Tyr | Ser | Arg | Leu |
|     |     |     | 420 |     |     |     |     | 425 |     |     |     |     | 430 |     |     |
| Thr | Val | Asp | Lys | Ser | Arg | Trp | Gln | Glu | Gly | Asn | Val | Phe | Ser | Cys | Ser |
|     |     | 435 |     |     |     |     | 440 |     |     |     |     | 445 |     |     |     |
| Val | Met | His | Glu | Ala | Leu | His | Asn | His | Tyr | Thr | Gln | Lys | Ser | Leu | Ser |
|     | 450 |     |     |     |     | 455 |     |     |     |     | 460 |     |     |     |     |
| Leu | Ser | Leu | Gly | Lys |     |     |     |     |     |     |     |     |     |     |     |
| 465 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |

&lt;210&gt; SEQ ID NO 19

&lt;211&gt; LENGTH: 714

&lt;212&gt; TYPE: DNA

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 19

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```

atggacatga gggccccgc tcagctcctg gggctcctgc tactctggct ccgaggtgcc 60
agatgtgaca tccagatgac ccagctctcca tctccctgt ctgcatctgt cggagacaga 120
gtcaccatca cttgccgggc aagtcagaat attagtagct atttaaattg gtttcagcag 180
aaaccaggga aagcccctaa gctcctgatc tatgctgcat ccggtttgaa gcgtggggtc 240
ccatcacggt tcagtggtag tggatctggg acagatttca ctctacccat caggactctg 300
caacctgatg attttgcaac ttactcctgt caccagagtt acagtctccc attcactttc 360
ggccctggga ccaaagtgga tatcaaacga actgtggctg caccatctgt cttcatcttc 420
ccgccatctg atgagcagtt gaaatctgga actgcctctg ttgtgtgcct gctgaataac 480
ttctatccca gagaggccaa agtacagtgg aaggtggata acgccctcca atcgggtaac 540
tcccaggaga gtgtcacaga gcaggacagc aaggacagca cctacagcct cagcagcacc 600
ctgacgctga gcaaagcaga ctacgagaaa cacaaagtct acgcctgcga agtcacccat 660
cagggcctga gctcgcccgt cacaaagagc ttcaacaggg gagagtgtta gtga 714

```

&lt;210&gt; SEQ ID NO 20

&lt;211&gt; LENGTH: 236

&lt;212&gt; TYPE: PRT

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 20

```

Met Asp Met Arg Val Pro Ala Gln Leu Leu Gly Leu Leu Leu Leu Trp
 1          5          10          15
Leu Arg Gly Ala Arg Cys Asp Ile Gln Met Thr Gln Ser Pro Ser Ser
          20          25          30
Leu Ser Ala Ser Val Gly Asp Arg Val Thr Ile Thr Cys Arg Ala Ser
          35          40          45
Gln Asn Ile Ser Ser Tyr Leu Asn Trp Phe Gln Gln Lys Pro Gly Lys
          50          55          60
Ala Pro Lys Leu Leu Ile Tyr Ala Ala Ser Gly Leu Lys Arg Gly Val
          65          70          75          80
Pro Ser Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr
          85          90          95
Ile Arg Thr Leu Gln Pro Asp Asp Phe Ala Thr Tyr Ser Cys His Gln
          100          105          110
Ser Tyr Ser Leu Pro Phe Thr Phe Gly Pro Gly Thr Lys Val Asp Ile
          115          120          125
Lys Arg Thr Val Ala Ala Pro Ser Val Phe Ile Phe Pro Pro Ser Asp
          130          135          140
Glu Gln Leu Lys Ser Gly Thr Ala Ser Val Val Cys Leu Leu Asn Asn
          145          150          155          160
Phe Tyr Pro Arg Glu Ala Lys Val Gln Trp Lys Val Asp Asn Ala Leu
          165          170          175
Gln Ser Gly Asn Ser Gln Glu Ser Val Thr Glu Gln Asp Ser Lys Asp
          180          185          190
Ser Thr Tyr Ser Leu Ser Ser Thr Leu Thr Leu Ser Lys Ala Asp Tyr
          195          200          205
Glu Lys His Lys Val Tyr Ala Cys Glu Val Thr His Gln Gly Leu Ser
          210          215          220
Ser Pro Val Thr Lys Ser Phe Asn Arg Gly Glu Cys
          225          230          235

```

&lt;210&gt; SEQ ID NO 21



-continued

&lt;211&gt; LENGTH: 1413

&lt;212&gt; TYPE: DNA

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 21

```

atgaaacacc tgtggttctt cctcctgctg gtggcagctc ccagatgggt cctgtcccag    60
gtgcagctgc aggagtcggg cccaggactg gtgaagcctt cggagaccct gtccctcacc    120
tgcaactgtct ctggtgactc catcagtagt aactattgga gctggatccg gcagcccgcc    180
gggaaggggac tggagtggat tgggcgtatc tataccagtg ggggcaccaa ctccaacccc    240
tccctcaggg gtcgagtcac cattttagca gacacgtcca agaaccagtt ctctctgaaa    300
ctgagttctg tgaccgccgc ggacacggcc gtgtattact gtgcgagaga tcgtattact    360
ataattcggg gacttattcc atccttcttt gactactggg gccagggaac cctggtcacc    420
gtctcctcag ctccaccaaa gggcccaccc gtcttcccc tggcgccctg ctccaggagc    480
acctccgaga gcacagccgc cctgggctgc ctggtcaagg actacttccc cgaaccgggtg    540
acggtgtcgt ggaactcagg cgccctgacc agcggcgtgc acaccttccc ggctgtccta    600
cagtcctcag gactctactc cctcagcagc gtggtgaccg tgccctccag cagcttgggc    660
acgaagacct acacctgcaa cgtagatcac aagcccagca acaccaaggt ggacaagaga    720
gttgagtcca aatatggtcc cccatgccc tcatgcccag cacctgagtt cctgggggga    780
ccatcagtct tcctgttccc cccaaaaccc aaggacactc tcatgatctc ccggaccctc    840
gaggtcacgt gcgtggtggt ggacgtgagc caggaagacc ccgaggtcca gttcaactgg    900
tacgtggatg gcgtggaggt gcataatgcc aagacaaagc cgcgggagga gcagttcaac    960
agcacgtacc gtgtggtcag cgctctcacc gtctctgacc aggactggct gaacggcaag   1020
gagtacaagt gcaaggtctc caacaaaggc ctcccgtcct ccatcgagaa aaccatctcc   1080
aaagccaaag ggcagccccg agagccacag gtgtacaccc tgccccatc ccaggaggag   1140
atgaccaaga accaggtcag cctgacctgc ctggtcaaag gcttctaccc cagcgacatc   1200
gccgtggagt gggagagcaa tgggcagccg gagaacaact acaagaccac gcctcccgtg   1260
ctggactccg acggctcctt cttcctctac agcaggctaa ccgtggacaa gagcaggtgg   1320
caggagggga atgtcttctc atgctccgtg atgcatgagg ctctgcacaa ccactacaca   1380
cagaagagcc tctcctgtc tctgggtaaa tga                                1413

```

&lt;210&gt; SEQ ID NO 22

&lt;211&gt; LENGTH: 470

&lt;212&gt; TYPE: PRT

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 22

```

Met Lys His Leu Trp Phe Phe Leu Leu Leu Val Ala Ala Pro Arg Trp
 1           5           10          15
Val Leu Ser Gln Val Gln Leu Gln Glu Ser Gly Pro Gly Leu Val Lys
 20          25          30
Pro Ser Glu Thr Leu Ser Leu Thr Cys Thr Val Ser Gly Asp Ser Ile
 35          40          45
Ser Ser Asn Tyr Trp Ser Trp Ile Arg Gln Pro Ala Gly Lys Gly Leu
 50          55          60
Glu Trp Ile Gly Arg Ile Tyr Thr Ser Gly Gly Thr Asn Ser Asn Pro
 65          70          75          80
Ser Leu Arg Gly Arg Val Thr Ile Leu Ala Asp Thr Ser Lys Asn Gln
 85          90          95

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Phe Ser Leu Lys Leu Ser Ser Val Thr Ala Ala Asp Thr Ala Val Tyr  
 100 105 110  
 Tyr Cys Ala Arg Asp Arg Ile Thr Ile Ile Arg Gly Leu Ile Pro Ser  
 115 120 125  
 Phe Phe Asp Tyr Trp Gly Gln Gly Thr Leu Val Thr Val Ser Ser Ala  
 130 135 140  
 Ser Thr Lys Gly Pro Ser Val Phe Pro Leu Ala Pro Cys Ser Arg Ser  
 145 150 155 160  
 Thr Ser Glu Ser Thr Ala Ala Leu Gly Cys Leu Val Lys Asp Tyr Phe  
 165 170 175  
 Pro Glu Pro Val Thr Val Ser Trp Asn Ser Gly Ala Leu Thr Ser Gly  
 180 185 190  
 Val His Thr Phe Pro Ala Val Leu Gln Ser Ser Gly Leu Tyr Ser Leu  
 195 200 205  
 Ser Ser Val Val Thr Val Pro Ser Ser Ser Leu Gly Thr Lys Thr Tyr  
 210 215 220  
 Thr Cys Asn Val Asp His Lys Pro Ser Asn Thr Lys Val Asp Lys Arg  
 225 230 235 240  
 Val Glu Ser Lys Tyr Gly Pro Pro Cys Pro Ser Cys Pro Ala Pro Glu  
 245 250 255  
 Phe Leu Gly Gly Pro Ser Val Phe Leu Phe Pro Pro Lys Pro Lys Asp  
 260 265 270  
 Thr Leu Met Ile Ser Arg Thr Pro Glu Val Thr Cys Val Val Val Asp  
 275 280 285  
 Val Ser Gln Glu Asp Pro Glu Val Gln Phe Asn Trp Tyr Val Asp Gly  
 290 295 300  
 Val Glu Val His Asn Ala Lys Thr Lys Pro Arg Glu Glu Gln Phe Asn  
 305 310 315 320  
 Ser Thr Tyr Arg Val Val Ser Val Leu Thr Val Leu His Gln Asp Trp  
 325 330 335  
 Leu Asn Gly Lys Glu Tyr Lys Cys Lys Val Ser Asn Lys Gly Leu Pro  
 340 345 350  
 Ser Ser Ile Glu Lys Thr Ile Ser Lys Ala Lys Gly Gln Pro Arg Glu  
 355 360 365  
 Pro Gln Val Tyr Thr Leu Pro Pro Ser Gln Glu Glu Met Thr Lys Asn  
 370 375 380  
 Gln Val Ser Leu Thr Cys Leu Val Lys Gly Phe Tyr Pro Ser Asp Ile  
 385 390 395 400  
 Ala Val Glu Trp Glu Ser Asn Gly Gln Pro Glu Asn Asn Tyr Lys Thr  
 405 410 415  
 Thr Pro Pro Val Leu Asp Ser Asp Gly Ser Phe Phe Leu Tyr Ser Arg  
 420 425 430  
 Leu Thr Val Asp Lys Ser Arg Trp Gln Glu Gly Asn Val Phe Ser Cys  
 435 440 445  
 Ser Val Met His Glu Ala Leu His Asn His Tyr Thr Gln Lys Ser Leu  
 450 455 460  
 Ser Leu Ser Leu Gly Lys  
 465 470

&lt;210&gt; SEQ ID NO 23

&lt;211&gt; LENGTH: 729

&lt;212&gt; TYPE: DNA

&lt;213&gt; ORGANISM: Homo sapiens



-continued

&lt;400&gt; SEQUENCE: 23

```

atggtgttgc agaccaggt cttcatttct ctgttgctct ggatctctgg tgectacggg    60
gacatcgtga tgaccagtc tccagactcc ctggctgtgt ctctgggcga gagggccacc    120
atcaactgca agtccagcca gagtgtttta tacagctcca acaataagac ctacttagct    180
tggtaccaac agaaaccaag acagcctcct aaattgctca tttactgggc atctatacgg    240
gaatatgggg tccctgaccg attcagtggc agcgggtctg ggacagattt cactctcacc    300
atcagcagcc tgcaggetga agatgtggca gtttatttct gtcaacaata ttatagtatt    360
cctcccctca ctttcggcgg agggaccaag gtggagatca aacgaactgt ggctgcacca    420
tctgttctca tcttcccgcc atctgatgag cagttgaaat ctggaactgc ctctgttctg    480
tgctgtctga ataacttcta tcccagagag gccaaagtac agtggaggt ggataacgcc    540
ctccaatcgg gtaactcca ggagagtgtc acagagcagg acagcaagga cagcacctac    600
agcctcagca gcaccctgac gctgagcaaa gcagactacg agaaacacaa agtctacgcc    660
tgcaagtca cccatcaggg cctgagctcg cccgtcacia agagcttcaa caggggagag    720
tgtagtga                                     729

```

&lt;210&gt; SEQ ID NO 24

&lt;211&gt; LENGTH: 241

&lt;212&gt; TYPE: PRT

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 24

```

Met Val Leu Gln Thr Gln Val Phe Ile Ser Leu Leu Leu Trp Ile Ser
  1           5           10          15
Gly Ala Tyr Gly Asp Ile Val Met Thr Gln Ser Pro Asp Ser Leu Ala
          20          25          30
Val Ser Leu Gly Glu Arg Ala Thr Ile Asn Cys Lys Ser Ser Gln Ser
          35          40          45
Val Leu Tyr Ser Ser Asn Asn Lys Thr Tyr Leu Ala Trp Tyr Gln Gln
          50          55          60
Lys Pro Arg Gln Pro Pro Lys Leu Leu Ile Tyr Trp Ala Ser Ile Arg
          65          70          75          80
Glu Tyr Gly Val Pro Asp Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp
          85          90          95
Phe Thr Leu Thr Ile Ser Ser Leu Gln Ala Glu Asp Val Ala Val Tyr
          100         105         110
Phe Cys Gln Gln Tyr Tyr Ser Ile Pro Pro Leu Thr Phe Gly Gly Gly
          115         120         125
Thr Lys Val Glu Ile Lys Arg Thr Val Ala Ala Pro Ser Val Phe Ile
          130         135         140
Phe Pro Pro Ser Asp Glu Gln Leu Lys Ser Gly Thr Ala Ser Val Val
          145         150         155         160
Cys Leu Leu Asn Asn Phe Tyr Pro Arg Glu Ala Lys Val Gln Trp Lys
          165         170         175
Val Asp Asn Ala Leu Gln Ser Gly Asn Ser Gln Glu Ser Val Thr Glu
          180         185         190
Gln Asp Ser Lys Asp Ser Thr Tyr Ser Leu Ser Ser Thr Leu Thr Leu
          195         200         205
Ser Lys Ala Asp Tyr Glu Lys His Lys Val Tyr Ala Cys Glu Val Thr
          210         215         220
His Gln Gly Leu Ser Ser Pro Val Thr Lys Ser Phe Asn Arg Gly Glu

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-continued

| 225                          | 230        | 235        | 240        |                            |
|------------------------------|------------|------------|------------|----------------------------|
| Cys                          |            |            |            |                            |
| <br><210> SEQ ID NO 25       |            |            |            |                            |
| <211> LENGTH: 1419           |            |            |            |                            |
| <212> TYPE: DNA              |            |            |            |                            |
| <213> ORGANISM: Homo sapiens |            |            |            |                            |
| <br><400> SEQUENCE: 25       |            |            |            |                            |
| atggagtttg                   | ggctgagctg | gctttttctt | gtggctatth | taaaagggtg ccagtgtgag 60   |
| gtgcagctgt                   | tggagtctgg | gggagacttg | gtccagcctg | gggggtccct gagactctcc 120  |
| tgtgcagcct                   | ctggattcac | ctttagaagt | tatgccatga | actgggtccg acaggctcca 180  |
| gggaaggggc                   | tggagtgggt | ctcagttatt | agtggctctg | gtggtactac atactacgca 240  |
| gactccgtga                   | agggccgggt | caccatctcc | agagacaatt | ccaagaacac gctgtatctg 300  |
| caaatgaaca                   | gcctgagagc | cgaggacgcg | gccgtatatt | actgtgcgaa gatagcagtg 360  |
| gctggagagg                   | ggctctacta | ctactacggg | atggacgtct | ggggccaagg gaccacggtc 420  |
| accgtctcct                   | cagcttccac | caagggccca | tccgtcttcc | ccctggcgcc ctgctccagg 480  |
| agcacctccg                   | agaacacagc | cgccctgggc | tgctgggtca | aggactactt ccccgaaccg 540  |
| gtgacggtgt                   | cgtggaactc | agggccctcg | accagcggcg | tgcacacctt cccggctgtc 600  |
| ctacagtect                   | caggactcta | ctccctcagc | agcgtgggtg | ccgtgccctc tagcagcttg 660  |
| ggcacgaaga                   | cctacacctg | caacgtagat | cacaagccca | gcaacaccaa ggtggacaag 720  |
| agagttgagt                   | ccaaatatgg | tccccatgc  | ccatcatgcc | cagcacctga gttcctgggg 780  |
| ggaccatcag                   | tcttctggt  | cccccaaaa  | ccaaggaca  | ctctcatgat ctcccggacc 840  |
| cctgaggtca                   | cgtgcgtggg | ggtggacgtg | agccaggaag | accccaggt ccagttcaac 900   |
| tggtagctgg                   | atggcgtgga | ggtgcataat | gccaaagaaa | agccgcggga ggagcagttc 960  |
| aacagcacgt                   | accgtgtggg | cagcgtcctc | accgtcctgc | accaggactg gctgaacggc 1020 |
| aaggagtaca                   | agtgcaaggt | ctccaacaaa | ggcctcccg  | cctccatcga gaaaaccatc 1080 |
| tccaaagcca                   | aagggcagcc | ccgagagcca | caggtgtaca | ccctgcccc atcccaggag 1140  |
| gagatgacca                   | agaaccaggt | cagcctgacc | tgctgggtca | aaggcttcta ccccagcgac 1200 |
| atcgccgtgg                   | agtgggagag | caatgggcag | ccggagaaca | actacaagac cagcctccc 1260  |
| gtgctggact                   | ccgacggctc | cttcttctc  | tacagcaggc | taaccgtgga caagagcagg 1320 |
| tggcaggagg                   | ggaatgtctt | ctcatgctcc | gtgatgcatg | aggctctgca caaccactac 1380 |
| acacagaaga                   | gcctctccct | gtctctgggt | aatgatag   | 1419                       |

<210> SEQ ID NO 26  
 <211> LENGTH: 471  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 26

|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Met | Glu | Phe | Gly | Leu | Ser | Trp | Leu | Phe | Leu | Val | Ala | Ile | Leu | Lys | Gly |
| 1   |     |     |     | 5   |     |     |     |     | 10  |     |     |     |     | 15  |     |
| Val | Gln | Cys | Glu | Val | Gln | Leu | Leu | Glu | Ser | Gly | Gly | Asp | Leu | Val | Gln |
|     | 20  |     |     |     |     | 25  |     |     |     |     |     |     | 30  |     |     |
| Pro | Gly | Gly | Ser | Leu | Arg | Leu | Ser | Cys | Ala | Ala | Ser | Gly | Phe | Thr | Phe |
|     | 35  |     |     |     |     | 40  |     |     |     |     |     | 45  |     |     |     |
| Arg | Ser | Tyr | Ala | Met | Asn | Trp | Val | Arg | Gln | Ala | Pro | Gly | Lys | Gly | Leu |
|     | 50  |     |     |     |     | 55  |     |     |     |     | 60  |     |     |     |     |



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Glu Trp Val Ser Val Ile Ser Gly Arg Gly Gly Thr Thr Tyr Tyr Ala  
 65 70 75 80  
 Asp Ser Val Lys Gly Arg Phe Thr Ile Ser Arg Asp Asn Ser Lys Asn  
 85 90 95  
 Thr Leu Tyr Leu Gln Met Asn Ser Leu Arg Ala Glu Asp Ala Ala Val  
 100 105 110  
 Tyr Tyr Cys Ala Lys Ile Ala Val Ala Gly Glu Gly Leu Tyr Tyr Tyr  
 115 120 125  
 Tyr Gly Met Asp Val Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser  
 130 135 140  
 Ala Ser Thr Lys Gly Pro Ser Val Phe Pro Leu Ala Pro Cys Ser Arg  
 145 150 155 160  
 Ser Thr Ser Glu Asn Thr Ala Ala Leu Gly Cys Leu Val Lys Asp Tyr  
 165 170 175  
 Phe Pro Glu Pro Val Thr Val Ser Trp Asn Ser Gly Ala Leu Thr Ser  
 180 185 190  
 Gly Val His Thr Phe Pro Ala Val Leu Gln Ser Ser Gly Leu Tyr Ser  
 195 200 205  
 Leu Ser Ser Val Val Thr Val Pro Ser Ser Ser Leu Gly Thr Lys Thr  
 210 215 220  
 Tyr Thr Cys Asn Val Asp His Lys Pro Ser Asn Thr Lys Val Asp Lys  
 225 230 235 240  
 Arg Val Glu Ser Lys Tyr Gly Pro Pro Cys Pro Ser Cys Pro Ala Pro  
 245 250 255  
 Glu Phe Leu Gly Gly Pro Ser Val Phe Leu Phe Pro Pro Lys Pro Lys  
 260 265 270  
 Asp Thr Leu Met Ile Ser Arg Thr Pro Glu Val Thr Cys Val Val Val  
 275 280 285  
 Asp Val Ser Gln Glu Asp Pro Glu Val Gln Phe Asn Trp Tyr Val Asp  
 290 295 300  
 Gly Val Glu Val His Asn Ala Lys Thr Lys Pro Arg Glu Glu Gln Phe  
 305 310 315 320  
 Asn Ser Thr Tyr Arg Val Val Ser Val Leu Thr Val Leu His Gln Asp  
 325 330 335  
 Trp Leu Asn Gly Lys Glu Tyr Lys Cys Lys Val Ser Asn Lys Gly Leu  
 340 345 350  
 Pro Ser Ser Ile Glu Lys Thr Ile Ser Lys Ala Lys Gly Gln Pro Arg  
 355 360 365  
 Glu Pro Gln Val Tyr Thr Leu Pro Pro Ser Gln Glu Glu Met Thr Lys  
 370 375 380  
 Asn Gln Val Ser Leu Thr Cys Leu Val Lys Gly Phe Tyr Pro Ser Asp  
 385 390 395 400  
 Ile Ala Val Glu Trp Glu Ser Asn Gly Gln Pro Glu Asn Asn Tyr Lys  
 405 410 415  
 Thr Thr Pro Pro Val Leu Asp Ser Asp Gly Ser Phe Phe Leu Tyr Ser  
 420 425 430  
 Arg Leu Thr Val Asp Lys Ser Arg Trp Gln Glu Gly Asn Val Phe Ser  
 435 440 445  
 Cys Ser Val Met His Glu Ala Leu His Asn His Tyr Thr Gln Lys Ser  
 450 455 460  
 Leu Ser Leu Ser Leu Gly Lys  
 465 470

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<210> SEQ ID NO 27  
 <211> LENGTH: 720  
 <212> TYPE: DNA  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 27

```

atggacatga gggccccgc tcagctcctg gggctcctgc tactctggct ccgaggtgcc      60
agatgtgaca tccagatgac ccagtctcca tctccctgt ctgcatctgt aggtgacaga      120
gtcaccttca cttgccgggc aagtcagaac attaccaact atttaaattg gtatcagcag      180
aaaccagggg aggcccctaa gctcctgatc tatgctgcgt ccagtttggc aagagggggtc      240
ccatcaaggt tccgtggcag tggatctggg acagatttca ctctcaccat cagcagtctg      300
caacctgaag attttgcaac ttactactgt caacagagtt acagtaatcc tccggagtgc      360
ggttttggcc aggggaccac gctggatata aaacgaactg tggctgcacc atctgtcttc      420
atcttccccg catctgatga gcagttgaaa tctggaactg cctctgttgt gtgctgtctg      480
aataacttct atcccagaga ggccaaagta cagtggaagg tggataacgc cctccaatcg      540
ggtaactccc aggagagtgt cacagagcag gacagcaagg acagcaccta cagcctcagc      600
agcaccttga cgctgagcaa agcagactac gagaaacaca aagtctacgc ctgcgaagtc      660
acccatcagg gcctgagctc gcccgtcaca aagagcttca acaggggaga gtgttagtga      720
  
```

<210> SEQ ID NO 28  
 <211> LENGTH: 238  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 28

```

Met Asp Met Arg Val Pro Ala Gln Leu Leu Gly Leu Leu Leu Leu Trp
  1           5           10           15
Leu Arg Gly Ala Arg Cys Asp Ile Gln Met Thr Gln Ser Pro Ser Ser
           20           25           30
Leu Ser Ala Ser Val Gly Asp Arg Val Thr Phe Thr Cys Arg Ala Ser
           35           40           45
Gln Asn Ile Thr Asn Tyr Leu Asn Trp Tyr Gln Gln Lys Pro Gly Lys
           50           55           60
Ala Pro Lys Leu Leu Ile Tyr Ala Ala Ser Ser Leu Pro Arg Gly Val
           65           70           75           80
Pro Ser Arg Phe Arg Gly Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr
           85           90           95
Ile Ser Ser Leu Gln Pro Glu Asp Phe Ala Thr Tyr Tyr Cys Gln Gln
           100          105          110
Ser Tyr Ser Asn Pro Pro Glu Cys Gly Phe Gly Gln Gly Thr Thr Leu
           115          120          125
Asp Ile Lys Arg Thr Val Ala Ala Pro Ser Val Phe Ile Phe Pro Pro
           130          135          140
Ser Asp Glu Gln Leu Lys Ser Gly Thr Ala Ser Val Val Cys Leu Leu
           145          150          155          160
Asn Asn Phe Tyr Pro Arg Glu Ala Lys Val Gln Trp Lys Val Asp Asn
           165          170          175
Ala Leu Gln Ser Gly Asn Ser Gln Glu Ser Val Thr Glu Gln Asp Ser
           180          185          190
Lys Asp Ser Thr Tyr Ser Leu Ser Ser Thr Leu Thr Leu Ser Lys Ala
           195          200          205
  
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Asp Tyr Glu Lys His Lys Val Tyr Ala Cys Glu Val Thr His Gln Gly  
 210 215 220

Leu Ser Ser Pro Val Thr Lys Ser Phe Asn Arg Gly Glu Cys  
 225 230 235

&lt;210&gt; SEQ ID NO 29

&lt;211&gt; LENGTH: 1434

&lt;212&gt; TYPE: DNA

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 29

atggaactgg ggctccgctg ggttttcctt gttgctatth tagaaggtgt ccagtgtgag 60  
 gtgcagctgg tggagtctgg gggaggcctg gtcaagcctg gggggtcctt gagactctcc 120  
 tgtgcagcct ctggattcac cttcagtagc tatagcatga actgggtccg ccaggctcca 180  
 ggaagggggc tggagtgggt ctcattccatt agtagtagta gtagttacat atactacgca 240  
 gactcagtga agggccgatt caccatctcc agagacaacg ccaagaactc actgtatctg 300  
 caaatgaaca gcctgagagc cgaggacacg gctgtgtatt actgtgagag agatgggtat 360  
 agcagtggct ggtcctacta ctactactac ggtatggagc tctggggcca agggaccacg 420  
 gtcaccgtct cctcagcttc caccaagggc ccatccgtct tccccctggc gccctgctcc 480  
 aggagcacct ccgagagcac agccgccttg ggctgcctgg tcaaggacta cttccccgaa 540  
 ccggtgacgg tgtcgtggaa ctcaggcgcc ctgaccagcg gcgtgcacac cttcccggct 600  
 gtcctacagt cctcaggact ctactcctc agcagcgtgg tgaccgtgcc ctccagcagc 660  
 ttgggcacga agacctacac ctgcaacgta gatcacaagc ccagcaacac caaggtggac 720  
 aagagagttg agtccaaata tggccccca tgccatcat gccagcacc tgagttcctg 780  
 gggggacat cagtcttctt gttccccca aaaccaagg acactctcat gatctcccgg 840  
 acccctgagg tcacgtgctt ggtgggtggc gtgagccagg aagaccccgga ggtccagttc 900  
 aactggtacg tggatggcgt ggaggtgcat aatgccaaga caaagccgag ggaggagcag 960  
 ttcaacagca cgtaccgtgt ggtcagcgtc ctcaccgtcc tgcaccagga ctggctgaac 1020  
 ggcaaggagt acaagtgcaa ggtctccaac aaaggcctcc cgtcctccat cgagaaaacc 1080  
 atctccaaag ccaaagggca gccccgagag ccacaggtgt acaccctgcc cccatcccag 1140  
 gaggagatga ccaagaacca ggtcagcctg acctgcctgg tcaaaggctt ctaccccagc 1200  
 gacatcgccg tggagtggga gagcaatggg cagccggaga acaactaaa gaccacgcct 1260  
 cccgtgctgg actccgacgg ctcttctctc ctctacagca ggctaaccgt ggacaagagc 1320  
 aggtggcagg aggggaatgt cttttcacgc tccgtgatgc atgaggctct gcacaaccac 1380  
 tacacacaga agagcctctc cctgtctctg ggtaaatgat aggaattctg atga 1434

&lt;210&gt; SEQ ID NO 30

&lt;211&gt; LENGTH: 472

&lt;212&gt; TYPE: PRT

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 30

Met Glu Leu Gly Leu Arg Trp Val Phe Leu Val Ala Ile Leu Glu Gly  
 1 5 10 15

Val Gln Cys Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Lys  
 20 25 30

Pro Gly Gly Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe  
 35 40 45





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465

470

<210> SEQ ID NO 31  
 <211> LENGTH: 723  
 <212> TYPE: DNA  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 31

```

atgaggctcc ctgctcagct cctggggctg ctaatgctct ggatacctgg atccagtgca    60
gatattgtga tgaccagac tccactctct ctgtccgta ctctggaca gccggcctcc    120
atctcctgca actctagtca gagcctcctg cttagtgatg gaaagaccta tttgaattgg    180
tacctgcaga agcccggcca gcctccacag ctctgatct atgaagtttc caaccggttc    240
tctggagtgc cagacaggtt cagtggcagc gggtcaggga cagatttcac actgaaaatc    300
agccgggtgg aggctgagga tgttgggggt tattcctgca tgcaaagtat acagcttatg    360
tgcagttttg gccaggggac caagctggag atcaaacgaa ctgtggctgc accatctgtc    420
ttcatcttcc cgccatctga tgagcagttg aaatctggaa ctgcctctgt tgtgtgctg    480
ctgaataact tctatcccag agaggccaaa gtacagtgga aggtggataa cgccctccaa    540
tcgggtaact cccaggagag tgtcacagag caggacagca aggacagcac ctacagcctc    600
agcagcaccg tgacgctgag caaagcagac tacgagaaac acaaagtcta cgctgcgaa    660
gtcaccatc agggcctgag ctgcccctgc acaaagagct tcaacagggg agagtgttag    720
tga                                                                    723
  
```

<210> SEQ ID NO 32  
 <211> LENGTH: 239  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 32

```

Met Arg Leu Pro Ala Gln Leu Leu Gly Leu Leu Met Leu Trp Ile Pro
  1           5           10           15
Gly Ser Ser Ala Asp Ile Val Met Thr Gln Thr Pro Leu Ser Leu Ser
           20           25           30
Val Thr Pro Gly Gln Pro Ala Ser Ile Ser Cys Asn Ser Ser Gln Ser
           35           40           45
Leu Leu Leu Ser Asp Gly Lys Thr Tyr Leu Asn Trp Tyr Leu Gln Lys
           50           55           60
Pro Gly Gln Pro Pro Gln Leu Leu Ile Tyr Glu Val Ser Asn Arg Phe
           65           70           75           80
Ser Gly Val Pro Asp Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe
           85           90           95
Thr Leu Lys Ile Ser Arg Val Glu Ala Glu Asp Val Gly Val Tyr Ser
           100          105          110
Cys Met Gln Ser Ile Gln Leu Met Cys Ser Phe Gly Gln Gly Thr Lys
           115          120          125
Leu Glu Ile Lys Arg Thr Val Ala Ala Pro Ser Val Phe Ile Phe Pro
           130          135          140
Pro Ser Asp Glu Gln Leu Lys Ser Gly Thr Ala Ser Val Val Cys Leu
           145          150          155          160
Leu Asn Asn Phe Tyr Pro Arg Glu Ala Lys Val Gln Trp Lys Val Asp
           165          170          175
Asn Ala Leu Gln Ser Gly Asn Ser Gln Glu Ser Val Thr Glu Gln Asp
           180          185          190
  
```

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Ser Lys Asp Ser Thr Tyr Ser Leu Ser Ser Thr Leu Thr Leu Ser Lys  
 195 200 205

Ala Asp Tyr Glu Lys His Lys Val Tyr Ala Cys Glu Val Thr His Gln  
 210 215 220

Gly Leu Ser Ser Pro Val Thr Lys Ser Phe Asn Arg Gly Glu Cys  
 225 230 235

<210> SEQ ID NO 33  
 <211> LENGTH: 1410  
 <212> TYPE: DNA  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 33

atggactgga cctggagcat ccttttcttg gtggcagcag caacaggtgc cactcccag 60  
 gttcagctgg tgcagtctgg agctgaggtg aagaagcctg gggcctcagt gaaggtctcc 120  
 tgcaaggctt ctggttacac ctttaccagc tatggtatca actgggtgcg acaggcccct 180  
 ggacaagggc ttgagtggat gggatggatc agcgtttaca gtggtaacac aaactatgca 240  
 cagaaggtcc agggcagagt caccatgacc gcagacacat ccacgagcac agcctacatg 300  
 gacctgagga gcctgagatc tgacgacacg gccgtgtatt actgtgagag agagggtagc 360  
 agctcgtccg gagactacta ttacggtatg gacgtctggg gcccaagggac cacggtcacc 420  
 gtctcctcag cctccaccaa gggcccacg gtcttcccc tggcgccctg ctccaggagc 480  
 acctccgaga gcacagcggc cctgggctgc ctggtcaagg actacttccc cgaaccggtg 540  
 acggtgtcgt ggaactcagg cgctctgacc agcggcgtgc acaccttccc agctgtccta 600  
 cagtcctcag gactctactc cctcagcagc gtggtgaccg tgccctccag caacttcggc 660  
 acccagacct acacctgcaa cgtagatcac aagcccagca acaccaaggt ggacaagaca 720  
 gttgagcgca aatggtgtgt cgagtgccca ccgtgcccag caccacctgt ggcaggaccg 780  
 tcagtcttcc tcttcccccc aaaacccaag gacaccctca tgatctccc gaccctgag 840  
 gtcacgtgcg tgggtgtgga cgtgagccac gaagacccc aggtccagt caactggtac 900  
 gtggacggcg tggaggtgca taatgccaa acaaagccac gggaggagca gttcaacagc 960  
 acgttcogtg tggtcagcgt cctcacctgt gtgcaccagg actggctgaa cggcaaggag 1020  
 tacaagtgca aggtctccaa caaaggcctc ccagccccca tcgagaaaac catctccaaa 1080  
 accaaagggc agccccgaga accacaggtg tacaccctgc ccccatccc ggaggagatg 1140  
 accaagaacc aggtcagcct gacctgctg gtcaaaggt tctaccccag cgacatcgcc 1200  
 gtggagtggg agagcaatgg gcagccggag aacaactaca agaccacacc tcccatgctg 1260  
 gactccgacg gctccttctt cctctacagc aagctcaccg tggacaagag caggtggcag 1320  
 caggggaacg tcttctcatg ctccgtgatg catgaggctc tgcacaacca ctacacgcag 1380  
 aagagcctct ccctgtctcc gggtaaatga 1410

<210> SEQ ID NO 34  
 <211> LENGTH: 469  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 34

Met Asp Trp Thr Trp Ser Ile Leu Phe Leu Val Ala Ala Ala Thr Gly  
 1 5 10 15

Ala His Ser Gln Val Gln Leu Val Gln Ser Gly Ala Glu Val Lys Lys  
 20 25 30





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Val Met His Glu Ala Leu His Asn His Tyr Thr Gln Lys Ser Leu Ser  
 450 455 460

Leu Ser Pro Gly Lys  
 465

<210> SEQ ID NO 35  
 <211> LENGTH: 723  
 <212> TYPE: DNA  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 35

atgaggctcc ctgctcagct cctggggctg ctaatgctct ggatacctgg atccagtgca 60  
 gatattgtga tgaccagac tccactctct ctgtccgtca ccctggaca gccggcctcc 120  
 atctcctgca agtctagtca gagcctcctg catactgatg gaacgaccta tttgtattgg 180  
 tacctgcaga agccaggcca gcctccacag ctctgatct atgaagtctt caaccggttc 240  
 tctggagtgc cagataggtt cagtggcagc gggtcagga cagatttcac actgaaaatc 300  
 agccgggtgg aggctgagga tgttgggatt tattactgca tgcaaaatat acagcttccg 360  
 tggacgttcg gccaaaggac caaggtggaa atcaaacgaa ctgtggctgc accatctgtc 420  
 ttcactctcc cgccatctga tgagcagttg aaatctggaa ctgcctctgt tgtgtgcctg 480  
 ctgaataact tctatcccag agaggccaaa gtacagtgga aggtggataa cgccctccaa 540  
 tcgggtaact cccaggagag tgtcacagag caggacagca aggacagcac ctacagcctc 600  
 agcagcacc ctagcctgag caaagcagac tacgagaaac acaaagteta cgctgcgaa 660  
 gtcacccatc agggcctgag ctcgcccgtc acaaagagct tcaacagggg agagtgttag 720  
 tga 723

<210> SEQ ID NO 36  
 <211> LENGTH: 239  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 36

Met Arg Leu Pro Ala Gln Leu Leu Gly Leu Leu Met Leu Trp Ile Pro  
 1 5 10 15  
 Gly Ser Ser Ala Asp Ile Val Met Thr Gln Thr Pro Leu Ser Leu Ser  
 20 25 30  
 Val Thr Pro Gly Gln Pro Ala Ser Ile Ser Cys Lys Ser Ser Gln Ser  
 35 40 45  
 Leu Leu His Thr Asp Gly Thr Thr Tyr Leu Tyr Trp Tyr Leu Gln Lys  
 50 55 60  
 Pro Gly Gln Pro Pro Gln Leu Leu Ile Tyr Glu Val Ser Asn Arg Phe  
 65 70 75 80  
 Ser Gly Val Pro Asp Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe  
 85 90 95  
 Thr Leu Lys Ile Ser Arg Val Glu Ala Glu Asp Val Gly Ile Tyr Tyr  
 100 105 110  
 Cys Met Gln Asn Ile Gln Leu Pro Trp Thr Phe Gly Gln Gly Thr Lys  
 115 120 125  
 Val Glu Ile Lys Arg Thr Val Ala Ala Pro Ser Val Phe Ile Phe Pro  
 130 135 140  
 Pro Ser Asp Glu Gln Leu Lys Ser Gly Thr Ala Ser Val Val Cys Leu  
 145 150 155 160  
 Leu Asn Asn Phe Tyr Pro Arg Glu Ala Lys Val Gln Trp Lys Val Asp



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| 165 |     |     |     | 170 |     |     |     | 175 |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Asn | Ala | Leu | Gln | Ser | Gly | Asn | Ser | Gln | Glu | Ser | Val | Thr | Glu | Gln | Asp |
|     |     |     | 180 |     |     |     |     |     |     |     |     |     |     |     | 190 |
| Ser | Lys | Asp | Ser | Thr | Tyr | Ser | Leu | Ser | Ser | Thr | Leu | Thr | Leu | Ser | Lys |
|     |     |     | 195 |     |     |     | 200 |     |     |     |     |     |     |     | 205 |
| Ala | Asp | Tyr | Glu | Lys | His | Lys | Val | Tyr | Ala | Cys | Glu | Val | Thr | His | Gln |
|     |     |     | 210 |     |     |     | 215 |     |     |     |     |     |     |     | 220 |
| Gly | Leu | Ser | Ser | Pro | Val | Thr | Lys | Ser | Phe | Asn | Arg | Gly | Glu | Cys |     |
|     |     |     |     |     |     |     | 230 |     |     |     | 235 |     |     |     |     |

<210> SEQ ID NO 37  
 <211> LENGTH: 1416  
 <212> TYPE: DNA  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 37

```

atgaaacacc tgtggttctt cctcctgctg gtggcagctc ccagatgggt cctgtcccag    60
gtgcagctgc aggagtcggg cccaggactg gtgaagcctt cggagaccct gtcctcacc    120
tgcactgtct ctggtagctc catcagtagt taccactgga actggatccg gcagcccgcc    180
gggaagggac tggagtggat tgggcgtatc tataccagtg ggagcaccaa ctacaacccc    240
tcctcaaga gtcgagtcac catgtcacta gacacgtcca agaaccagtt ctccctgaag    300
ctgagctctg tgaccgccgc ggacacggcc gtgtattact gtgcgagaga gggggtcagg    360
tattactatg ctteggggag ttattactac ggtctggacg tctggggcca agggaccacg    420
gtcacctctc cctcagcctc caccaagggc ccatcggctt tccccctggc gccctgctcc    480
aggagcacct ccgagagcac agcggccctg ggctgcctgg tcaaggacta cttccccgaa    540
ccggtgacgg tgcgtggaa ctcagggcgt ctgaccagcg gcgtgcacac cttcccagct    600
gtcctacagt cctcaggact ctactccctc agcagcgtgg tgaccgtgcc ctccagcaac    660
ttcggcacc cagactacac ctgcaacgta gatcacaagc ccagcaacac caaggtggac    720
aagacagttg agcgcaaatg ttgtgctgag tgcccaccgt gccagcacc acctgtggca    780
ggaccgtcag tcttctctt ccccccaaaa cccaaggaca ccctcatgat ctcccggacc    840
cctgaggtca cgtgcgtggt ggtggacgtg agccacgaag accccgaggt ccagttcaac    900
tggtacgtgg acggcgtgga ggtgcataat gccaaagaaa agccacggga ggagcagttc    960
aacagcacgt tccgtgtggt cagcgtcctc accgttgtgc accaggactg gctgaacggc   1020
aaggagtaca agtgcaaggt ctccaacaaa ggctcccag cccccatcga gaaaaccatc   1080
tccaaaacca aagggcagcc ccgagaacca caggtgtaca ccctgcccc atcccgggag   1140
gagatgacca agaaccaggt cagcctgacc tgcttggtca aaggcttcta ccccagcgac   1200
atcgccgtgg agtgggagag caatgggcag ccggagaaca actacaagac cacacctccc   1260
atgctggact ccgacggctc cttcttctc tacagcaagc tcaccgtgga caagagcagg   1320
tggcagcagg ggaacgtctt ctcatgctcc gtgatgcatg aggctctgca caaccactac   1380
acgcagaaga gcctctcct gtctccgggt aatga                                     1416

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<210> SEQ ID NO 38  
 <211> LENGTH: 471  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 38

Met Lys His Leu Trp Phe Phe Leu Leu Leu Val Ala Ala Pro Arg Trp

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| 1   | 5           | 10                      | 15                              |
|-----|-------------|-------------------------|---------------------------------|
| Val | Leu Ser     | Gln Val Gln Leu Gln     | Glu Ser Gly Pro Gly Leu Val Lys |
|     | 20          | 25                      | 30                              |
| Pro | Ser Glu Thr | Leu Ser Leu Thr Cys Thr | Val Ser Gly Ser Ser Ile         |
|     | 35          | 40                      | 45                              |
| Ser | Ser Tyr His | Trp Asn Trp Ile Arg     | Gln Pro Ala Gly Lys Gly Leu     |
|     | 50          | 55                      | 60                              |
| Glu | Trp Ile Gly | Arg Ile Tyr Thr Ser     | Gly Ser Thr Asn Tyr Asn Pro     |
|     | 65          | 70                      | 75                              |
| Ser | Leu Lys Ser | Arg Val Thr Met Ser     | Leu Asp Thr Ser Lys Asn Gln     |
|     | 85          | 90                      | 95                              |
| Phe | Ser Leu Lys | Leu Ser Ser Val Thr     | Ala Ala Asp Thr Ala Val Tyr     |
|     | 100         | 105                     | 110                             |
| Tyr | Cys Ala Arg | Glu Gly Val Arg Tyr     | Tyr Tyr Ala Ser Gly Ser Tyr     |
|     | 115         | 120                     | 125                             |
| Tyr | Tyr Gly Leu | Asp Val Trp Gly Gln     | Gly Thr Thr Val Thr Val Ser     |
|     | 130         | 135                     | 140                             |
| Ser | Ala Ser Thr | Lys Gly Pro Ser Val     | Phe Pro Leu Ala Pro Cys Ser     |
|     | 145         | 150                     | 155                             |
| Arg | Ser Thr Ser | Glu Ser Thr Ala Ala     | Leu Gly Cys Leu Val Lys Asp     |
|     | 165         | 170                     | 175                             |
| Tyr | Phe Pro Glu | Pro Val Thr Val Ser     | Trp Asn Ser Gly Ala Leu Thr     |
|     | 180         | 185                     | 190                             |
| Ser | Gly Val His | Thr Phe Pro Ala Val     | Leu Gln Ser Ser Gly Leu Tyr     |
|     | 195         | 200                     | 205                             |
| Ser | Leu Ser Ser | Val Val Thr Val Pro     | Ser Ser Asn Phe Gly Thr Gln     |
|     | 210         | 215                     | 220                             |
| Thr | Tyr Thr Cys | Asn Val Asp His Lys     | Pro Ser Asn Thr Lys Val Asp     |
|     | 225         | 230                     | 235                             |
| Lys | Thr Val Glu | Arg Lys Cys Cys Val     | Glu Cys Pro Pro Cys Pro Ala     |
|     | 245         | 250                     | 255                             |
| Pro | Pro Val Ala | Gly Pro Ser Val Phe     | Leu Phe Pro Pro Lys Pro Lys     |
|     | 260         | 265                     | 270                             |
| Asp | Thr Leu Met | Ile Ser Arg Thr Pro     | Glu Val Thr Cys Val Val Val     |
|     | 275         | 280                     | 285                             |
| Asp | Val Ser His | Glu Asp Pro Glu Val     | Gln Phe Asn Trp Tyr Val Asp     |
|     | 290         | 295                     | 300                             |
| Gly | Val Glu Val | His Asn Ala Lys Thr     | Lys Pro Arg Glu Glu Gln Phe     |
|     | 305         | 310                     | 315                             |
| Asn | Ser Thr Phe | Arg Val Val Ser Val     | Leu Thr Val Val His Gln Asp     |
|     | 325         | 330                     | 335                             |
| Trp | Leu Asn Gly | Lys Glu Tyr Lys Cys     | Lys Val Ser Asn Lys Gly Leu     |
|     | 340         | 345                     | 350                             |
| Pro | Ala Pro Ile | Glu Lys Thr Ile Ser     | Lys Thr Lys Gly Gln Pro Arg     |
|     | 355         | 360                     | 365                             |
| Glu | Pro Gln Val | Tyr Thr Leu Pro Pro     | Ser Arg Glu Glu Met Thr Lys     |
|     | 370         | 375                     | 380                             |
| Asn | Gln Val Ser | Leu Thr Cys Leu Val     | Lys Gly Phe Tyr Pro Ser Asp     |
|     | 385         | 390                     | 395                             |
| Ile | Ala Val Glu | Trp Glu Ser Asn Gly     | Gln Pro Glu Asn Asn Tyr Lys     |
|     | 405         | 410                     | 415                             |
| Thr | Thr Pro Pro | Met Leu Asp Ser Asp     | Gly Ser Phe Phe Leu Tyr Ser     |
|     | 420         | 425                     | 430                             |



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Lys Leu Thr Val Asp Lys Ser Arg Trp Gln Gln Gly Asn Val Phe Ser  
435 440 445

Cys Ser Val Met His Glu Ala Leu His Asn His Tyr Thr Gln Lys Ser  
450 455 460

Leu Ser Leu Ser Pro Gly Lys  
465 470

<210> SEQ ID NO 39  
<211> LENGTH: 720  
<212> TYPE: DNA  
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 39

atgaggctcc ctgctcagct cctggggctg ctaatgctct gggctctctgg atccagtggg 60  
gatattgtga tgactcagtc tccactctcc ctgcccgtca cccctggaga gccggcctcc 120  
atctcctgca ggtctagtca gagcctcctg catggtaatg gatacaacta tttggattgg 180  
tacctgcaga agccagggca gtctccacag ctctgatct atttgggttc taatcgggcc 240  
tccggggctcc ctgacaggtt cagtggcagt ggatcaggca cagattttac actgaaaatc 300  
agcagagtgg aggctgagga tgttgggggtt tattactgca tgcaagctct acaaactctc 360  
actttcggcg gagggaccaa ggtggagatc aaacgaactg tggctgcacc atctgtcttc 420  
atcttcccgc catctgatga gcagttgaaa tctggaactg cctctgttgt gtgctgctg 480  
aataacttct atcccagaga ggccaaagta cagtggaagg tggataacgc cctccaatcg 540  
ggtaactccc aggagagtgt cacagagcag gacagcaagg acagcaccta cagcctcagc 600  
agcacctga cgctgagcaa agcagactac gagaacaca aagtctacgc ctgcgaagtc 660  
accatcagg gcctgagctc gcccgtcaca aagagcttca acaggggaga gtgttagtga 720

<210> SEQ ID NO 40  
<211> LENGTH: 238  
<212> TYPE: PRT  
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 40

Met Arg Leu Pro Ala Gln Leu Leu Gly Leu Leu Met Leu Trp Val Ser  
1 5 10 15

Gly Ser Ser Gly Asp Ile Val Met Thr Gln Ser Pro Leu Ser Leu Pro  
20 25 30

Val Thr Pro Gly Glu Pro Ala Ser Ile Ser Cys Arg Ser Ser Gln Ser  
35 40 45

Leu Leu His Gly Asn Gly Tyr Asn Tyr Leu Asp Trp Tyr Leu Gln Lys  
50 55 60

Pro Gly Gln Ser Pro Gln Leu Leu Ile Tyr Leu Gly Ser Asn Arg Ala  
65 70 75 80

Ser Gly Val Pro Asp Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe  
85 90 95

Thr Leu Lys Ile Ser Arg Val Glu Ala Glu Asp Val Gly Val Tyr Tyr  
100 105 110

Cys Met Gln Ala Leu Gln Thr Leu Thr Phe Gly Gly Gly Thr Lys Val  
115 120 125

Glu Ile Lys Arg Thr Val Ala Ala Pro Ser Val Phe Ile Phe Pro Pro  
130 135 140

Ser Asp Glu Gln Leu Lys Ser Gly Thr Ala Ser Val Val Cys Leu Leu  
145 150 155 160

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Asn Asn Phe Tyr Pro Arg Glu Ala Lys Val Gln Trp Lys Val Asp Asn  
 165 170 175

Ala Leu Gln Ser Gly Asn Ser Gln Glu Ser Val Thr Glu Gln Asp Ser  
 180 185 190

Lys Asp Ser Thr Tyr Ser Leu Ser Ser Thr Leu Thr Leu Ser Lys Ala  
 195 200 205

Asp Tyr Glu Lys His Lys Val Tyr Ala Cys Glu Val Thr His Gln Gly  
 210 215 220

Leu Ser Ser Pro Val Thr Lys Ser Phe Asn Arg Gly Glu Cys  
 225 230 235

<210> SEQ ID NO 41  
 <211> LENGTH: 1410  
 <212> TYPE: DNA  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 41

atggactgga cctggagcat ccttttcttg gtggcagcag caacaggtgc ccaactcccag 60  
 gttcagctgg tgcagtctgg agctgaggtg aagaagcctg gggcctcagt gaaggtctcc 120  
 tgcgaggctt ctggttacac ctttaccagc tatggtatcg actgggtgcg acaggcccct 180  
 ggacaagggc ttgagtggat gggatggatc agcgtttaca gtggtaacac aaactatgca 240  
 cagaagctcc agggcagagt caccatgtcc acagacacat ccacgagcac agcctacatg 300  
 gagctgagga gcctgagatc tgacgacacg gccgtgtatt actgtgagag agagggtagc 360  
 agctcgtccg gagactacta ctacggtatg gacgtctggg gccaaaggac cacggtcacc 420  
 gtctcctcag cctccaccaa gggcccacag gtcttcccc tggcgccctg ctccaggagc 480  
 acctccgaga gcacagcggc cctgggctgc ctggtcaagg actacttccc cgaaccgggtg 540  
 acgggtgctg ggaactcagg cgctctgacc agcggcgtgc acaccttccc agctgtccta 600  
 cagtcctcag gactctactc cctcagcagc gtggtgaccg tgcctccag caacttcggc 660  
 acccagacct acacctgcaa cgtagatcac aagcccagca acaccaaggt ggacaagaca 720  
 gttgagcgca aatggtgtgt cgagtgccca ccgtgcccag caccacctgt ggcaggaccg 780  
 tcagtcttcc tcttcccccc aaaacccaag gacaccctca tgatctccc gaccctgag 840  
 gtcaactgag tgggtggtga cgtgagccac gaagacccc aggtccagtt caactggtac 900  
 gtggacggcg tggaggtgca taatgccaa acaaagccac gggaggagca gttcaacagc 960  
 acgttccgtg tggtcagcgt cctcaccgtt gtgcaccagg actggctgaa cggcaaggag 1020  
 tacaagtgca aggtctcaa caaaggcctc ccagccccca ttgagaaaac catctccaaa 1080  
 accaaagggc agccccgaga accacaggtg tacaccctgc ccccatccc ggaggagatg 1140  
 accaagaacc aggtcagcct gacctgcctg gtcaaaggct tctaccccag cgacatcgcc 1200  
 gtggagtggg agagcaatgg gcagccggag aacaactaca agaccacacc tcccatgctg 1260  
 gactccgacg gctccttctt cctctacagc aagctcaccg tggacaagag caggtggcag 1320  
 caggggaacg tcttctcatg ctccgtgatg catgaggctc tgcacaacca ctacacgcag 1380  
 aagagcctct ccctgtctcc gggtaaatga 1410

<210> SEQ ID NO 42  
 <211> LENGTH: 469  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 42



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Met Asp Trp Thr Trp Ser Ile Leu Phe Leu Val Ala Ala Ala Thr Gly  
 1 5 10 15  
 Ala His Ser Gln Val Gln Leu Val Gln Ser Gly Ala Glu Val Lys Lys  
 20 25 30  
 Pro Gly Ala Ser Val Lys Val Ser Cys Glu Ala Ser Gly Tyr Thr Phe  
 35 40 45  
 Thr Ser Tyr Gly Ile Asp Trp Val Arg Gln Ala Pro Gly Gln Gly Leu  
 50 55 60  
 Glu Trp Met Gly Trp Ile Ser Val Tyr Ser Gly Asn Thr Asn Tyr Ala  
 65 70 75 80  
 Gln Lys Leu Gln Gly Arg Val Thr Met Ser Thr Asp Thr Ser Thr Ser  
 85 90 95  
 Thr Ala Tyr Met Glu Leu Arg Ser Leu Arg Ser Asp Asp Thr Ala Val  
 100 105 110  
 Tyr Tyr Cys Ala Arg Glu Gly Ser Ser Ser Ser Gly Asp Tyr Tyr Tyr  
 115 120 125  
 Gly Met Asp Val Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser Ala  
 130 135 140  
 Ser Thr Lys Gly Pro Ser Val Phe Pro Leu Ala Pro Cys Ser Arg Ser  
 145 150 155 160  
 Thr Ser Glu Ser Thr Ala Ala Leu Gly Cys Leu Val Lys Asp Tyr Phe  
 165 170 175  
 Pro Glu Pro Val Thr Val Ser Trp Asn Ser Gly Ala Leu Thr Ser Gly  
 180 185 190  
 Val His Thr Phe Pro Ala Val Leu Gln Ser Ser Gly Leu Tyr Ser Leu  
 195 200 205  
 Ser Ser Val Val Thr Val Pro Ser Ser Asn Phe Gly Thr Gln Thr Tyr  
 210 215 220  
 Thr Cys Asn Val Asp His Lys Pro Ser Asn Thr Lys Val Asp Lys Thr  
 225 230 235 240  
 Val Glu Arg Lys Cys Cys Val Glu Cys Pro Pro Cys Pro Ala Pro Pro  
 245 250 255  
 Val Ala Gly Pro Ser Val Phe Leu Phe Pro Pro Lys Pro Lys Asp Thr  
 260 265 270  
 Leu Met Ile Ser Arg Thr Pro Glu Val Thr Cys Val Val Val Asp Val  
 275 280 285  
 Ser His Glu Asp Pro Glu Val Gln Phe Asn Trp Tyr Val Asp Gly Val  
 290 295 300  
 Glu Val His Asn Ala Lys Thr Lys Pro Arg Glu Glu Gln Phe Asn Ser  
 305 310 315 320  
 Thr Phe Arg Val Val Ser Val Leu Thr Val Val His Gln Asp Trp Leu  
 325 330 335  
 Asn Gly Lys Glu Tyr Lys Cys Lys Val Ser Asn Lys Gly Leu Pro Ala  
 340 345 350  
 Pro Ile Glu Lys Thr Ile Ser Lys Thr Lys Gly Gln Pro Arg Glu Pro  
 355 360 365  
 Gln Val Tyr Thr Leu Pro Pro Ser Arg Glu Glu Met Thr Lys Asn Gln  
 370 375 380  
 Val Ser Leu Thr Cys Leu Val Lys Gly Phe Tyr Pro Ser Asp Ile Ala  
 385 390 395 400  
 Val Glu Trp Glu Ser Asn Gly Gln Pro Glu Asn Asn Tyr Lys Thr Thr  
 405 410 415

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Pro Pro Met Leu Asp Ser Asp Gly Ser Phe Phe Leu Tyr Ser Lys Leu  
 420 425 430

Thr Val Asp Lys Ser Arg Trp Gln Gln Gly Asn Val Phe Ser Cys Ser  
 435 440 445

Val Met His Glu Ala Leu His Asn His Tyr Thr Gln Lys Ser Leu Ser  
 450 455 460

Leu Ser Pro Gly Lys  
 465

<210> SEQ ID NO 43  
 <211> LENGTH: 723  
 <212> TYPE: DNA  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 43

atgaggctcc ctgctcagct cctggggctg ctaatgctct ggatacctgg atccagtgcg 60  
 gatattgtga tgaccagac tccactctct ctgtccgtca cccctggaca gccggcctcc 120  
 atctcctgca agtctaata gagcctcctg tatagtgatg gaaagaccta tttgttttgg 180  
 tacctgcaga agccaggcca gcctccacag ctctgatct atgaagtffc caaccgattc 240  
 tctggagtgc cagataggtt cagtggcagc gggtcaggga cagatttcac actgaaaatc 300  
 agccgggtgg aggctgagga tgttgggggtt tattactgca tgcaaagtat acagcttccg 360  
 tggacgttcg gccaaaggac caaggtggaa atcaaacgaa ctgtggctgc accatctgtc 420  
 ttcatcttcc cgccatctga tgagcagttg aaatctggaa ctgcctctgt tgtgtgctg 480  
 ctgaataact tctatcccag agaggccaaa gtacagtgga aggtggataa cgccctccaa 540  
 tcgggtaact cccaggagag tgtcacagag caggacagca aggacagcac ctacagcctc 600  
 agcagcacc cagcgtgag caaagcagac tacgagaaac acaaagtcta cgctgcgaa 660  
 gtcacccatc agggcctgag ctgcgccgtc acaaagagct tcaacagggg agagtgttag 720  
 tga 723

<210> SEQ ID NO 44  
 <211> LENGTH: 239  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 44

Met Arg Leu Pro Ala Gln Leu Leu Gly Leu Leu Met Leu Trp Ile Pro  
 1 5 10 15

Gly Ser Ser Ala Asp Ile Val Met Thr Gln Thr Pro Leu Ser Leu Ser  
 20 25 30

Val Thr Pro Gly Gln Pro Ala Ser Ile Ser Cys Lys Ser Asn Gln Ser  
 35 40 45

Leu Leu Tyr Ser Asp Gly Lys Thr Tyr Leu Phe Trp Tyr Leu Gln Lys  
 50 55 60

Pro Gly Gln Pro Pro Gln Leu Leu Ile Tyr Glu Val Ser Asn Arg Phe  
 65 70 75 80

Ser Gly Val Pro Asp Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe  
 85 90 95

Thr Leu Lys Ile Ser Arg Val Glu Ala Glu Asp Val Gly Val Tyr Tyr  
 100 105 110

Cys Met Gln Ser Ile Gln Leu Pro Trp Thr Phe Gly Gln Gly Thr Lys  
 115 120 125

Val Glu Ile Lys Arg Thr Val Ala Ala Pro Ser Val Phe Ile Phe Pro



-continued

| 130  | 135 | 140 |
|--|-----|-----|
| Pro Ser Asp Glu Gln Leu Lys Ser Gly Thr Ala Ser Val Val Cys Leu<br>145 | 150 | 155 |
| Leu Asn Asn Phe Tyr Pro Arg Glu Ala Lys Val Gln Trp Lys Val Asp<br>165 | 170 | 175 |
| Asn Ala Leu Gln Ser Gly Asn Ser Gln Glu Ser Val Thr Glu Gln Asp<br>180 | 185 | 190 |
| Ser Lys Asp Ser Thr Tyr Ser Leu Ser Ser Thr Leu Thr Leu Ser Lys<br>195 | 200 | 205 |
| Ala Asp Tyr Glu Lys His Lys Val Tyr Ala Cys Glu Val Thr His Gln<br>210 | 215 | 220 |
| Gly Leu Ser Ser Pro Val Thr Lys Ser Phe Asn Arg Gly Glu Cys<br>225     | 230 | 235 |

<210> SEQ ID NO 45  
 <211> LENGTH: 1389  
 <212> TYPE: DNA  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 45

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atggagtttg ggctgagctg ggttttcctc gttgctcttt taagaggtgt ccagtgtcag      60
gtgcagctgg tggagtctgg gggaggcgtg gtccagcctg ggaggtcct gagactctcc      120
tgtgcagcgt ctggattcac cttcagtagc tatggcatgc actgggtccg ccaggctcca      180
ggcaaggggc tggagtgggt ggcagttata tggatgatg gaagtaatga atactatgca      240
gactccgtga agggccgatt caccatctcc agagacaatt ccaagaacac gctgtatctg      300
caaatgaaca gcctgagagc cgaggacacg gctgtgtatt actgtgagag gggggcgtac      360
cactttgect actggggcca ggaaccctg gtcaccgtct cctcagcttc caccaagggc      420
ccatccgtct tccccctggc gccctgctcc aggagcacct ccgagagcac agccgacctg      480
ggctgectgg tcaaggacta cttccccgaa ccggtgacgg tgtcgtggaa ctcaggcgcc      540
ctgaccagcg gcgtgcacac cttcccggct gtccctacagt cctcaggact ctactccctc      600
agcagcgtgg tgaccgtgcc ctccagcagc ttgggcaaga agacctacac ctgcaacgta      660
gatcacaagc ccagcaacac caaggtggac aagagagttg agtccaaata tgggtccccca      720
tgcccatcat gccagcacc tgagttcctg gggggacct cagtcttct gttccccca      780
aaaccaagg acactctcat gatctcccgg acccctgagg tcacgtgcgt ggtggtggac      840
gtgagccagg aagaccccga ggtccagttc aactggtacg tggatggcgt ggagggtgcat      900
aatgccaaga caaagccgcg ggaggagcag ttcaacagca cgtaccgtgt ggtcagcgtc      960
ctcaccgtcc tgcaccagga ctggctgaac ggcaaggagt acaagtgcaa ggtctccaac     1020
aaaggcctcc cgtcctccat cgagaaaacc atctcaaag ccaagggca gccccgagag     1080
ccacaggtgt acaccctgcc cccatcccag gaggagatga ccaagaacca ggtcagcctg     1140
acctgectgg tcaaaggett ctacccagc gacatgcgag tggagtggga gagcaatggg     1200
cagccggaga acaactaaa gaccacgcct cccgtgctgg actccgacgg ctcttcttc     1260
ctctacagca ggctaaccgt ggacaagagc aggtggcagg aggggaatgt cttctcatgc     1320
tccgtgatgc atgaggctct gcacaaccac tacacacaga agagcctctc cctgtctctg     1380
ggtaaatga                                           1389

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<210> SEQ ID NO 46  
 <211> LENGTH: 462

-continued

&lt;212&gt; TYPE: PRT

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 46

Met Glu Phe Gly Leu Ser Trp Val Phe Leu Val Ala Leu Leu Arg Gly  
 1 5 10 15  
 Val Gln Cys Gln Val Gln Leu Val Glu Ser Gly Gly Gly Val Val Gln  
 20 25 30  
 Pro Gly Arg Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe  
 35 40 45  
 Ser Ser Tyr Gly Met His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu  
 50 55 60  
 Glu Trp Val Ala Val Ile Trp Tyr Asp Gly Ser Asn Glu Tyr Tyr Ala  
 65 70 75 80  
 Asp Ser Val Lys Gly Arg Phe Thr Ile Ser Arg Asp Asn Ser Lys Asn  
 85 90 95  
 Thr Leu Tyr Leu Gln Met Asn Ser Leu Arg Ala Glu Asp Thr Ala Val  
 100 105 110  
 Tyr Tyr Cys Ala Arg Gly Ala Tyr His Phe Ala Tyr Trp Gly Gln Gly  
 115 120 125  
 Thr Leu Val Thr Val Ser Ser Ala Ser Thr Lys Gly Pro Ser Val Phe  
 130 135 140  
 Pro Leu Ala Pro Cys Ser Arg Ser Thr Ser Glu Ser Thr Ala Ala Leu  
 145 150 155 160  
 Gly Cys Leu Val Lys Asp Tyr Phe Pro Glu Pro Val Thr Val Ser Trp  
 165 170 175  
 Asn Ser Gly Ala Leu Thr Ser Gly Val His Thr Phe Pro Ala Val Leu  
 180 185 190  
 Gln Ser Ser Gly Leu Tyr Ser Leu Ser Ser Val Val Thr Val Pro Ser  
 195 200 205  
 Ser Ser Leu Gly Thr Lys Thr Tyr Thr Cys Asn Val Asp His Lys Pro  
 210 215 220  
 Ser Asn Thr Lys Val Asp Lys Arg Val Glu Ser Lys Tyr Gly Pro Pro  
 225 230 235 240  
 Cys Pro Ser Cys Pro Ala Pro Glu Phe Leu Gly Gly Pro Ser Val Phe  
 245 250 255  
 Leu Phe Pro Pro Lys Pro Lys Asp Thr Leu Met Ile Ser Arg Thr Pro  
 260 265 270  
 Glu Val Thr Cys Val Val Val Asp Val Ser Gln Glu Asp Pro Glu Val  
 275 280 285  
 Gln Phe Asn Trp Tyr Val Asp Gly Val Glu Val His Asn Ala Lys Thr  
 290 295 300  
 Lys Pro Arg Glu Glu Gln Phe Asn Ser Thr Tyr Arg Val Val Ser Val  
 305 310 315 320  
 Leu Thr Val Leu His Gln Asp Trp Leu Asn Gly Lys Glu Tyr Lys Cys  
 325 330 335  
 Lys Val Ser Asn Lys Gly Leu Pro Ser Ser Ile Glu Lys Thr Ile Ser  
 340 345 350  
 Lys Ala Lys Gly Gln Pro Arg Glu Pro Gln Val Tyr Thr Leu Pro Pro  
 355 360 365  
 Ser Gln Glu Glu Met Thr Lys Asn Gln Val Ser Leu Thr Cys Leu Val  
 370 375 380  
 Lys Gly Phe Tyr Pro Ser Asp Ile Ala Val Glu Trp Glu Ser Asn Gly  
 385 390 395 400



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Gln Pro Glu Asn Asn Tyr Lys Thr Thr Pro Pro Val Leu Asp Ser Asp  
 405 410 415

Gly Ser Phe Phe Leu Tyr Ser Arg Leu Thr Val Asp Lys Ser Arg Trp  
 420 425 430

Gln Glu Gly Asn Val Phe Ser Cys Ser Val Met His Glu Ala Leu His  
 435 440 445

Asn His Tyr Thr Gln Lys Ser Leu Ser Leu Ser Leu Gly Lys  
 450 455 460

<210> SEQ ID NO 47  
 <211> LENGTH: 720  
 <212> TYPE: DNA  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 47

atggacatga gggtcctgc tcagctcctg gggtcctgc tgctctgget ctcaagtcgca 60  
 ggtgccagat gtgacatcca gatgaccag tctccatcct ccctgtctgc atctgtagga 120  
 gacagagtca ccataccttg ccaggcgagt caggacatta gcaactattt aaattggtat 180  
 cagcagaaac cagggaaagc ccctaagctc ctgatctacg atgcatcaa tttggaaca 240  
 ggggtcccat caaggttcag tggaagtgga tctgggacag attttacttt caccatcagc 300  
 agcctgcagc ctgaagatat tgcaacatat tcctgtcaac actctgataa tctctcgatc 360  
 accttcggcc aggggacacg actggagatt aaacgaactg tggctgcacc atctgtcttc 420  
 atcttcccgc catctgatga gcagttgaaa tctggaactg cctctgttgt gtgctgctg 480  
 aataacttct accccagaga ggccaaagta cagtggaagg tggataacgc cctccaatcg 540  
 ggtaactccc aggagagtgt cacagagcag gacagcaagg acagcaccta cagcctcagc 600  
 agcaccctga cgctgagcaa agcagactac gagaacaca aagtctacgc ctgcgaagtc 660  
 acccatcagg gcctgagctc gcccgtcaca aagagcttca acaggggaga gtgtagtga 720

<210> SEQ ID NO 48  
 <211> LENGTH: 238  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 48

Met Asp Met Arg Val Pro Ala Gln Leu Leu Gly Leu Leu Leu Leu Trp  
 1 5 10 15

Leu Ser Val Ala Gly Ala Arg Cys Asp Ile Gln Met Thr Gln Ser Pro  
 20 25 30

Ser Ser Leu Ser Ala Ser Val Gly Asp Arg Val Thr Ile Thr Cys Gln  
 35 40 45

Ala Ser Gln Asp Ile Ser Asn Tyr Leu Asn Trp Tyr Gln Gln Lys Pro  
 50 55 60

Gly Lys Ala Pro Lys Leu Leu Ile Tyr Asp Ala Ser Asn Leu Glu Thr  
 65 70 75 80

Gly Val Pro Ser Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe Thr  
 85 90 95

Phe Thr Ile Ser Ser Leu Gln Pro Glu Asp Ile Ala Thr Tyr Ser Cys  
 100 105 110

Gln His Ser Asp Asn Leu Ser Ile Thr Phe Gly Gln Gly Thr Arg Leu  
 115 120 125

Glu Ile Lys Arg Thr Val Ala Ala Pro Ser Val Phe Ile Phe Pro Pro  
 130 135 140

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Ser Asp Glu Gln Leu Lys Ser Gly Thr Ala Ser Val Val Cys Leu Leu  
 145 150 155 160

Asn Asn Phe Tyr Pro Arg Glu Ala Lys Val Gln Trp Lys Val Asp Asn  
 165 170 175

Ala Leu Gln Ser Gly Asn Ser Gln Glu Ser Val Thr Glu Gln Asp Ser  
 180 185 190

Lys Asp Ser Thr Tyr Ser Leu Ser Ser Thr Leu Thr Leu Ser Lys Ala  
 195 200 205

Asp Tyr Glu Lys His Lys Val Tyr Ala Cys Glu Val Thr His Gln Gly  
 210 215 220

Leu Ser Ser Pro Val Thr Lys Ser Phe Asn Arg Gly Glu Cys  
 225 230 235

<210> SEQ ID NO 49  
 <211> LENGTH: 681  
 <212> TYPE: DNA  
 <213> ORGANISM: Macaca fascicularis

<400> SEQUENCE: 49

atggatcggg gcctggcct cctgctggcg gggcttctgg ggctcctcca gccgggctgc 60  
 ggccagtcce tccaggtgaa gcccctgcag gtggagcccc cggagccggt ggtggccgtg 120  
 gccctgggag cctctcgcca gctcacctgc cgctggact gcgcggacgg cggggccacg 180  
 gtgcagtggc ggggcttga caccagcctg ggcgcggtgc agtcggacgc gggccgcagc 240  
 gtcctcaccg tgcgcaacgc ctgctgtctg gcggccggga cccgtgtgtg cgtgggctcc 300  
 tgcggggggc gcaccttcca gcacaccgtg cggctccttg tgtacgcctt cccggaccag 360  
 ctgaccatct ccccgccagc cctgggtgct ggtgaccgag aggtggcctg tacggctcac 420  
 aaagtccagc ctgtggacc caatgcgctc tccttctccc tgctcctggg ggaccaggaa 480  
 ctggaggggg cccaggtctt gggcccggag gtggaggagg aggaggagcc ccaggaggag 540  
 gaggacgtgc tgttcagggt gacagagcgc tggcggctgc cgaccctggc aaccctgtc 600  
 ctgcccgcgc tctactgcca ggccacgatg aggtgctctg gcttggagct cagccaccgc 660  
 caggccatcc cggctctgca c 681

<210> SEQ ID NO 50  
 <211> LENGTH: 227  
 <212> TYPE: PRT  
 <213> ORGANISM: Macaca fascicularis

<400> SEQUENCE: 50

Met Asp Arg Gly Leu Ala Leu Leu Leu Ala Gly Leu Leu Gly Leu Leu  
 1 5 10 15

Gln Pro Gly Cys Gly Gln Ser Leu Gln Val Lys Pro Leu Gln Val Glu  
 20 25 30

Pro Pro Glu Pro Val Val Ala Val Ala Leu Gly Ala Ser Arg Gln Leu  
 35 40 45

Thr Cys Arg Leu Asp Cys Ala Asp Gly Gly Ala Thr Val Gln Trp Arg  
 50 55 60

Gly Leu Asp Thr Ser Leu Gly Ala Val Gln Ser Asp Ala Gly Arg Ser  
 65 70 75 80

Val Leu Thr Val Arg Asn Ala Ser Leu Ser Ala Ala Gly Thr Arg Val  
 85 90 95

Cys Val Gly Ser Cys Gly Gly Arg Thr Phe Gln His Thr Val Arg Leu  
 100 105 110



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Leu Val Tyr Ala Phe Pro Asp Gln Leu Thr Ile Ser Pro Ala Ala Leu  
 115 120 125  
 Val Pro Gly Asp Pro Glu Val Ala Cys Thr Ala His Lys Val Thr Pro  
 130 135 140  
 Val Asp Pro Asn Ala Leu Ser Phe Ser Leu Leu Leu Gly Asp Gln Glu  
 145 150 155 160  
 Leu Glu Gly Ala Gln Ala Leu Gly Pro Glu Val Glu Glu Glu Glu Glu  
 165 170 175  
 Pro Gln Glu Glu Glu Asp Val Leu Phe Arg Val Thr Glu Arg Trp Arg  
 180 185 190  
 Leu Pro Thr Leu Ala Thr Pro Val Leu Pro Ala Leu Tyr Cys Gln Ala  
 195 200 205  
 Thr Met Arg Leu Pro Gly Leu Glu Leu Ser His Arg Gln Ala Ile Pro  
 210 215 220  
 Val Leu His  
 225

&lt;210&gt; SEQ ID NO 51

&lt;211&gt; LENGTH: 1398

&lt;212&gt; TYPE: DNA

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 51

atggagtttg ggctgagctg ggttttcctc gttgctcttt taagaggtgt ccagtgtcag 60  
 gtgcagctgg tggagtctgg gggaggcgtg gtccagcctg ggaggtccct gagactctcc 120  
 tgtgcagcgt ctggattcac cttcagtagc gatggcatgc actgggtccg ccaggctcca 180  
 ggcaaggggc tggagtgggt ggcaattata tggatgatg gaagtaataa atattatgca 240  
 gactccgtga agggccgatt caccatctcc agagacaatt ccaagaacac gctgtatctg 300  
 caaatgaaca gcctgagagc cgaggacacg gctgtatatt actgtgagag agatcccggc 360  
 tactattacg gtatggacgt ctggggccaa gggaccacgg tcaccgtctc ctcagcttcc 420  
 accaagggcc catcctctt ccccctggcg cctgctcta gaagcacctc cgagagcaca 480  
 gcggccctgg gctgctggt caaggactac ttccccgaac cggtgacggt gtcgtggaac 540  
 tcaggcgtc tgaccagcgg cgtgcacacc ttcccagctg tcctacagtc ctcaggactc 600  
 tactccctca gcagcgtggt gaccgtgccc tccagcaact tcggcaccca gacctacacc 660  
 tgcaacgtag atcacaagcc cagcaacacc aaggtggaca agacagttga gcgcaaatgt 720  
 tgtgtcgagt gccaccctg cccagcacca cctgtggcag gaccgtcagt cttcctcttc 780  
 cccccaaaac ccaaggacac cctcatgatc tcccggaccc ctgaggtcac gtgctggtg 840  
 gtggacgtga gccacgaaga ccccagagtc cagttcaact ggtacgtgga cggcgtggag 900  
 gtgcataatg ccaagacaaa gccacgggag gagcagttca acagcacgtt ccgtgtggtc 960  
 agcgtcctca ccgttgtgca ccaggactgg ctgaacggca aggagtataa gtgcaaggtc 1020  
 tccaacaaag gcctcccagc ccccatcgag aaaaccatct ccaaaaccaa agggcagccc 1080  
 cgagaaccac aggtgtacac cctgccccca tcccgggagg agatgaccaa gaaccaggtc 1140  
 agcctgacct gcctggtcaa aggtttctac cccagcgaca tcgccgtgga gtgggagagc 1200  
 aatgggcagc cggagaacaa ctacaagacc acacctccca tgctggactc cgacggctcc 1260  
 ttcttctct acagcaagct caccgtggac aagagcaggt ggcagcaggg gaacgtcttc 1320  
 tcatgctccg tgatgatga ggctctgcac aaccactaca cgcagaagag cctctccctg 1380

-continued

tctccgggta aatgatag

1398

&lt;210&gt; SEQ ID NO 52

&lt;211&gt; LENGTH: 464

&lt;212&gt; TYPE: PRT

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 52

Met Glu Phe Gly Leu Ser Trp Val Phe Leu Val Ala Leu Leu Arg Gly  
 1 5 10 15  
 Val Gln Cys Gln Val Gln Leu Val Glu Ser Gly Gly Gly Val Val Gln  
 20 25 30  
 Pro Gly Arg Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe  
 35 40 45  
 Ser Ser Asp Gly Met His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu  
 50 55 60  
 Glu Trp Val Ala Ile Ile Trp Tyr Asp Gly Ser Asn Lys Tyr Tyr Ala  
 65 70 75 80  
 Asp Ser Val Lys Gly Arg Phe Thr Ile Ser Arg Asp Asn Ser Lys Asn  
 85 90 95  
 Thr Leu Tyr Leu Gln Met Asn Ser Leu Arg Ala Glu Asp Thr Ala Val  
 100 105 110  
 Tyr Tyr Cys Ala Arg Asp Pro Gly Tyr Tyr Tyr Gly Met Asp Val Trp  
 115 120 125  
 Gly Gln Gly Thr Thr Val Thr Val Ser Ser Ala Ser Thr Lys Gly Pro  
 130 135 140  
 Ser Val Phe Pro Leu Ala Pro Cys Ser Arg Ser Thr Ser Glu Ser Thr  
 145 150 155 160  
 Ala Ala Leu Gly Cys Leu Val Lys Asp Tyr Phe Pro Glu Pro Val Thr  
 165 170 175  
 Val Ser Trp Asn Ser Gly Ala Leu Thr Ser Gly Val His Thr Phe Pro  
 180 185 190  
 Ala Val Leu Gln Ser Ser Gly Leu Tyr Ser Leu Ser Ser Val Val Thr  
 195 200 205  
 Val Pro Ser Ser Asn Phe Gly Thr Gln Thr Tyr Thr Cys Asn Val Asp  
 210 215 220  
 His Lys Pro Ser Asn Thr Lys Val Asp Lys Thr Val Glu Arg Lys Cys  
 225 230 235 240  
 Cys Val Glu Cys Pro Pro Cys Pro Ala Pro Pro Val Ala Gly Pro Ser  
 245 250 255  
 Val Phe Leu Phe Pro Pro Lys Pro Lys Asp Thr Leu Met Ile Ser Arg  
 260 265 270  
 Thr Pro Glu Val Thr Cys Val Val Val Asp Val Ser His Glu Asp Pro  
 275 280 285  
 Glu Val Gln Phe Asn Trp Tyr Val Asp Gly Val Glu Val His Asn Ala  
 290 295 300  
 Lys Thr Lys Pro Arg Glu Glu Gln Phe Asn Ser Thr Phe Arg Val Val  
 305 310 315 320  
 Ser Val Leu Thr Val Val His Gln Asp Trp Leu Asn Gly Lys Glu Tyr  
 325 330 335  
 Lys Cys Lys Val Ser Asn Lys Gly Leu Pro Ala Pro Ile Glu Lys Thr  
 340 345 350  
 Ile Ser Lys Thr Lys Gly Gln Pro Arg Glu Pro Gln Val Tyr Thr Leu  
 355 360 365



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|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Pro | Pro | Ser | Arg | Glu | Glu | Met | Thr | Lys | Asn | Gln | Val | Ser | Leu | Thr | Cys |
|     | 370 |     |     |     |     | 375 |     |     |     |     | 380 |     |     |     |     |
|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Leu | Val | Lys | Gly | Phe | Tyr | Pro | Ser | Asp | Ile | Ala | Val | Glu | Trp | Glu | Ser |
| 385 |     |     |     |     | 390 |     |     |     |     | 395 |     |     |     |     | 400 |
|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Asn | Gly | Gln | Pro | Glu | Asn | Asn | Tyr | Lys | Thr | Thr | Pro | Pro | Met | Leu | Asp |
|     |     |     |     | 405 |     |     |     |     | 410 |     |     |     |     | 415 |     |
|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Ser | Asp | Gly | Ser | Phe | Phe | Leu | Tyr | Ser | Lys | Leu | Thr | Val | Asp | Lys | Ser |
|     |     |     | 420 |     |     |     |     | 425 |     |     |     |     | 430 |     |     |
|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Arg | Trp | Gln | Gln | Gly | Asn | Val | Phe | Ser | Cys | Ser | Val | Met | His | Glu | Ala |
|     |     | 435 |     |     |     |     | 440 |     |     |     |     | 445 |     |     |     |
|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Leu | His | Asn | His | Tyr | Thr | Gln | Lys | Ser | Leu | Ser | Leu | Ser | Pro | Gly | Lys |
| 450 |     |     |     |     |     | 455 |     |     |     |     | 460 |     |     |     |     |

<210> SEQ ID NO 53  
 <211> LENGTH: 705  
 <212> TYPE: DNA  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 53

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atgttgccat cacaactcat tgggtttctg ctgctctggg ttccagcttc caggggtgaa      60
attgtgctga ctcagtctcc agactttcag tctgtgactc caaaagagaa agtcaccatc     120
acctgccggg ccagtcagag aattggtagt agcttacct ggtaccagca gaaaccagat     180
cagtctccaa aactcctcat caagtatgct tcccagtctt tctcaggggt cccctcgagg     240
ttcagtggca gtggatctgg gacagatttc acctcacca tcaatagcct ggaagctgaa     300
gatgctgcaa cttattactg tcatcagagt ggtcgtttac cgctcacttt cggcggaggg     360
accaaggtgg agatcaaacg aactgtggct gcaccatctg tcttcatctt cccgccatct     420
gatgagcagt tgaaatctgg aactgcctct gttgtgtgcc tgctgaataa cttctatccc     480
agagaggcca aagtacagtg gaaggtggat aacgccctcc aatcgggtaa ctcccaggag     540
agtgtcacag agcaggacag caaggacagc acctacagcc tcagcagcac cctgacgctg     600
agcaaagcag actacgagaa acacaaagtc tacgcctgcg aagtcacca tcagggcctg     660
agctcgcccc tcacaaagag cttcaacagg ggagagtgtt agtga                          705

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<210> SEQ ID NO 54  
 <211> LENGTH: 233  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 54

|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Met | Leu | Pro | Ser | Gln | Leu | Ile | Gly | Phe | Leu | Leu | Leu | Trp | Val | Pro | Ala |
| 1   |     |     |     | 5   |     |     |     |     | 10  |     |     |     |     | 15  |     |
|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Ser | Arg | Gly | Glu | Ile | Val | Leu | Thr | Gln | Ser | Pro | Asp | Phe | Gln | Ser | Val |
|     |     |     | 20  |     |     |     |     | 25  |     |     |     |     | 30  |     |     |
|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Thr | Pro | Lys | Glu | Lys | Val | Thr | Ile | Thr | Cys | Arg | Ala | Ser | Gln | Arg | Ile |
|     |     | 35  |     |     |     |     | 40  |     |     |     |     | 45  |     |     |     |
|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Gly | Ser | Ser | Leu | His | Trp | Tyr | Gln | Gln | Lys | Pro | Asp | Gln | Ser | Pro | Lys |
|     | 50  |     |     |     |     | 55  |     |     |     |     | 60  |     |     |     |     |
|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Leu | Leu | Ile | Lys | Tyr | Ala | Ser | Gln | Ser | Phe | Ser | Gly | Val | Pro | Ser | Arg |
| 65  |     |     |     |     | 70  |     |     |     |     | 75  |     |     |     |     | 80  |
|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Phe | Ser | Gly | Ser | Gly | Ser | Gly | Thr | Asp | Phe | Thr | Leu | Thr | Ile | Asn | Ser |
|     |     |     |     | 85  |     |     |     |     | 90  |     |     |     |     | 95  |     |
|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Leu | Glu | Ala | Glu | Asp | Ala | Ala | Thr | Tyr | Tyr | Cys | His | Gln | Ser | Gly | Arg |
|     |     |     | 100 |     |     |     |     | 105 |     |     |     |     | 110 |     |     |

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|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Leu | Pro | Leu | Thr | Phe | Gly | Gly | Gly | Thr | Lys | Val | Glu | Ile | Lys | Arg | Thr |
|     |     | 115 |     |     |     |     | 120 |     |     |     |     | 125 |     |     |     |
| Val | Ala | Ala | Pro | Ser | Val | Phe | Ile | Phe | Pro | Pro | Ser | Asp | Glu | Gln | Leu |
|     | 130 |     |     |     |     | 135 |     |     |     |     | 140 |     |     |     |     |
| Lys | Ser | Gly | Thr | Ala | Ser | Val | Val | Cys | Leu | Leu | Asn | Asn | Phe | Tyr | Pro |
| 145 |     |     |     |     | 150 |     |     |     | 155 |     |     |     |     |     | 160 |
| Arg | Glu | Ala | Lys | Val | Gln | Trp | Lys | Val | Asp | Asn | Ala | Leu | Gln | Ser | Gly |
|     |     |     |     | 165 |     |     |     |     | 170 |     |     |     |     | 175 |     |
| Asn | Ser | Gln | Glu | Ser | Val | Thr | Glu | Gln | Asp | Ser | Lys | Asp | Ser | Thr | Tyr |
|     |     |     | 180 |     |     |     |     | 185 |     |     |     |     | 190 |     |     |
| Ser | Leu | Ser | Ser | Thr | Leu | Thr | Leu | Ser | Lys | Ala | Asp | Tyr | Glu | Lys | His |
|     | 195 |     |     |     |     |     | 200 |     |     |     |     | 205 |     |     |     |
| Lys | Val | Tyr | Ala | Cys | Glu | Val | Thr | His | Gln | Gly | Leu | Ser | Ser | Pro | Val |
|     | 210 |     |     |     |     | 215 |     |     |     |     | 220 |     |     |     |     |
| Thr | Lys | Ser | Phe | Asn | Arg | Gly | Glu | Cys |     |     |     |     |     |     |     |
| 225 |     |     |     |     | 230 |     |     |     |     |     |     |     |     |     |     |

&lt;210&gt; SEQ ID NO 55

&lt;211&gt; LENGTH: 1410

&lt;212&gt; TYPE: DNA

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 55

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atggagtttg ggctgagctg ggttttcctc gttgctcttt taagaggtgt ccagtgtcag      60
gtgcagctgg tggagtctgg gggaggcgtg gtccagcctg ggaggtcctt gagactctcc      120
tgtgcagcct ctggattcac cttcagtagc tatggcatgc actgggtccg ccaggctcca      180
ggcaaggggc tggagtgggt ggcagttata tcaaatgatg gaaataataa atactatgca      240
gactccgtga agggccgatt caccatctcc agagacaatt ccaaaaacac gctgtatctg      300
caaatgaaca gcctgcgcgc tgaggacacg gctgtgtatt actgtgagag agatagtacg      360
gcgataacct actactacta cggaatggac gtctggggcc aaggaccac ggtaaccgtc      420
tcctcagctt ccaccaaggg cccatccgtc ttccccctgg cgccctgctc tagaagcacc      480
tccgagagca cagcggccct gggctgcctg gtcaaggact acttccccga accggtgacg      540
gtgtcgtgga actcaggcgc tctgaccagc ggcgtgcaca ccttcccagc tgcctacag      600
tcctcaggac tctactccct cagcagcgtg gtgaccgtgc cctccagcaa cttcggcacc      660
cagacctaca cctgcaacgt agatcacaag cccagcaaca ccaaggtgga caagacagtt      720
gagcgcaaat gttgtgtcga gtgccaccg tgcccagcac cacctgtggc aggaccgtca      780
gtcttctctt tcccccaaaa acccaaggac accctcatga tctcccggac ccctgaggtc      840
acgtgcgtgg tgggtggacgt gagccacgaa gaccccaggg tccagttcaa ctggtacgtg      900
gacggcgtgg aggtgcataa tgccaagaca aagccacggg aggagcagtt caacagcacg      960
ttccgtgtgg tcagcgtcct caccgttgtg caccaggact ggctgaacgg caaggagtac     1020
aagtgcaggg tctccaacaa aggcctccca gccccatcg agaaaacat ctccaaaacc     1080
aaagggcagc cccgagaacc acaggtgtac accctgcccc catcccggga ggagatgacc     1140
aagaaccagg tcagcctgac ctgcctggtc aaaggcttct accccagcga catcgccgtg     1200
gagtgggaga gcaatgggca gccggagaac aactacaaga ccacacctcc catgctggac     1260
tccgacggct ctttcttct ctacagcaag ctaccgtgg acaagagcag gtggcagcag     1320
gggaacgtct tctcatgctc cgtgatgcat gaggtctctg acaaccacta cagcagaag     1380
agcctctccc tgtctccggg taaatgatag                                     1410

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<210> SEQ ID NO 56  
 <211> LENGTH: 468  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens  
  
 <400> SEQUENCE: 56  
  
 Met Glu Phe Gly Leu Ser Trp Val Phe Leu Val Ala Leu Leu Arg Gly  
   1                  5                  10                  15  
 Val Gln Cys Gln Val Gln Leu Val Glu Ser Gly Gly Gly Val Val Gln  
                   20                  25                  30  
 Pro Gly Arg Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe  
                   35                  40                  45  
 Ser Ser Tyr Gly Met His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu  
                   50                  55                  60  
 Glu Trp Val Ala Val Ile Ser Asn Asp Gly Asn Asn Lys Tyr Tyr Ala  
   65                  70                  75                  80  
 Asp Ser Val Lys Gly Arg Phe Thr Ile Ser Arg Asp Asn Ser Lys Asn  
                   85                  90                  95  
 Thr Leu Tyr Leu Gln Met Asn Ser Leu Arg Ala Glu Asp Thr Ala Val  
                   100                  105                  110  
 Tyr Tyr Cys Ala Arg Asp Ser Thr Ala Ile Thr Tyr Tyr Tyr Tyr Gly  
                   115                  120                  125  
 Met Asp Val Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser Ala Ser  
   130                  135                  140  
 Thr Lys Gly Pro Ser Val Phe Pro Leu Ala Pro Cys Ser Arg Ser Thr  
   145                  150                  155                  160  
 Ser Glu Ser Thr Ala Ala Leu Gly Cys Leu Val Lys Asp Tyr Phe Pro  
                   165                  170                  175  
 Glu Pro Val Thr Val Ser Trp Asn Ser Gly Ala Leu Thr Ser Gly Val  
                   180                  185                  190  
 His Thr Phe Pro Ala Val Leu Gln Ser Ser Gly Leu Tyr Ser Leu Ser  
   195                  200                  205  
 Ser Val Val Thr Val Pro Ser Ser Asn Phe Gly Thr Gln Thr Tyr Thr  
   210                  215                  220  
 Cys Asn Val Asp His Lys Pro Ser Asn Thr Lys Val Asp Lys Thr Val  
   225                  230                  235                  240  
 Glu Arg Lys Cys Cys Val Glu Cys Pro Pro Cys Pro Ala Pro Pro Val  
                   245                  250                  255  
 Ala Gly Pro Ser Val Phe Leu Phe Pro Pro Lys Pro Lys Asp Thr Leu  
                   260                  265                  270  
 Met Ile Ser Arg Thr Pro Glu Val Thr Cys Val Val Val Asp Val Ser  
                   275                  280                  285  
 His Glu Asp Pro Glu Val Gln Phe Asn Trp Tyr Val Asp Gly Val Glu  
   290                  295                  300  
 Val His Asn Ala Lys Thr Lys Pro Arg Glu Glu Gln Phe Asn Ser Thr  
   305                  310                  315                  320  
 Phe Arg Val Val Ser Val Leu Thr Val Val His Gln Asp Trp Leu Asn  
                   325                  330                  335  
 Gly Lys Glu Tyr Lys Cys Lys Val Ser Asn Lys Gly Leu Pro Ala Pro  
                   340                  345                  350  
 Ile Glu Lys Thr Ile Ser Lys Thr Lys Gly Gln Pro Arg Glu Pro Gln  
                   355                  360                  365  
 Val Tyr Thr Leu Pro Pro Ser Arg Glu Glu Met Thr Lys Asn Gln Val

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|   |     |     |  |     |
|---|-----|-----|--|-----|
| 370   | 375 | 380 |  |     |
| Ser Leu Thr Cys Leu Val Lys Gly Phe Tyr Pro Ser Asp Ile Ala Val |     |     |  |     |
| 385   | 390 | 395 |  | 400 |
| Glu Trp Glu Ser Asn Gly Gln Pro Glu Asn Asn Tyr Lys Thr Thr Pro |     |     |  |     |
|   | 405 | 410 |  | 415 |
| Pro Met Leu Asp Ser Asp Gly Ser Phe Phe Leu Tyr Ser Lys Leu Thr |     |     |  |     |
|   | 420 | 425 |  | 430 |
| Val Asp Lys Ser Arg Trp Gln Gln Gly Asn Val Phe Ser Cys Ser Val |     |     |  |     |
|   | 435 | 440 |  | 445 |
| Met His Glu Ala Leu His Asn His Tyr Thr Gln Lys Ser Leu Ser Leu |     |     |  |     |
|   | 450 | 455 |  | 460 |
| Ser Pro Gly Lys   |     |     |  |     |
| 465   |     |     |  |     |

<210> SEQ ID NO 57  
 <211> LENGTH: 714  
 <212> TYPE: DNA  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 57

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atggacatga gggccccgc tcagctcctg gggctcctgc tactctggct ccgaggtgcc      60
agatgtgaca tccagatgac ccagtctcca tcctccctgt ctgcatctgt cggagacaga      120
gtcaccatca cttgccgggc aagtcagagt attagtagct atttaaattg gtatcagcag      180
aaaccaggga aagcccctaa gctcctgatc tatgctgcat ccggtttgaa gcgtggggtc      240
ccatcacggt tcagtggtag tggatctggg acagatttca ctctcaccat cagttctctg      300
caacctgagg attttgcaac ttactactgt caccagagtt acagtctccc attcactttc      360
ggccttgga ccaaagtga tatcaaacga actgtggctg caccatctgt cttcatcttc      420
ccgccatctg atgagcagtt gaaatctgga actgcctctg ttgtgtgcct gctgaataac      480
ttctatccca gagaggccaa agtacagtgg aaggtggata acgccctcca atcgggtaac      540
tcccaggaga gtgtcacaga gcaggacagc aaggacagca cctacagcct cagcagcacc      600
ctgacgctga gcaaagcaga ctacgagaaa cacaaagtct acgcctgcga agtcacccat      660
cagggcctga gctcgcccgt cacaaagagc ttcaacaggg gagagtgtta gtga          714

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<210> SEQ ID NO 58  
 <211> LENGTH: 236  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 58

|   |    |    |    |    |
|---|----|----|----|----|
| Met Asp Met Arg Val Pro Ala Gln Leu Leu Gly Leu Leu Leu Leu Trp |    |    |    |    |
| 1   | 5  | 10 | 15 |    |
| Leu Arg Gly Ala Arg Cys Asp Ile Gln Met Thr Gln Ser Pro Ser Ser |    |    |    |    |
|   | 20 | 25 | 30 |    |
| Leu Ser Ala Ser Val Gly Asp Arg Val Thr Ile Thr Cys Arg Ala Ser |    |    |    |    |
|   | 35 | 40 | 45 |    |
| Gln Ser Ile Ser Ser Tyr Leu Asn Trp Tyr Gln Gln Lys Pro Gly Lys |    |    |    |    |
|   | 50 | 55 | 60 |    |
| Ala Pro Lys Leu Leu Ile Tyr Ala Ala Ser Gly Leu Lys Arg Gly Val |    |    |    |    |
|   | 65 | 70 | 75 | 80 |
| Pro Ser Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr |    |    |    |    |
|   | 85 | 90 | 95 |    |
| Ile Ser Ser Leu Gln Pro Glu Asp Phe Ala Thr Tyr Tyr Cys His Gln |    |    |    |    |



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| 100 |     |     | 105 |     |     | 110 |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Ser | Tyr | Ser | Leu | Pro | Phe | Thr | Phe | Gly | Pro | Gly | Thr | Lys | Val | Asp | Ile |
|     |     | 115 |     |     |     |     |     | 120 |     |     |     |     |     | 125 |     |
| Lys | Arg | Thr | Val | Ala | Ala | Pro | Ser | Val | Phe | Ile | Phe | Pro | Pro | Ser | Asp |
|     |     | 130 |     |     |     |     |     | 135 |     |     |     |     |     | 140 |     |
| Glu | Gln | Leu | Lys | Ser | Gly | Thr | Ala | Ser | Val | Val | Cys | Leu | Leu | Asn | Asn |
|     |     | 145 |     |     | 150 |     |     |     |     |     | 155 |     |     | 160 |     |
| Phe | Tyr | Pro | Arg | Glu | Ala | Lys | Val | Gln | Trp | Lys | Val | Asp | Asn | Ala | Leu |
|     |     |     |     |     | 165 |     |     |     |     |     | 170 |     |     | 175 |     |
| Gln | Ser | Gly | Asn | Ser | Gln | Glu | Ser | Val | Thr | Glu | Gln | Asp | Ser | Lys | Asp |
|     |     |     |     |     | 180 |     |     |     |     |     |     |     |     | 190 |     |
| Ser | Thr | Tyr | Ser | Leu | Ser | Ser | Thr | Leu | Thr | Leu | Ser | Lys | Ala | Asp | Tyr |
|     |     | 195 |     |     |     |     |     | 200 |     |     |     |     |     | 205 |     |
| Glu | Lys | His | Lys | Val | Tyr | Ala | Cys | Glu | Val | Thr | His | Gln | Gly | Leu | Ser |
|     |     | 210 |     |     |     |     |     | 215 |     |     |     |     |     | 220 |     |
| Ser | Pro | Val | Thr | Lys | Ser | Phe | Asn | Arg | Gly | Glu | Cys |     |     |     |     |
|     |     | 225 |     |     |     |     |     | 230 |     |     | 235 |     |     |     |     |

&lt;210&gt; SEQ ID NO 59

&lt;211&gt; LENGTH: 1413

&lt;212&gt; TYPE: DNA

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 59

```

atgaaacacc tgtggttctt cctcctgctg gtggcagctc ccagatgggt cctgtcccag    60
gtgcagctgc aggagtcggg cccaggactg gtgaagcctt cggagaccct gtccctcacc    120
tgcaactgtc ctggtgactc catcagtagt aactattgga gctggatccg gcagcccgcc    180
gggaaggac  tggagtggat tgggcgtatc tataccagtg ggggcaccaa ctccaacccc    240
tcctcaggg  gtcgagtcac catgtcagta gacacgtcca agaaccagtt ctctctgaaa    300
ctgagttctg tgaccgccgc ggacacggcc gtgtattact gtgcgagaga tcgtattact    360
ataattcggg gacttattcc atccttcttt gactactggg gccagggaac cctggtcacc    420
gtctcctcag cttccaccaa gggcccaccc gtcttcccc tggcgcctct ctctagaagc    480
acctccgaga gcacagcggc cctgggctgc ctggtcaagg actacttccc cgaaccggtg    540
acgggtgctg ggaactcagg cgctctgacc agcggcgtgc acaccttccc agctgtccta    600
cagtcctcag gactctactc cctcagcagc gtggtgaccg tgccctccag caacttcggc    660
accagacct  acacctgcaa cgtagatcac aagcccagca acaccaaggt ggacaagaca    720
gttgagcgca aatggtgtgt cgagtgccca ccgtgcccag caccacctgt ggcaggaccg    780
tcagtcttcc tcttcccccc aaaaccaag  gacacctca tgatctccc gaccttgag    840
gtcacgtgcg tgggtgtgga cgtgagccac gaagacccc aggtccagtt caactggtac    900
gtggacggcg tggaggtgca taatgccaa acaaagccac gggaggagca gttcaacagc    960
acgttccgtg tggtcagcgt cctcaccggt gtgcaccagg actggctgaa cggcaaggag   1020
tacaagtgca aggtctcaa caaaggcctc ccagcccca tcgagaaaac catctccaaa   1080
accaaagggc agccccgaga accacaggtg tacaccctgc ccccatccc ggaggagatg   1140
accaagaacc aggtcagcct gacctgcctg gtcaaaggct tctaccccag cgacatcgcc   1200
gtggagtggg agagcaatgg gcagccggag aacaactaca agaccacacc tcccatgctg   1260
gactccgacg gctccttctt cctctacagc aagctcaccg tggacaagag caggtggcag   1320
caggggaacg tcttctcatg ctccgtgatg catgaggctc tgcacaacca ctacacgcag   1380

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aagagcctct ccctgtctcc gggtaaata tag

1413

&lt;210&gt; SEQ ID NO 60

&lt;211&gt; LENGTH: 469

&lt;212&gt; TYPE: PRT

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 60

Met Lys His Leu Trp Phe Phe Leu Leu Leu Val Ala Ala Pro Arg Trp  
 1 5 10 15

Val Leu Ser Gln Val Gln Leu Gln Glu Ser Gly Pro Gly Leu Val Lys  
 20 25 30

Pro Ser Glu Thr Leu Ser Leu Thr Cys Thr Val Ser Gly Asp Ser Ile  
 35 40 45

Ser Ser Asn Tyr Trp Ser Trp Ile Arg Gln Pro Ala Gly Lys Gly Leu  
 50 55 60

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

Ser Leu Arg Gly Arg Val Thr Met Ser Val Asp Thr Ser Lys Asn Gln  
 85 90 95

Phe Ser Leu Lys Leu Ser Ser Val Thr Ala Ala Asp Thr Ala Val Tyr  
 100 105 110

Tyr Cys Ala Arg Asp Arg Ile Thr Ile Ile Arg Gly Leu Ile Pro Ser  
 115 120 125

Phe Phe Asp Tyr Trp Gly Gln Gly Thr Leu Val Thr Val Ser Ser Ala  
 130 135 140

Ser Thr Lys Gly Pro Ser Val Phe Pro Leu Ala Pro Cys Ser Arg Ser  
 145 150 155 160

Thr Ser Glu Ser Thr Ala Ala Leu Gly Cys Leu Val Lys Asp Tyr Phe  
 165 170 175

Pro Glu Pro Val Thr Val Ser Trp Asn Ser Gly Ala Leu Thr Ser Gly  
 180 185 190

Val His Thr Phe Pro Ala Val Leu Gln Ser Ser Gly Leu Tyr Ser Leu  
 195 200 205

Ser Ser Val Val Thr Val Pro Ser Ser Asn Phe Gly Thr Gln Thr Tyr  
 210 215 220

Thr Cys Asn Val Asp His Lys Pro Ser Asn Thr Lys Val Asp Lys Thr  
 225 230 235 240

Val Glu Arg Lys Cys Cys Val Glu Cys Pro Pro Cys Pro Ala Pro Pro  
 245 250 255

Val Ala Gly Pro Ser Val Phe Leu Phe Pro Pro Lys Pro Lys Asp Thr  
 260 265 270

Leu Met Ile Ser Arg Thr Pro Glu Val Thr Cys Val Val Val Asp Val  
 275 280 285

Ser His Glu Asp Pro Glu Val Gln Phe Asn Trp Tyr Val Asp Gly Val  
 290 295 300

Glu Val His Asn Ala Lys Thr Lys Pro Arg Glu Glu Gln Phe Asn Ser  
 305 310 315 320

Thr Phe Arg Val Val Ser Val Leu Thr Val Val His Gln Asp Trp Leu  
 325 330 335

Asn Gly Lys Glu Tyr Lys Cys Lys Val Ser Asn Lys Gly Leu Pro Ala  
 340 345 350

Pro Ile Glu Lys Thr Ile Ser Lys Thr Lys Gly Gln Pro Arg Glu Pro  
 355 360 365



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Gln Val Tyr Thr Leu Pro Pro Ser Arg Glu Glu Met Thr Lys Asn Gln  
 370 375 380

Val Ser Leu Thr Cys Leu Val Lys Gly Phe Tyr Pro Ser Asp Ile Ala  
 385 390 395 400

Val Glu Trp Glu Ser Asn Gly Gln Pro Glu Asn Asn Tyr Lys Thr Thr  
 405 410 415

Pro Pro Met Leu Asp Ser Asp Gly Ser Phe Phe Leu Tyr Ser Lys Leu  
 420 425 430

Thr Val Asp Lys Ser Arg Trp Gln Gln Gly Asn Val Phe Ser Cys Ser  
 435 440 445

Val Met His Glu Ala Leu His Asn His Tyr Thr Gln Lys Ser Leu Ser  
 450 455 460

Leu Ser Pro Gly Lys  
 465

<210> SEQ ID NO 61  
 <211> LENGTH: 729  
 <212> TYPE: DNA  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 61

atgggtgttg agaccaggt cttcatttct ctgttgcctt ggatctctgg tgccctacggg 60  
 gacatcgtga tgaccagtc tccagactcc ctggctgtgt ctctgggcca gagggccacc 120  
 atcaactgca agtccagcca gagtgtttta tacagctcca acaataagaa ctacttagct 180  
 tggtagcaac agaaaccagg acagcctcct aaattgctca tttactgggc atctatacgg 240  
 gaatatgggg tccctgaccg attcagtggc agcgggtctg ggacagattt cactctcacc 300  
 atcagcagcc tgcaggctga agatgtggca gtttatttct gtcaacaata ttatagtatt 360  
 cctcccctca ctttcggcgg agggaccaag gtggagatca aacgaactgt ggctgcacca 420  
 tctgtettca tcttcccgcc atctgatgag cagttgaaat ctggaactgc ctctgttgtg 480  
 tgccctgctga ataacttcta tccagagag gccaaagtac agtggaaggt ggataacgcc 540  
 ctccaatcgg gtaactcca ggagagtgtc acagagcagg acagcaagga cagcacctac 600  
 agcctcagca gcaccctgac gctgagcaaa gcagactacg agaaacaaa agtctacgcc 660  
 tgccaagtca cccatcaggg cctgagctcg cccgtcacia agagcttcaa caggggagag 720  
 tgtagtagga 729

<210> SEQ ID NO 62  
 <211> LENGTH: 241  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 62

Met Val Leu Gln Thr Gln Val Phe Ile Ser Leu Leu Leu Trp Ile Ser  
 1 5 10 15

Gly Ala Tyr Gly Asp Ile Val Met Thr Gln Ser Pro Asp Ser Leu Ala  
 20 25 30

Val Ser Leu Gly Glu Arg Ala Thr Ile Asn Cys Lys Ser Ser Gln Ser  
 35 40 45

Val Leu Tyr Ser Ser Asn Asn Lys Asn Tyr Leu Ala Trp Tyr Gln Gln  
 50 55 60

Lys Pro Gly Gln Pro Pro Lys Leu Leu Ile Tyr Trp Ala Ser Ile Arg  
 65 70 75 80

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|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Glu | Tyr | Gly | Val | Pro | Asp | Arg | Phe | Ser | Gly | Ser | Gly | Ser | Gly | Thr | Asp |
|     |     |     |     | 85  |     |     |     |     | 90  |     |     |     |     | 95  |     |
| Phe | Thr | Leu | Thr | Ile | Ser | Ser | Leu | Gln | Ala | Glu | Asp | Val | Ala | Val | Tyr |
|     |     |     | 100 |     |     |     |     | 105 |     |     |     |     | 110 |     |     |
| Phe | Cys | Gln | Gln | Tyr | Tyr | Ser | Ile | Pro | Pro | Leu | Thr | Phe | Gly | Gly | Gly |
|     |     | 115 |     |     |     |     | 120 |     |     |     |     | 125 |     |     |     |
| Thr | Lys | Val | Glu | Ile | Lys | Arg | Thr | Val | Ala | Ala | Pro | Ser | Val | Phe | Ile |
|     | 130 |     |     |     |     | 135 |     |     |     |     | 140 |     |     |     |     |
| Phe | Pro | Pro | Ser | Asp | Glu | Gln | Leu | Lys | Ser | Gly | Thr | Ala | Ser | Val | Val |
| 145 |     |     |     | 150 |     |     |     |     | 155 |     |     |     |     |     | 160 |
| Cys | Leu | Leu | Asn | Asn | Phe | Tyr | Pro | Arg | Glu | Ala | Lys | Val | Gln | Trp | Lys |
|     |     |     | 165 |     |     |     |     |     | 170 |     |     |     |     | 175 |     |
| Val | Asp | Asn | Ala | Leu | Gln | Ser | Gly | Asn | Ser | Gln | Glu | Ser | Val | Thr | Glu |
|     |     |     | 180 |     |     |     |     | 185 |     |     |     |     | 190 |     |     |
| Gln | Asp | Ser | Lys | Asp | Ser | Thr | Tyr | Ser | Leu | Ser | Ser | Thr | Leu | Thr | Leu |
|     |     | 195 |     |     |     |     | 200 |     |     |     |     | 205 |     |     |     |
| Ser | Lys | Ala | Asp | Tyr | Glu | Lys | His | Lys | Val | Tyr | Ala | Cys | Glu | Val | Thr |
|     | 210 |     |     |     |     | 215 |     |     |     |     | 220 |     |     |     |     |
| His | Gln | Gly | Leu | Ser | Ser | Pro | Val | Thr | Lys | Ser | Phe | Asn | Arg | Gly | Glu |
| 225 |     |     |     |     | 230 |     |     |     |     | 235 |     |     |     |     | 240 |

Cys

&lt;210&gt; SEQ ID NO 63

&lt;211&gt; LENGTH: 1419

&lt;212&gt; TYPE: DNA

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 63

|  |      |
|--|------|
| atggaactgg ggctccgctg ggttttcctt gttgctatth tagaagggtg ccagtgtgag  | 60   |
| gtgcagctgg tggagtctgg gggaggcctg gtcaagcctg gggggtcctt gagactctcc  | 120  |
| tgtgcagcct ctggattcac cttcagtagc tatagcatga actgggtccg ccaggctcca  | 180  |
| gggaaggggc tggagtgggt ctcattccatt agtagtagta gtagttacat atactacgca | 240  |
| gactcagtga agggccgatt caccatctcc agagacaacg ccaagaactc actgtatctg  | 300  |
| caaatgaaca gcctgagagc cgaggacacg gctgtgtatt actgtgagag agatgggtat  | 360  |
| agcagtggct ggtcctacta ctactactac ggtatggagc tctggggcca agggaccacg  | 420  |
| gtcaccgtct cctcagcttc caccaagggc ccatccgtct tccccctggc gccctgctct  | 480  |
| agaagcacct ccgagagcac agcggccctg ggtgcctgg tcaaggacta cttccccgaa   | 540  |
| ccggtgacgg tgctcgtgaa ctcaggcgct ctgaccagcg gcgtgcacac cttcccagct  | 600  |
| gtcctacagt cctcaggact ctactccctc agcagcgtgg tgaccgtgcc ctccagcaac  | 660  |
| ttcggcacc agacctacac ctgcaacgta gatcacaagc ccagcaacac caaggtggac   | 720  |
| aagacagttg agcgcaaatg ttgtgctgag tgcccaccgt gccagcacc acctgtggca   | 780  |
| ggaccgtcag tcttctctt cccccaaaa cccaaggaca ccctcatgat ctcccggacc    | 840  |
| cctgaggtca cgtgcgtggg ggtggacgtg agccacgaag accccgaggt ccagttcaac  | 900  |
| tggtacgtgg acggcgtgga ggtgcataat gccaaagaaa agccacggga ggagcagttc  | 960  |
| aacagcacgt tccgtgtggt cagcgtcctc accgttgtgc accaggactg gctgaacggc  | 1020 |
| aaggagtaca agtgcaaggt ctccaacaaa ggctcccag cccccatcga gaaaaccatc   | 1080 |
| tccaaaacca aagggcagcc ccgagaacca caggtgtaca ccctgcccc atcccgggag   | 1140 |
| gagatgacca agaaccaggt cagcctgacc tgcttggtca aaggcttcta cccagcgcac  | 1200 |



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atcgccgtgg agtgggagag caatgggcag ccggagaaca actacaagac cacacctccc 1260
atgctggact ccgaeggctc cttcttcttc tacagcaagc tcaccgtgga caagagcagg 1320
tggcagcagg ggaacgtctt ctcattgctcc gtgatgcatg aggctctgca caaccactac 1380
acgcagaaga gcctctccct gtctccgggt aatgatag 1419

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<210> SEQ ID NO 64
<211> LENGTH: 471
<212> TYPE: PRT
<213> ORGANISM: Homo sapiens

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<400> SEQUENCE: 64

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Met Glu Leu Gly Leu Arg Trp Val Phe Leu Val Ala Ile Leu Glu Gly
  1           5           10          15
Val Gln Cys Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Lys
          20          25          30
Pro Gly Gly Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe
          35          40          45
Ser Ser Tyr Ser Met Asn Trp Val Arg Gln Ala Pro Gly Lys Gly Leu
          50          55          60
Glu Trp Val Ser Ser Ile Ser Ser Ser Ser Ser Tyr Ile Tyr Tyr Ala
          65          70          75          80
Asp Ser Val Lys Gly Arg Phe Thr Ile Ser Arg Asp Asn Ala Lys Asn
          85          90          95
Ser Leu Tyr Leu Gln Met Asn Ser Leu Arg Ala Glu Asp Thr Ala Val
          100         105         110
Tyr Tyr Cys Ala Arg Asp Gly Tyr Ser Ser Gly Trp Ser Tyr Tyr Tyr
          115         120         125
Tyr Tyr Gly Met Asp Val Trp Gly Gln Gly Thr Thr Val Thr Val Ser
          130         135         140
Ser Ala Ser Thr Lys Gly Pro Ser Val Phe Pro Leu Ala Pro Cys Ser
          145         150         155         160
Arg Ser Thr Ser Glu Ser Thr Ala Ala Leu Gly Cys Leu Val Lys Asp
          165         170         175
Tyr Phe Pro Glu Pro Val Thr Val Ser Trp Asn Ser Gly Ala Leu Thr
          180         185         190
Ser Gly Val His Thr Phe Pro Ala Val Leu Gln Ser Ser Gly Leu Tyr
          195         200         205
Ser Leu Ser Ser Val Val Thr Val Pro Ser Ser Asn Phe Gly Thr Gln
          210         215         220
Thr Tyr Thr Cys Asn Val Asp His Lys Pro Ser Asn Thr Lys Val Asp
          225         230         235         240
Lys Thr Val Glu Arg Lys Cys Cys Val Glu Cys Pro Pro Cys Pro Ala
          245         250         255
Pro Pro Val Ala Gly Pro Ser Val Phe Leu Phe Pro Pro Lys Pro Lys
          260         265         270
Asp Thr Leu Met Ile Ser Arg Thr Pro Glu Val Thr Cys Val Val Val
          275         280         285
Asp Val Ser His Glu Asp Pro Glu Val Gln Phe Asn Trp Tyr Val Asp
          290         295         300
Gly Val Glu Val His Asn Ala Lys Thr Lys Pro Arg Glu Glu Gln Phe
          305         310         315         320
Asn Ser Thr Phe Arg Val Val Ser Val Leu Thr Val Val His Gln Asp
          325         330         335

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Trp Leu Asn Gly Lys Glu Tyr Lys Cys Lys Val Ser Asn Lys Gly Leu  
 340 345 350  
 Pro Ala Pro Ile Glu Lys Thr Ile Ser Lys Thr Lys Gly Gln Pro Arg  
 355 360 365  
 Glu Pro Gln Val Tyr Thr Leu Pro Pro Ser Arg Glu Glu Met Thr Lys  
 370 375 380  
 Asn Gln Val Ser Leu Thr Cys Leu Val Lys Gly Phe Tyr Pro Ser Asp  
 385 390 395 400  
 Ile Ala Val Glu Trp Glu Ser Asn Gly Gln Pro Glu Asn Asn Tyr Lys  
 405 410 415  
 Thr Thr Pro Pro Met Leu Asp Ser Asp Gly Ser Phe Phe Leu Tyr Ser  
 420 425 430  
 Lys Leu Thr Val Asp Lys Ser Arg Trp Gln Gln Gly Asn Val Phe Ser  
 435 440 445  
 Cys Ser Val Met His Glu Ala Leu His Asn His Tyr Thr Gln Lys Ser  
 450 455 460  
 Leu Ser Leu Ser Pro Gly Lys  
 465 470

<210> SEQ ID NO 65  
 <211> LENGTH: 723  
 <212> TYPE: DNA  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 65

atgaggctcc ctgctcagct cctggggctg ctaatgctct ggatacctgg atccagtgca 60  
 gatattgtga tgaccagac tccactctct ctgtccgca ctctggaca gccggcctcc 120  
 atctctgca agtctagca gagcctctct cttagtgatg gaaagaccta tttgaattgg 180  
 tacctgcaga agcccggcca gcctccacag ctctgatct atgaagtttc caaccggttc 240  
 tctggagtgc cagacaggtt cagtggcagc gggtcagggc cagatttcac actgaaaatc 300  
 agccgggtgg aggctgagga tgttgggggt tattactgca tgcaaagtat acagcttatg 360  
 tgcagttttg gccaggggac caagctggag atcaaacgaa ctgtggctgc accatctgtc 420  
 ttcattctcc cgccatctga tgagcagttg aaatctggaa ctgcctctgt tgtgtgcctg 480  
 ctgaataact tctatcccag agaggccaaa gtacagtgga aggtggataa cgccctccaa 540  
 tcgggtaact cccaggagag tgtcacagag caggacagca aggacagcac ctacagcctc 600  
 agcagcacc tgacgtgag caaagcagac tacgagaaac acaaagteta cgctgcgaa 660  
 gtcacccatc agggcctgag ctcgcccgtc acaaagagct tcaacagggg agagtgttag 720  
 tga 723

<210> SEQ ID NO 66  
 <211> LENGTH: 239  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 66

Met Arg Leu Pro Ala Gln Leu Leu Gly Leu Leu Met Leu Trp Ile Pro  
 1 5 10 15  
 Gly Ser Ser Ala Asp Ile Val Met Thr Gln Thr Pro Leu Ser Leu Ser  
 20 25 30  
 Val Thr Pro Gly Gln Pro Ala Ser Ile Ser Cys Lys Ser Ser Gln Ser  
 35 40 45



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

Pro Gly Gln Pro Pro Gln Leu Leu Ile Tyr Glu Val Ser Asn Arg Phe  
 65 70 75 80

Ser Gly Val Pro Asp Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe  
 85 90 95

Thr Leu Lys Ile Ser Arg Val Glu Ala Glu Asp Val Gly Val Tyr Ser  
 100 105 110

Cys Met Gln Ser Ile Gln Leu Met Ser Ser Phe Gly Gln Gly Thr Lys  
 115 120 125

Leu Glu Ile Lys Arg Thr Val Ala Ala Pro Ser Val Phe Ile Phe Pro  
 130 135 140

Pro Ser Asp Glu Gln Leu Lys Ser Gly Thr Ala Ser Val Val Cys Leu  
 145 150 155 160

Leu Asn Asn Phe Tyr Pro Arg Glu Ala Lys Val Gln Trp Lys Val Asp  
 165 170 175

Asn Ala Leu Gln Ser Gly Asn Ser Gln Glu Ser Val Thr Glu Gln Asp  
 180 185 190

Ser Lys Asp Ser Thr Tyr Ser Leu Ser Ser Thr Leu Thr Leu Ser Lys  
 195 200 205

Ala Asp Tyr Glu Lys His Lys Val Tyr Ala Cys Glu Val Thr His Gln  
 210 215 220

Gly Leu Ser Ser Pro Val Thr Lys Ser Phe Asn Arg Gly Glu Cys  
 225 230 235

&lt;210&gt; SEQ ID NO 67

&lt;211&gt; LENGTH: 723

&lt;212&gt; TYPE: DNA

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 67

atgaggetcc ctgctcagct cctggggctg ctaatgctct ggatacctgg atccagtgcg 60

gatattgtga tgaccagac tccactctct ctgtccgtca cccctggaca gccggcctcc 120

atctcctgca agtctagtca gagcctcctg tatagtgatg gaaagaccta tttgttttgg 180

tacctgcaga agccaggcca gcctccacag ctctgatct atgaagtttc caaccgattc 240

tctggagtgc cagataggtt cagtggcagc gggtcaggga cagatttcac actgaaaatc 300

agccgggtgg aggctgagga tgttgggggt tattactgca tgcaaagtat acagcttccg 360

tggacgttcg gccaagggac caaggtgaa atcaaacgaa ctgtggctgc accatctgtc 420

ttcatcttcc cgccatctga tgagcagttg aaatctggaa ctgcctctgt tgtgtgcctg 480

ctgaataact tctatcccag agaggccaaa gtacagtgga aggtggataa cgccctccaa 540

tcgggtaact cccaggagag tgtcacagag caggacagca aggacagcac ctacagcctc 600

agcagcacc tgacgctgag caaagcagac tacgagaaac acaaagtcta cgctgcgaa 660

gtcaccatc agggcctgag ctgccccgtc acaaagagct tcaacagggg agagtgttag 720

tga 723

&lt;210&gt; SEQ ID NO 68

&lt;211&gt; LENGTH: 239

&lt;212&gt; TYPE: PRT

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 68

Met Arg Leu Pro Ala Gln Leu Leu Gly Leu Leu Met Leu Trp Ile Pro

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| 1   | 5   | 10  | 15  |
|---|-----|-----|-----|
| Gly Ser Ser Ala Asp Ile Val Met Thr Gln Thr Pro Leu Ser Leu Ser | 20  | 25  | 30  |
| Val Thr Pro Gly Gln Pro Ala Ser Ile Ser Cys Lys Ser Ser Gln Ser | 35  | 40  | 45  |
| Leu Leu Tyr Ser Asp Gly Lys Thr Tyr Leu Phe Trp Tyr Leu Gln Lys | 50  | 55  | 60  |
| Pro Gly Gln Pro Pro Gln Leu Leu Ile Tyr Glu Val Ser Asn Arg Phe | 65  | 70  | 75  |
| Ser Gly Val Pro Asp Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe | 85  | 90  | 95  |
| Thr Leu Lys Ile Ser Arg Val Glu Ala Glu Asp Val Gly Val Tyr Tyr | 100 | 105 | 110 |
| Cys Met Gln Ser Ile Gln Leu Pro Trp Thr Phe Gly Gln Gly Thr Lys | 115 | 120 | 125 |
| Val Glu Ile Lys Arg Thr Val Ala Ala Pro Ser Val Phe Ile Phe Pro | 130 | 135 | 140 |
| Pro Ser Asp Glu Gln Leu Lys Ser Gly Thr Ala Ser Val Val Cys Leu | 145 | 150 | 155 |
| Leu Asn Asn Phe Tyr Pro Arg Glu Ala Lys Val Gln Trp Lys Val Asp | 165 | 170 | 175 |
| Asn Ala Leu Gln Ser Gly Asn Ser Gln Glu Ser Val Thr Glu Gln Asp | 180 | 185 | 190 |
| Ser Lys Asp Ser Thr Tyr Ser Leu Ser Ser Thr Leu Thr Leu Ser Lys | 195 | 200 | 205 |
| Ala Asp Tyr Glu Lys His Lys Val Tyr Ala Cys Glu Val Thr His Gln | 210 | 215 | 220 |
| Gly Leu Ser Ser Pro Val Thr Lys Ser Phe Asn Arg Gly Glu Cys     | 225 | 230 | 235 |

<210> SEQ ID NO 69  
 <211> LENGTH: 14  
 <212> TYPE: PRT  
 <213> ORGANISM: Artificial Sequence  
 <220> FEATURE:  
 <223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic peptide

<400> SEQUENCE: 69

|   |   |   |    |
|---|---|---|----|
| Ser Ser Gln Ser Leu Leu Gln Ser Asn Gly Tyr Asn Tyr Leu | 1 | 5 | 10 |
|---|---|---|----|

<210> SEQ ID NO 70  
 <211> LENGTH: 53  
 <212> TYPE: DNA  
 <213> ORGANISM: Artificial Sequence  
 <220> FEATURE:  
 <223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer

<400> SEQUENCE: 70

tatctaagct tctagactcg agcgccacca tggactggac ctggagcatc ctt 53

<210> SEQ ID NO 71  
 <211> LENGTH: 53  
 <212> TYPE: DNA  
 <213> ORGANISM: Artificial Sequence  
 <220> FEATURE:  
 <223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer



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<400> SEQUENCE: 71

tatctaagct tctagactcg agcgccacca tggagtttgg gctgagctgg att 53

<210> SEQ ID NO 72

<211> LENGTH: 53

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer

<400> SEQUENCE: 72

tatctaagct tctagactcg agcgccacca tggaaactggg gctccgctgg gtt 53

<210> SEQ ID NO 73

<211> LENGTH: 53

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer

<400> SEQUENCE: 73

tatctaagct tctagactcg agcgccacca tggagtttgg gctgagctgg ctt 53

<210> SEQ ID NO 74

<211> LENGTH: 53

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer

<400> SEQUENCE: 74

tatctaagct tctagactcg agcgccacca tggagtttgg gctgagctgg gtt 53

<210> SEQ ID NO 75

<211> LENGTH: 53

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer

<400> SEQUENCE: 75

tatctaagct tctagactcg agcgccacca tggagtttgg gctgagctgg gtt 53

<210> SEQ ID NO 76

<211> LENGTH: 53

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer

<400> SEQUENCE: 76

tatctaagct tctagactcg agcgccacca tgaaacacct gtggttcttc ctc 53

<210> SEQ ID NO 77

<211> LENGTH: 53

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer

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<400> SEQUENCE: 77

tatctaagct tctagaccg ggcgccacca tgaggctccc tgctcagctc ctg 53

<210> SEQ ID NO 78

<211> LENGTH: 53

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer

<400> SEQUENCE: 78

tatctaagct tctagaccg ggcgccacca tgttgccatc acaactcatt ggg 53

<210> SEQ ID NO 79

<211> LENGTH: 53

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer

<400> SEQUENCE: 79

tatctaagct tctagaccg ggcgccacca tggtgttgca gaccaggtc ttc 53

<210> SEQ ID NO 80

<211> LENGTH: 53

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer

<400> SEQUENCE: 80

tatctaagct tctagaccg ggcgccacca tggacatgag ggtccccgct cag 53

<210> SEQ ID NO 81

<211> LENGTH: 53

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer

<400> SEQUENCE: 81

tatctaagct tctagaccg ggcgccacca tggacatgag ggtccctgct cag 53

<210> SEQ ID NO 82

<211> LENGTH: 44

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer

<400> SEQUENCE: 82

ttctctgatc agaattccta tcatttaccg ggagacaggg agag 44

<210> SEQ ID NO 83

<211> LENGTH: 43

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer

<400> SEQUENCE: 83



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ttctttgatc agaattctca ctaacactct ccctgttga agc 43

<210> SEQ ID NO 84  
<211> LENGTH: 44  
<212> TYPE: DNA  
<213> ORGANISM: Artificial Sequence  
<220> FEATURE:  
<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer

<400> SEQUENCE: 84

ttctctgatc agaattccta tcatttacc agagacaggg agag 44

<210> SEQ ID NO 85  
<211> LENGTH: 44  
<212> TYPE: DNA  
<213> ORGANISM: Artificial Sequence  
<220> FEATURE:  
<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer

<400> SEQUENCE: 85

ggatctggga cagatttcac cctcaccatc aatagcctgg aagc 44

<210> SEQ ID NO 86  
<211> LENGTH: 44  
<212> TYPE: DNA  
<213> ORGANISM: Artificial Sequence  
<220> FEATURE:  
<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer

<400> SEQUENCE: 86

gcttcaggc tattgatggt gagggtgaaa tctgtcccag atcc 44

<210> SEQ ID NO 87  
<211> LENGTH: 27  
<212> TYPE: DNA  
<213> ORGANISM: Artificial Sequence  
<220> FEATURE:  
<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer

<400> SEQUENCE: 87

gcagcgtctg gattcacctt cagtagc 27

<210> SEQ ID NO 88  
<211> LENGTH: 27  
<212> TYPE: DNA  
<213> ORGANISM: Artificial Sequence  
<220> FEATURE:  
<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer

<400> SEQUENCE: 88

gctactgaag gtgaatccag acgtgc 27

<210> SEQ ID NO 89  
<211> LENGTH: 24  
<212> TYPE: DNA  
<213> ORGANISM: Artificial Sequence  
<220> FEATURE:  
<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer

<400> SEQUENCE: 89

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cggaggtgct tctagagcag ggcg 24

<210> SEQ ID NO 90  
<211> LENGTH: 47  
<212> TYPE: DNA  
<213> ORGANISM: Artificial Sequence  
<220> FEATURE:  
<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic  
primer  
  
<400> SEQUENCE: 90

gcaagtcaga gtattagtag ctatttaa at tggtatcagc agaaacc 47

<210> SEQ ID NO 91  
<211> LENGTH: 47  
<212> TYPE: DNA  
<213> ORGANISM: Artificial Sequence  
<220> FEATURE:  
<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic  
primer  
  
<400> SEQUENCE: 91

ggtttctgct gataccaatt taaatagcta ctaatactct gacttgc 47

<210> SEQ ID NO 92  
<211> LENGTH: 48  
<212> TYPE: DNA  
<213> ORGANISM: Artificial Sequence  
<220> FEATURE:  
<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic  
primer  
  
<400> SEQUENCE: 92

ccatcagttc tctgcaacct gaggattttg caacttacta ctgtcacc 48

<210> SEQ ID NO 93  
<211> LENGTH: 48  
<212> TYPE: DNA  
<213> ORGANISM: Artificial Sequence  
<220> FEATURE:  
<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic  
primer  
  
<400> SEQUENCE: 93

ggtgacagta gtaagttgca aaatcctcag gttgcagaga actgatgg 48

<210> SEQ ID NO 94  
<211> LENGTH: 31  
<212> TYPE: DNA  
<213> ORGANISM: Artificial Sequence  
<220> FEATURE:  
<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic  
primer  
  
<400> SEQUENCE: 94

gcaaatgaac agcctgcgcg ctgaggacac g 31

<210> SEQ ID NO 95  
<211> LENGTH: 31  
<212> TYPE: DNA  
<213> ORGANISM: Artificial Sequence  
<220> FEATURE:  
<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic  
primer  
  
<400> SEQUENCE: 95

ctgtcctca gcgcgcaggc tgttcatttg c 31



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<210> SEQ ID NO 96  
<211> LENGTH: 45  
<212> TYPE: DNA  
<213> ORGANISM: Artificial Sequence  
<220> FEATURE:  
<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer  
  
<400> SEQUENCE: 96  
  
caataagaac tacttagctt ggtaccaaca gaaaccagga cagcc 45

<210> SEQ ID NO 97  
<211> LENGTH: 45  
<212> TYPE: DNA  
<213> ORGANISM: Artificial Sequence  
<220> FEATURE:  
<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer  
  
<400> SEQUENCE: 97  
  
ggctgtcctg gtttctgttg gtaccaagct aagtagttct tattg 45

<210> SEQ ID NO 98  
<211> LENGTH: 45  
<212> TYPE: DNA  
<213> ORGANISM: Artificial Sequence  
<220> FEATURE:  
<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer  
  
<400> SEQUENCE: 98  
  
ccctcagggg tcgagtcacc atgtcagtag acacgtccaa gaacc 45

<210> SEQ ID NO 99  
<211> LENGTH: 45  
<212> TYPE: DNA  
<213> ORGANISM: Artificial Sequence  
<220> FEATURE:  
<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer  
  
<400> SEQUENCE: 99  
  
ggttcttgga cgtgtctact gacatggtga ctcgaccct gaggg 45

<210> SEQ ID NO 100  
<211> LENGTH: 21  
<212> TYPE: DNA  
<213> ORGANISM: Artificial Sequence  
<220> FEATURE:  
<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer  
  
<400> SEQUENCE: 100  
  
attctagagc agggcgccag g 21

<210> SEQ ID NO 101  
<211> LENGTH: 30  
<212> TYPE: DNA  
<213> ORGANISM: Artificial Sequence  
<220> FEATURE:  
<223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer  
  
<400> SEQUENCE: 101  
  
ccatctctg caagtctagt cagagcctcc 30

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<210> SEQ ID NO 102  
 <211> LENGTH: 30  
 <212> TYPE: DNA  
 <213> ORGANISM: Artificial Sequence  
 <220> FEATURE:  
 <223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer  
 <400> SEQUENCE: 102  
 ggaggctctg actagacttg caggagatgg 30

<210> SEQ ID NO 103  
 <211> LENGTH: 47  
 <212> TYPE: DNA  
 <213> ORGANISM: Artificial Sequence  
 <220> FEATURE:  
 <223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer  
 <400> SEQUENCE: 103  
 ggtttattac tgcattgcaaa gtatacagct tatgtccagt tttggcc 47

<210> SEQ ID NO 104  
 <211> LENGTH: 47  
 <212> TYPE: DNA  
 <213> ORGANISM: Artificial Sequence  
 <220> FEATURE:  
 <223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer  
 <400> SEQUENCE: 104  
 ggccaaaact ggacataagc tgtatacttt gcatgcagta ataaacc 47

<210> SEQ ID NO 105  
 <211> LENGTH: 24  
 <212> TYPE: DNA  
 <213> ORGANISM: Artificial Sequence  
 <220> FEATURE:  
 <223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer  
 <400> SEQUENCE: 105  
 cctgcaagtc tagtcagagc ctcc 24

<210> SEQ ID NO 106  
 <211> LENGTH: 24  
 <212> TYPE: DNA  
 <213> ORGANISM: Artificial Sequence  
 <220> FEATURE:  
 <223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer  
 <400> SEQUENCE: 106  
 ggaggctctg actagacttg cagg 24

<210> SEQ ID NO 107  
 <211> LENGTH: 543  
 <212> TYPE: PRT  
 <213> ORGANISM: Artificial Sequence  
 <220> FEATURE:  
 <223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic polypeptide  
 <400> SEQUENCE: 107

Met Asp Phe Gly Leu Ala Leu Leu Leu Ala Gly Leu Leu Gly Leu Leu  
 1 5 10 15



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|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Leu | Gly | Gln | Ser | Leu | Gln | Val | Lys | Pro | Leu | Gln | Val | Glu | Pro | Pro | Glu |
|     |     |     | 20  |     |     |     |     | 25  |     |     |     |     | 30  |     |     |
| Pro | Val | Val | Ala | Val | Ala | Leu | Gly | Ala | Ser | Arg | Gln | Leu | Thr | Cys | Arg |
|     |     | 35  |     |     |     |     | 40  |     |     |     |     | 45  |     |     |     |
| Leu | Ala | Cys | Ala | Asp | Arg | Gly | Ala | Ser | Val | Gln | Trp | Arg | Gly | Leu | Asp |
|     | 50  |     |     |     |     | 55  |     |     |     |     | 60  |     |     |     |     |
| Thr | Ser | Leu | Gly | Ala | Val | Gln | Ser | Asp | Thr | Gly | Arg | Ser | Val | Leu | Thr |
| 65  |     |     |     |     | 70  |     |     |     |     | 75  |     |     |     |     | 80  |
| Val | Arg | Asn | Ala | Ser | Leu | Ser | Ala | Ala | Gly | Thr | Arg | Val | Cys | Val | Gly |
|     |     |     |     | 85  |     |     |     |     | 90  |     |     |     |     | 95  |     |
| Ser | Cys | Gly | Gly | Arg | Thr | Phe | Gln | His | Thr | Val | Gln | Leu | Leu | Val | Tyr |
|     |     |     | 100 |     |     |     |     | 105 |     |     |     |     | 110 |     |     |
| Ala | Phe | Pro | Asp | Gln | Leu | Thr | Val | Ser | Pro | Ala | Ala | Leu | Val | Pro | Gly |
|     |     | 115 |     |     |     |     | 120 |     |     |     |     | 125 |     |     |     |
| Asp | Pro | Glu | Val | Ala | Cys | Thr | Ala | His | Lys | Val | Thr | Pro | Val | Asp | Pro |
|     | 130 |     |     |     |     | 135 |     |     |     |     | 140 |     |     |     |     |
| Asn | Ala | Leu | Ser | Phe | Ser | Leu | Leu | Val | Gly | Gly | Gln | Glu | Leu | Glu | Gly |
| 145 |     |     |     |     | 150 |     |     |     |     | 155 |     |     |     |     | 160 |
| Ala | Gln | Ala | Leu | Gly | Pro | Glu | Val | Gln | Glu | Glu | Glu | Glu | Pro | Gln |     |
|     |     |     |     | 165 |     |     |     |     | 170 |     |     |     |     | 175 |     |
| Gly | Asp | Glu | Asp | Val | Leu | Phe | Arg | Val | Thr | Glu | Arg | Trp | Arg | Leu | Pro |
|     |     |     | 180 |     |     |     |     | 185 |     |     |     |     | 190 |     |     |
| Pro | Leu | Gly | Thr | Pro | Val | Pro | Pro | Ala | Leu | Tyr | Cys | Gln | Ala | Thr | Met |
|     |     | 195 |     |     |     |     | 200 |     |     |     |     | 205 |     |     |     |
| Arg | Leu | Pro | Gly | Leu | Glu | Leu | Ser | His | Arg | Gln | Ala | Ile | Pro | Val | Leu |
|     | 210 |     |     |     |     | 215 |     |     |     |     | 220 |     |     |     |     |
| His | Ser | Pro | Thr | Ser | Pro | Glu | Pro | Pro | Asp | Thr | Thr | Ser | Pro | Glu | Ser |
| 225 |     |     |     |     | 230 |     |     |     |     | 235 |     |     |     |     | 240 |
| Pro | Asp | Thr | Thr | Ser | Pro | Glu | Ser | Pro | Asp | Thr | Thr | Ser | Gln | Glu | Pro |
|     |     |     |     | 245 |     |     |     |     | 250 |     |     |     |     | 255 |     |
| Pro | Asp | Thr | Thr | Ser | Gln | Glu | Pro | Pro | Asp | Thr | Thr | Ser | Gln | Glu | Pro |
|     |     |     |     | 260 |     |     |     | 265 |     |     |     |     |     | 270 |     |
| Pro | Asp | Thr | Thr | Ser | Pro | Glu | Pro | Pro | Asp | Lys | Thr | Ser | Pro | Glu | Pro |
|     |     | 275 |     |     |     |     | 280 |     |     |     |     | 285 |     |     |     |
| Ala | Pro | Gln | Gln | Gly | Ser | Thr | His | Thr | Pro | Arg | Ser | Pro | Gly | Ser | Thr |
|     | 290 |     |     |     |     | 295 |     |     |     |     | 300 |     |     |     |     |
| Arg | Thr | Arg | Arg | Pro | Glu | Ile | Gln | Pro | Lys | Ser | Cys | Asp | Lys | Thr | His |
| 305 |     |     |     |     | 310 |     |     |     |     | 315 |     |     |     |     | 320 |
| Thr | Cys | Pro | Pro | Cys | Pro | Ala | Pro | Glu | Leu | Leu | Gly | Gly | Pro | Ser | Val |
|     |     |     |     | 325 |     |     |     |     | 330 |     |     |     |     | 335 |     |
| Phe | Leu | Phe | Pro | Pro | Lys | Pro | Lys | Asp | Thr | Leu | Met | Ile | Ser | Arg | Thr |
|     |     | 340 |     |     |     |     |     | 345 |     |     |     |     | 350 |     |     |
| Pro | Glu | Val | Thr | Cys | Val | Val | Val | Asp | Val | Ser | His | Glu | Asp | Pro | Glu |
|     |     | 355 |     |     |     |     | 360 |     |     |     |     | 365 |     |     |     |
| Val | Lys | Phe | Asn | Trp | Tyr | Val | Asp | Gly | Val | Glu | Val | His | Asn | Ala | Lys |
|     | 370 |     |     |     |     | 375 |     |     |     |     |     | 380 |     |     |     |
| Thr | Lys | Pro | Arg | Glu | Glu | Gln | Tyr | Asn | Ser | Thr | Tyr | Arg | Val | Val | Ser |
| 385 |     |     |     |     | 390 |     |     |     |     | 395 |     |     |     |     | 400 |
| Val | Leu | Thr | Val | Leu | His | Gln | Asp | Trp | Leu | Asn | Gly | Lys | Glu | Tyr | Lys |
|     |     |     |     | 405 |     |     |     |     | 410 |     |     |     |     | 415 |     |
| Cys | Lys | Val | Ser | Asn | Lys | Ala | Leu | Pro | Ala | Pro | Ile | Glu | Lys | Thr | Ile |
|     |     |     | 420 |     |     |     |     | 425 |     |     |     |     | 430 |     |     |
| Ser | Lys | Ala | Lys | Gly | Gln | Pro | Arg | Glu | Pro | Gln | Val | Tyr | Thr | Leu | Pro |

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| 435  | 440 | 445     |
|--|-----|---------|
| Pro Ser Arg Asp Glu Leu Thr Lys Asn Gln Val Ser Leu Thr Cys Leu<br>450 | 455 | 460     |
| Val Lys Gly Phe Tyr Pro Ser Asp Ile Ala Val Glu Trp Glu Ser Asn<br>465 | 470 | 475 480 |
| Gly Gln Pro Glu Asn Asn Tyr Lys Ala Thr Pro Pro Val Leu Asp Ser<br>485 | 490 | 495     |
| Asp Gly Ser Phe Phe Leu Tyr Ser Lys Leu Thr Val Asp Lys Ser Arg<br>500 | 505 | 510     |
| Trp Gln Gln Gly Asn Val Phe Ser Cys Ser Val Met His Glu Ala Leu<br>515 | 520 | 525     |
| His Asn His Tyr Thr Gln Lys Ser Leu Ser Leu Ser Pro Gly Lys<br>530     | 535 | 540     |

<210> SEQ ID NO 108  
 <211> LENGTH: 23  
 <212> TYPE: DNA  
 <213> ORGANISM: Artificial Sequence  
 <220> FEATURE:  
 <223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic  
 primer  
 <220> FEATURE:  
 <221> NAME/KEY: modified\_base  
 <222> LOCATION: (21)  
 <223> OTHER INFORMATION: Inosine

<400> SEQUENCE: 108

caggtgcagc tggagcagtc ngg 23

<210> SEQ ID NO 109  
 <211> LENGTH: 24  
 <212> TYPE: DNA  
 <213> ORGANISM: Artificial Sequence  
 <220> FEATURE:  
 <223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic  
 primer

<400> SEQUENCE: 109

gctgagggag tagagtcctg agga 24

<210> SEQ ID NO 110  
 <211> LENGTH: 28  
 <212> TYPE: DNA  
 <213> ORGANISM: Artificial Sequence  
 <220> FEATURE:  
 <223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic  
 primer

<400> SEQUENCE: 110

gctgagggag tagagtcctg aggactgt 28

<210> SEQ ID NO 111  
 <211> LENGTH: 21  
 <212> TYPE: DNA  
 <213> ORGANISM: Artificial Sequence  
 <220> FEATURE:  
 <223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic  
 primer

<400> SEQUENCE: 111

agcatggatc ggggctggc c 21

<210> SEQ ID NO 112  
 <211> LENGTH: 21



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<212> TYPE: DNA  
 <213> ORGANISM: Artificial Sequence  
 <220> FEATURE:  
 <223> OTHER INFORMATION: Description of Artificial Sequence: Synthetic primer

<400> SEQUENCE: 112

gtgcaggacc gggatggcct g

21

<210> SEQ ID NO 113  
 <211> LENGTH: 116  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 113

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 Asn Ala  
 20 25 30  
 Trp Met Ser Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val  
 35 40 45  
 Gly Arg Ile Lys Ser Lys Thr Asp Gly Gly Thr Thr Asp Tyr Ala Ala  
 50 55 60  
 Pro Val Lys Gly Arg Phe Thr Ile Ser Arg Asp Asp Ser Lys Asn Thr  
 65 70 75 80  
 Leu Tyr Leu Gln Met Asn Ser Leu Lys Thr Glu Asp Thr Ala Val Tyr  
 85 90 95  
 Tyr Cys Thr Thr Val Ala Asp Tyr Trp Gly Gln Gly Thr Leu Val Thr  
 100 105 110  
 Val Ser Ser Ala  
 115

<210> SEQ ID NO 114  
 <211> LENGTH: 116  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 114

Glu Val Gln Leu Leu Glu Ser Gly Gly Gly Leu Val Gln 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  
 Ala Met Ser Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val  
 35 40 45  
 Ser Ala Ile Ser Gly Ser Gly Gly Ser Thr Tyr Tyr Ala Asp Ser Val  
 50 55 60  
 Lys Gly Arg Phe Thr Ile Ser Arg Asp Asn Ser Lys Asn Thr Leu Tyr  
 65 70 75 80  
 Leu Gln Met Asn Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys  
 85 90 95  
 Ala Ala Gly Tyr Ser Tyr Gly Tyr Trp Gly Gln Gly Thr Leu Val Thr  
 100 105 110  
 Val Ser Ser Ala  
 115

<210> SEQ ID NO 115  
 <211> LENGTH: 117  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

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&lt;400&gt; SEQUENCE: 115

Gln Val Gln Leu Val Glu Ser Gly Gly Gly Val Val Gln Pro Gly Arg  
 1 5 10 15  
 Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe Ser Ser Tyr  
 20 25 30  
 Gly Met His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val  
 35 40 45  
 Ala Val Ile Trp Tyr Asp Gly Ser Asn Lys Tyr Tyr Ala Asp Ser Val  
 50 55 60  
 Lys Gly Arg Phe Thr Ile Ser Arg Asp Asn Ser Lys Asn Thr Leu Tyr  
 65 70 75 80  
 Leu Gln Met Asn Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys  
 85 90 95  
 Ala Arg Tyr Tyr Tyr Gly Met Asp Val Trp Gly Gln Gly Thr Thr Val  
 100 105 110  
 Thr Val Ser Ser Ala  
 115

&lt;210&gt; SEQ ID NO 116

&lt;211&gt; LENGTH: 122

&lt;212&gt; TYPE: PRT

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 116

Gln Val Gln Leu Val Glu Ser Gly Gly Gly Val Val Gln Pro Gly Arg  
 1 5 10 15  
 Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe Ser Ser Tyr  
 20 25 30  
 Gly Met His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val  
 35 40 45  
 Ala Val Ile Ser Tyr Asp Gly Ser Asn Lys Tyr Tyr Ala Asp Ser Val  
 50 55 60  
 Lys Gly Arg Phe Thr Ile Ser Arg Asp Asn Ser Lys Asn Thr Leu Tyr  
 65 70 75 80  
 Leu Gln Met Asn Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys  
 85 90 95  
 Ala Arg Thr Val Val Thr Tyr Tyr Tyr Tyr Gly Met Asp Val Trp Gly  
 100 105 110  
 Gln Gly Thr Thr Val Thr Val Ser Ser Ala  
 115 120

&lt;210&gt; SEQ ID NO 117

&lt;211&gt; LENGTH: 120

&lt;212&gt; TYPE: PRT

&lt;213&gt; ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 117

Gln Val Gln Leu Gln Glu Ser Gly Pro Gly Leu Val Lys Pro Ser Glu  
 1 5 10 15  
 Thr Leu Ser Leu Thr Cys Thr Val Ser Gly Gly Ser Ile Ser Ser Tyr  
 20 25 30  
 Tyr Trp Ser Trp Ile Arg Gln Pro Ala Gly Lys Gly Leu Glu Trp Ile  
 35 40 45  
 Gly Arg Ile Tyr Thr Ser Gly Ser Thr Asn Tyr Asn Pro Ser Leu Lys  
 50 55 60



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Ser Arg Val Thr Met Ser Val Asp Thr Ser Lys Asn Gln Phe Ser Leu  
 65 70 75 80

Lys Leu Ser Ser Val Thr Ala Ala Asp Thr Ala Val Tyr Tyr Cys Ala  
 85 90 95

Arg Ile Thr Met Val Arg Gly Val Ile Phe Asp Tyr Trp Gly Gln Gly  
 100 105 110

Thr Leu Val Thr Val Ser Ser Ala  
 115 120

<210> SEQ ID NO 118  
 <211> LENGTH: 121  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 118

Glu Val Gln Leu Leu Glu Ser Gly Gly Gly Leu Val Gln 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

Ala Met Ser Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val  
 35 40 45

Ser Ala Ile Ser Gly Ser Gly Gly Ser Thr Tyr Tyr Ala Asp Ser Val  
 50 55 60

Lys Gly Arg Phe Thr Ile Ser Arg Asp Asn Ser Lys Asn Thr Leu Tyr  
 65 70 75 80

Leu Gln Met Asn Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys  
 85 90 95

Ala Ile Ala Val Ala Tyr Tyr Tyr Tyr Gly Met Asp Val Trp Gly Gln  
 100 105 110

Gly Thr Thr Val Thr Val Ser Ser Ala  
 115 120

<210> SEQ ID NO 119  
 <211> LENGTH: 125  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 119

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

Ser Met Asn Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val  
 35 40 45

Ser Ser Ile Ser Ser Ser Ser Ser Tyr Ile Tyr Tyr Ala Asp Ser Val  
 50 55 60

Lys Gly Arg Phe Thr Ile Ser Arg Asp Asn Ala Lys Asn Ser Leu Tyr  
 65 70 75 80

Leu Gln Met Asn Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr Tyr Cys  
 85 90 95

Ala Arg Gly Tyr Ser Ser Gly Trp Tyr Tyr Tyr Tyr Tyr Gly Met Asp  
 100 105 110

Val Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser Ala  
 115 120 125

<210> SEQ ID NO 120  
 <211> LENGTH: 121

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<212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens  
 <400> SEQUENCE: 120

Gln Val Gln Leu Val Gln Ser Gly Ala Glu Val Lys Lys Pro Gly Ala  
 1 5 10 15  
 Ser Val Lys Val Ser Cys Lys Ala Ser Gly Tyr Thr Phe Thr Ser Tyr  
 20 25 30  
 Gly Ile Ser Trp Val Arg Gln Ala Pro Gly Gln Gly Leu Glu Trp Met  
 35 40 45  
 Gly Trp Ile Ser Ala Tyr Asn Gly Asn Thr Asn Tyr Ala Gln Lys Leu  
 50 55 60  
 Gln Gly Arg Val Thr Met Thr Thr Asp Thr Ser Thr Ser Thr Ala Tyr  
 65 70 75 80  
 Met Glu Leu Arg Ser Leu Arg Ser Asp Asp Thr Ala Val Tyr Tyr Cys  
 85 90 95  
 Ala Arg Ser Ser Ser Ser Tyr Tyr Tyr Gly Met Asp Val Trp Gly Gln  
 100 105 110  
 Gly Thr Thr Val Thr Val Ser Ser Ala  
 115 120

<210> SEQ ID NO 121  
 <211> LENGTH: 122  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens  
 <400> SEQUENCE: 121

Gln Val Gln Leu Gln Glu Ser Gly Pro Gly Leu Val Lys Pro Ser Glu  
 1 5 10 15  
 Thr Leu Ser Leu Thr Cys Thr Val Ser Gly Gly Ser Ile Ser Ser Tyr  
 20 25 30  
 Tyr Trp Ser Trp Ile Arg Gln Pro Ala Gly Lys Gly Leu Glu Trp Ile  
 35 40 45  
 Gly Arg Ile Tyr Thr Ser Gly Ser Thr Asn Tyr Asn Pro Ser Leu Lys  
 50 55 60  
 Ser Arg Val Thr Met Ser Val Asp Thr Ser Lys Asn Gln Phe Ser Leu  
 65 70 75 80  
 Lys Leu Ser Ser Val Thr Ala Ala Asp Thr Ala Val Tyr Tyr Cys Ala  
 85 90 95  
 Arg Tyr Tyr Tyr Gly Ser Gly Ser Tyr Tyr Gly Met Asp Val Trp Gly  
 100 105 110  
 Gln Gly Thr Thr Val Thr Val Ser Ser Ala  
 115 120

<210> SEQ ID NO 122  
 <211> LENGTH: 112  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens  
 <400> SEQUENCE: 122

Gln Val Gln Leu Val Glu Ser Gly Gly Gly Val Val Gln Pro Gly Arg  
 1 5 10 15  
 Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Thr Phe Ser Ser Tyr  
 20 25 30  
 Gly Met His Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp Val  
 35 40 45  
 Ala Val Ile Trp Tyr Asp Gly Ser Asn Lys Tyr Tyr Ala Asp Ser Val



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|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |  |  |  |  |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|--|--|--|--|
| 50  | 55  | 60  |     |     |     |     |     |     |     |     |     |     |     |     |     |  |  |  |  |  |
| Lys | Gly | Arg | Phe | Thr | Ile | Ser | Arg | Asp | Asn | Ser | Lys | Asn | Thr | Leu | Tyr |  |  |  |  |  |
| 65  |     |     |     |     | 70  |     |     |     |     | 75  |     |     |     |     | 80  |  |  |  |  |  |
| Leu | Gln | Met | Asn | Ser | Leu | Arg | Ala | Glu | Asp | Thr | Ala | Val | Tyr | Tyr | Cys |  |  |  |  |  |
|     |     |     |     | 85  |     |     |     |     | 90  |     |     |     |     |     | 95  |  |  |  |  |  |
| Ala | Phe | Asp | Tyr | Trp | Gly | Gln | Gly | Thr | Leu | Val | Thr | Val | Ser | Ser | Ala |  |  |  |  |  |
|     |     |     | 100 |     |     |     |     | 105 |     |     |     |     |     | 110 |     |  |  |  |  |  |

<210> SEQ ID NO 123  
 <211> LENGTH: 112  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 123

|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |  |  |  |  |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|--|--|--|--|
| Asp | Ile | Val | Met | Thr | Gln | Ser | Pro | Leu | Ser | Leu | Pro | Val | Thr | Pro | Gly |  |  |  |  |  |
| 1   |     |     |     | 5   |     |     |     |     | 10  |     |     |     |     | 15  |     |  |  |  |  |  |
| Glu | Pro | Ala | Ser | Ile | Ser | Cys | Arg | Ser | Ser | Gln | Ser | Leu | Leu | Gln | Ser |  |  |  |  |  |
|     |     |     | 20  |     |     |     |     | 25  |     |     |     |     | 30  |     |     |  |  |  |  |  |
| Asn | Gly | Tyr | Asn | Tyr | Leu | Asp | Trp | Tyr | Leu | Gln | Lys | Pro | Gly | Gln | Ser |  |  |  |  |  |
|     |     | 35  |     |     |     |     | 40  |     |     |     |     | 45  |     |     |     |  |  |  |  |  |
| Pro | Gln | Leu | Leu | Ile | Tyr | Leu | Gly | Ser | Asn | Arg | Ala | Ser | Gly | Val | Pro |  |  |  |  |  |
|     | 50  |     |     |     |     | 55  |     |     |     | 60  |     |     |     |     |     |  |  |  |  |  |
| Asp | Arg | Phe | Ser | Gly | Ser | Gly | Ser | Gly | Thr | Asp | Phe | Thr | Leu | Lys | Ile |  |  |  |  |  |
| 65  |     |     |     |     | 70  |     |     |     |     | 75  |     |     |     |     | 80  |  |  |  |  |  |
| Ser | Arg | Val | Glu | Ala | Glu | Asp | Val | Gly | Val | Tyr | Tyr | Cys | Met | Gln | Ala |  |  |  |  |  |
|     |     |     |     | 85  |     |     |     |     | 90  |     |     |     |     | 95  |     |  |  |  |  |  |
| Leu | Gln | Thr | Ile | Thr | Phe | Gly | Gln | Gly | Thr | Arg | Leu | Glu | Ile | Lys | Arg |  |  |  |  |  |
|     |     |     | 100 |     |     |     |     | 105 |     |     |     |     |     | 110 |     |  |  |  |  |  |

<210> SEQ ID NO 124  
 <211> LENGTH: 107  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 124

|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |  |  |  |  |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|--|--|--|--|
| Asp | Ile | Gln | Met | Thr | Gln | Ser | Pro | Ser | Ser | Leu | Ser | Ala | Ser | Val | Gly |  |  |  |  |  |
| 1   |     |     |     | 5   |     |     |     |     | 10  |     |     |     |     | 15  |     |  |  |  |  |  |
| Asp | Arg | Val | Thr | Ile | Thr | Cys | Arg | Ala | Ser | Gln | Ser | Ile | Ser | Ser | Tyr |  |  |  |  |  |
|     |     | 20  |     |     |     |     |     | 25  |     |     |     |     | 30  |     |     |  |  |  |  |  |
| Leu | Asn | Trp | Tyr | Gln | Gln | Lys | Pro | Gly | Lys | Ala | Pro | Lys | Val | Leu | Ile |  |  |  |  |  |
|     |     | 35  |     |     |     |     | 40  |     |     |     |     | 45  |     |     |     |  |  |  |  |  |
| Phe | Ala | Ala | Ser | Ser | Leu | Gln | Ser | Gly | Val | Pro | Ser | Arg | Phe | Ser | Gly |  |  |  |  |  |
|     | 50  |     |     |     |     | 55  |     |     |     | 60  |     |     |     |     |     |  |  |  |  |  |
| Ser | Gly | Ser | Gly | Thr | Asp | Phe | Thr | Leu | Thr | Ile | Ser | Ser | Leu | Gln | Pro |  |  |  |  |  |
| 65  |     |     |     |     | 70  |     |     |     |     | 75  |     |     |     |     | 80  |  |  |  |  |  |
| Glu | Asp | Phe | Ala | Thr | Tyr | Tyr | Cys | Gln | Gln | Ser | Tyr | Ser | Thr | Pro | Thr |  |  |  |  |  |
|     |     |     |     | 85  |     |     |     |     | 90  |     |     |     |     | 95  |     |  |  |  |  |  |
| Phe | Gly | Gln | Gly | Thr | Arg | Leu | Glu | Ile | Lys | Arg |     |     |     |     |     |  |  |  |  |  |
|     |     | 100 |     |     |     |     |     | 105 |     |     |     |     |     |     |     |  |  |  |  |  |

<210> SEQ ID NO 125  
 <211> LENGTH: 106  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 125

|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |  |  |  |  |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|--|--|--|--|
| Glu | Ile | Val | Leu | Thr | Gln | Ser | Pro | Asp | Phe | Gln | Ser | Val | Thr | Pro | Lys |  |  |  |  |  |
| 1   |     |     |     | 5   |     |     |     |     | 10  |     |     |     |     | 15  |     |  |  |  |  |  |

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Glu Lys Val Thr Ile Thr Cys Arg Ala Ser Gln Ser Ile Gly Ser Ser  
                   20                  25                  30  
 Leu His Trp Tyr Gln Gln Lys Pro Asp Gln Ser Pro Lys Leu Leu Ile  
                   35                  40                  45  
 Lys Tyr Ala Ser Gln Ser Phe Thr Gly Val Pro Ser Arg Phe Ser Gly  
                   50                  55                  60  
 Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr Ile Asn Ser Leu Glu Ala  
                   65                  70                  75                  80  
 Glu Asp Ala Ala Thr Tyr Tyr Cys His Gln Ser Ser Ser Leu Thr Phe  
                   85                  90                  95  
 Gly Gly Gly Thr Lys Val Glu Ile Lys Arg  
                   100                  105

<210> SEQ ID NO 126  
 <211> LENGTH: 108  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 126

Asp Ile Gln Met Thr Gln Ser Pro Ser Ser Leu Ser Ala Ser Val Gly  
           1                  5                  10                  15  
 Asp Arg Val Thr Ile Thr Cys Arg Ala Ser Gln Ser Ile Ser Ser Tyr  
                   20                  25                  30  
 Leu Asn Trp Tyr Gln Gln Lys Pro Gly Lys Ala Pro Lys Leu Leu Ile  
                   35                  40                  45  
 Tyr Ala Ala Ser Ser Leu Ser Gln Gly Val Pro Ser Arg Phe Ser Gly  
                   50                  55                  60  
 Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr Ile Ser Ser Leu Gln Pro  
                   65                  70                  75                  80  
 Glu Asp Phe Ala Thr Tyr Tyr Cys Gln Gln Ser Tyr Ser Thr Pro Phe  
                   85                  90                  95  
 Thr Phe Gly Pro Gly Thr Lys Val Asp Ile Lys Arg  
                   100                  105

<210> SEQ ID NO 127  
 <211> LENGTH: 114  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 127

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 Asn Cys Lys Ser Ser Gln Ser Val Leu Tyr Ser  
                   20                  25                  30  
 Ser Asn Asn Lys Asn Tyr Leu Ala Trp Tyr Gln Gln Lys Pro Gly Gln  
                   35                  40                  45  
 Pro Pro Lys Leu Leu Ile Tyr Trp Ala Ser Thr Arg Glu Ser Gly Val  
                   50                  55                  60  
 Pro Asp Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr  
                   65                  70                  75                  80  
 Ile Ser Ser Leu Gln Ala Glu Asp Val Ala Val Tyr Tyr Cys Gln Gln  
                   85                  90                  95  
 Tyr Tyr Ser Thr Pro Leu Thr Phe Gly Gly Gly Thr Lys Val Glu Ile  
                   100                  105                  110

Lys Arg



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<210> SEQ ID NO 128  
 <211> LENGTH: 106  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 128

Asp Ile Gln Met Thr Gln Ser Pro Ser Ser Leu Ser Ala Ser Val Gly  
 1 5 10 15  
 Asp Arg Val Thr Ile Thr Cys Arg Ala Ser Gln Ser Ile Ser Ser Tyr  
 20 25 30  
 Leu Asn Trp Tyr Gln Gln Lys Pro Gly Lys Ala Pro Lys Leu Leu Ile  
 35 40 45  
 Tyr Ala Ala Ser Ser Leu Gln Ser Gly Val Pro Ser Arg Phe Ser Gly  
 50 55 60  
 Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr Ile Ser Ser Leu Gln Pro  
 65 70 75 80  
 Glu Asp Phe Ala Thr Tyr Tyr Cys Gln Gln Ser Tyr Ser Thr Pro Phe  
 85 90 95  
 Gly Gln Gly Thr Thr Leu Asp Ile Lys Arg  
 100 105

<210> SEQ ID NO 129  
 <211> LENGTH: 110  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 129

Asp Ile Val Met Thr Gln Thr Pro Leu Ser Leu Ser Val Thr Pro Gly  
 1 5 10 15  
 Gln Pro Ala Ser Ile Ser Cys Lys Ser Ser Gln Ser Leu Leu His Ser  
 20 25 30  
 Asp Gly Lys Thr Tyr Leu Tyr Trp Tyr Leu Gln Lys Pro Gly Gln Pro  
 35 40 45  
 Pro Gln Leu Leu Ile Tyr Glu Val Ser Asn Arg Phe Ser Gly Val Pro  
 50 55 60  
 Asp Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe Thr Leu Lys Ile  
 65 70 75 80  
 Ser Arg Val Glu Ala Glu Asp Val Gly Val Tyr Tyr Cys Met Gln Ser  
 85 90 95  
 Ile Gln Leu Phe Gly Gln Gly Thr Lys Leu Glu Ile Lys Arg  
 100 105 110

<210> SEQ ID NO 130  
 <211> LENGTH: 113  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 130

Asp Ile Val Met Thr Gln Thr Pro Leu Ser Leu Ser Val Thr Pro Gly  
 1 5 10 15  
 Gln Pro Ala Ser Ile Ser Cys Lys Ser Ser Gln Ser Leu Leu His Ser  
 20 25 30  
 Asp Gly Lys Thr Tyr Leu Tyr Trp Tyr Leu Gln Lys Pro Gly Gln Pro  
 35 40 45  
 Pro Gln Leu Leu Ile Tyr Glu Val Ser Asn Arg Phe Ser Gly Val Pro  
 50 55 60  
 Asp Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe Thr Leu Lys Ile

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|   |     |     |     |
|---|-----|-----|-----|
| 65  | 70  | 75  | 80  |
| Ser Arg Val Glu Ala Glu Asp Val Gly Val Tyr Tyr Cys Met Gln Ser | 85  | 90  | 95  |
| Ile Gln Leu Pro Trp Thr Phe Gly Gln Gly Thr Lys Val Glu Ile Lys | 100 | 105 | 110 |

Arg

<210> SEQ ID NO 131  
 <211> LENGTH: 112  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 131

|   |     |     |     |    |
|---|-----|-----|-----|----|
| Asp Ile Val Met Thr Gln Ser Pro Leu Ser Leu Pro Val Thr Pro Gly | 1   | 5   | 10  | 15 |
| Glu Pro Ala Ser Ile Ser Cys Arg Ser Ser Gln Ser Leu Leu His Gly | 20  | 25  | 30  |    |
| Asn Gly Tyr Asn Tyr Leu Asp Trp Tyr Leu Gln Lys Pro Gly Gln Ser | 35  | 40  | 45  |    |
| Pro Gln Leu Leu Ile Tyr Leu Gly Ser Asn Arg Ala Ser Gly Val Pro | 50  | 55  | 60  |    |
| Asp Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe Thr Leu Lys Ile | 65  | 70  | 75  | 80 |
| Ser Arg Val Glu Ala Glu Asp Val Gly Val Tyr Tyr Cys Met Gln Ala | 85  | 90  | 95  |    |
| Leu Gln Thr Leu Thr Phe Gly Gly Gly Thr Lys Val Glu Ile Lys Arg | 100 | 105 | 110 |    |

<210> SEQ ID NO 132  
 <211> LENGTH: 107  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 132

|   |     |     |    |    |
|---|-----|-----|----|----|
| Asp Ile Gln Met Thr Gln Ser Pro Ser Ser Leu Ser Ala Ser Val Gly | 1   | 5   | 10 | 15 |
| Asp Arg Val Thr Ile Thr Cys Gln Ala Ser Gln Asp Ile Ser Asn Tyr | 20  | 25  | 30 |    |
| Leu Asn Trp Tyr Gln Gln Lys Pro Gly Lys Ala Pro Lys Leu Leu Ile | 35  | 40  | 45 |    |
| Tyr Asp Ala Ser Asn Leu Glu Thr Gly Val Pro Ser Arg Phe Ser Gly | 50  | 55  | 60 |    |
| Ser Gly Ser Gly Thr Asp Phe Thr Phe Thr Ile Ser Ser Leu Gln Pro | 65  | 70  | 75 | 80 |
| Glu Asp Ile Ala Thr Tyr Tyr Cys Gln Gln Tyr Asp Asn Leu Ile Thr | 85  | 90  | 95 |    |
| Phe Gly Gln Gly Thr Arg Leu Glu Ile Lys Arg                     | 100 | 105 |    |    |

<210> SEQ ID NO 133  
 <211> LENGTH: 125  
 <212> TYPE: PRT  
 <213> ORGANISM: Homo sapiens

&lt;400&gt; SEQUENCE: 133

|   |   |   |    |    |
|---|---|---|----|----|
| Gln Val Gln Leu Val Gln Ser Gly Ala Glu Val Lys Lys Pro Gly Ala | 1 | 5 | 10 | 15 |
|---|---|---|----|----|



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Ser Val Lys Val Ser Cys Glu Ala Ser Gly Tyr Thr Phe Thr Ser Tyr  
                   20                  25                  30

Gly Ile Asp Trp Val Arg Gln Ala Pro Gly Gln Gly Leu Glu Trp Met  
                   35                  40                  45

Gly Trp Ile Ser Val Tyr Ser Gly Asn Thr Asn Tyr Ala Gln Lys Leu  
                   50                  55                  60

Gln Gly Arg Val Thr Met Ser Thr Asp Thr Ser Thr Ser Thr Ala Phe  
                   65                  70                  75                  80

Phe Leu Leu Arg Ser Leu Arg Ser Asp Asp Thr Ala Val Tyr Tyr Cys  
                   85                  90                  95

Ala Arg Glu Gly Ser Ser Ser Ser Gly Asp Tyr Tyr Tyr Gly Met Asp  
                   100                  105                  110

Val Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser Ala  
                   115                  120                  125

<210> SEQ ID NO 134  
 <211> LENGTH: 11  
 <212> TYPE: PRT  
 <213> ORGANISM: *Macaca fascicularis*

<400> SEQUENCE: 134

Cys Lys Pro Leu Gln Val Glu Pro Pro Glu Pro  
   1                  5                  10

<210> SEQ ID NO 135  
 <211> LENGTH: 8  
 <212> TYPE: PRT  
 <213> ORGANISM: *Homo sapiens*

<400> SEQUENCE: 135

Thr Phe Asn Asn Ser Ala Met Thr  
   1                  5

<210> SEQ ID NO 136  
 <211> LENGTH: 9  
 <212> TYPE: PRT  
 <213> ORGANISM: *Homo sapiens*

<400> SEQUENCE: 136

Cys Lys Ser Asn Gln Ser Leu Leu Tyr  
   1                  5

<210> SEQ ID NO 137  
 <211> LENGTH: 9  
 <212> TYPE: PRT  
 <213> ORGANISM: *Homo sapiens*

<400> SEQUENCE: 137

Ser Gly Thr Asn Phe Thr Leu Thr Ile  
   1                  5

<210> SEQ ID NO 138  
 <211> LENGTH: 9  
 <212> TYPE: PRT  
 <213> ORGANISM: *Homo sapiens*

<400> SEQUENCE: 138

Ala Ser Gln Asn Ile Ser Ser Tyr Leu  
   1                  5

<210> SEQ ID NO 139  
 <211> LENGTH: 9

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<212> TYPE: PRT  
<213> ORGANISM: Homo sapiens  
  
<400> SEQUENCE: 139  
  
Ser Ser Asn Asn Lys Thr Tyr Leu Ala  
1 5

<210> SEQ ID NO 140  
<211> LENGTH: 8  
<212> TYPE: PRT  
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 140  
  
Arg Ala Ser Gln Asn Ile Thr Asn  
1 5

<210> SEQ ID NO 141  
<211> LENGTH: 8  
<212> TYPE: PRT  
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 141  
  
Ser Cys Asn Ser Ser Gln Ser Leu  
1 5

<210> SEQ ID NO 142  
<211> LENGTH: 8  
<212> TYPE: PRT  
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 142  
  
His Ser Asp Asn Leu Ser Ile Thr  
1 5

<210> SEQ ID NO 143  
<211> LENGTH: 7  
<212> TYPE: PRT  
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 143  
  
Leu Gln Ser Asn Gly Tyr Asn  
1 5

<210> SEQ ID NO 144  
<211> LENGTH: 7  
<212> TYPE: PRT  
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 144  
  
Leu Gln Ser Asn Gly Tyr Asn  
1 5

<210> SEQ ID NO 145  
<211> LENGTH: 7  
<212> TYPE: PRT  
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 145  
  
His Gly Asn Gly Tyr Asn Tyr  
1 5

<210> SEQ ID NO 146  
<211> LENGTH: 8  
<212> TYPE: PRT  
<213> ORGANISM: Homo sapiens



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&lt;400&gt; SEQUENCE: 146

Leu Thr Ile Asn Gly Leu Glu Ala  
 1 5

&lt;210&gt; SEQ ID NO 147

&lt;211&gt; LENGTH: 15

&lt;212&gt; TYPE: PRT

&lt;213&gt; ORGANISM: Artificial Sequence

&lt;220&gt; FEATURE:

&lt;223&gt; OTHER INFORMATION: Description of Artificial Sequence: Synthetic linker peptide

&lt;400&gt; SEQUENCE: 147

Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser  
 1 5 10 15

What is claimed is:

**[1.** An isolated nucleic acid molecule comprising a nucleotide sequence that encodes a heavy chain, or an antigen-binding portion thereof, or a light chain, or an antigen-binding portion thereof, of a monoclonal antibody that specifically binds to human Mucosal Addressin Cell Adhesion Molecule (MAdCAM), wherein said antibody comprises the heavy or light chain CDR1, CDR2 and CDR3 amino acid sequences of the monoclonal antibody produced by the hybridoma cell line 7.16.6 (ECACC Accession No. 03090909).]

**[2.** An isolated cell line comprising the nucleic acid molecule according to claim 1.]

**[3.** A vector comprising the nucleic acid molecule according to claim 1, wherein the vector optionally comprises an expression control sequence operably linked to the nucleic acid molecule.]

**[4.** A host cell comprising the vector according to claim 3.]

**[5.** A host cell comprising a nucleic acid molecule comprising a nucleotide sequence encoding the heavy chain, or an antigen-binding portion thereof, and a nucleic acid molecule comprising a nucleotide sequence encoding the light chain, or an antigen-binding portion thereof, of a monoclonal antibody that specifically binds to human MAdCAM, wherein said antibody comprises the heavy and light chain CDR1, CDR2 and CDR3 amino acid sequences of the monoclonal antibody produced by the hybridoma cell line 7.16.6 (ECACC Accession No. 03090909).]

**[6.** A method for producing a monoclonal antibody or an antigen-binding portion thereof that specifically binds to human MAdCAM, comprising culturing the host cell according to claim 5 under suitable conditions and recovering said antibody or antigen-binding portion.]

**[7.** An isolated nucleic acid molecule comprising a nucleotide sequence encoding the light chain, or an antigen-binding portion thereof, of a monoclonal antibody that specifically binds to human MAdCAM, wherein said light chain comprises the light chain variable domain of the monoclonal antibody produced by the hybridoma cell line 7.16.6 (ECACC Accession No. 03090909).]

**[8.** A vector comprising the nucleic acid molecule according to claim 7.]

**[9.** An isolated cell line comprising the nucleic acid molecule according to claim 7.]

**[10.** A host cell comprising the vector according to claim 8.]

**[11.** An isolated nucleic acid molecule comprising a nucleotide sequence encoding the heavy chain, or an antigen-binding portion, of a monoclonal antibody that specifically binds

20 to human MAdCAM, wherein said heavy chain comprises the heavy chain variable domain of the monoclonal antibody produced by the hybridoma cell line 7.16.6 (ECACC Accession No. 03090909).]

**[12.** A vector comprising the nucleic acid molecule according to claim 11.]

**[13.** An isolated cell line comprising the nucleic acid molecule according to claim 11.]

**[14.** A host cell comprising the vector according to claim 12.]

**[15.** The host cell of claim 14, further comprising a vector comprising a nucleic acid molecule comprising a nucleotide sequence encoding the light chain, or an antigen-binding portion thereof, of a monoclonal antibody that specifically binds to human MAdCAM, wherein said light chain comprises the light chain variable domain of the monoclonal antibody produced by the hybridoma cell line 7.16.6 (ECACC Accession No. 03090909).]

**[16.** A method for producing a monoclonal antibody or an antigen-binding portion thereof that specifically binds to human MAdCAM, comprising culturing the host cell according to claim 15 under suitable conditions and recovering said antibody or antigen-binding portion.]

**[17.** An isolated nucleic acid molecule comprising a nucleotide sequence encoding the light chain of the monoclonal antibody produced by the hybridoma cell line 7.16.6 (ECACC Accession No. 03090909).]

**[18.** A vector comprising the nucleic acid molecule according to claim 17.]

**[19.** An isolated cell line comprising the nucleic acid molecule according to claim 17.]

**[20.** A host cell comprising the vector according to claim 18.]

**[21.** An isolated nucleic acid molecule comprising a nucleotide sequence encoding the heavy chain of the monoclonal antibody produced by the hybridoma cell line 7.16.6 (ECACC Accession No. 03090909).]

**[22.** A vector comprising the nucleic acid molecule according to claim 21.]

**[23.** An isolated cell line comprising the nucleic acid molecule according to claim 21.]

**[24.** A host cell comprising the vector according to claim 22.]

**[25.** The host cell of claim 24, further comprising a vector comprising a nucleic acid molecule comprising a nucleotide sequence encoding the light chain of the monoclonal antibody produced by the hybridoma cell line 7.16.6 (ECACC Accession No. 03090909).]



**[26.** A method for producing a monoclonal antibody or an antigen-binding portion thereof that specifically binds to human MAdCAM, comprising culturing the host cell according to claim 25 under suitable conditions and recovering said antibody or antigen-binding portion.]

**[27.** An isolated nucleic acid molecule comprising a nucleotide sequence that encodes the heavy chain, or an antigen-binding portion thereof, or the light chain, or an antigen-binding portion thereof, of a monoclonal antibody that specifically binds to human MAdCAM, wherein said antibody comprises the heavy chain CDR1, CDR2 and CDR3 amino acid sequences of SEQ ID NO: 34 and the light chain CDR1, CDR2 and CDR3 amino acid sequences of SEQ ID NO: 36.]

**[28.** A vector comprising the nucleic acid molecule according to claim 27.]

**[29.** An isolated cell line comprising the nucleic acid molecule according to claim 27.]

**[30.** A host cell comprising the vector according to claim 28.]

**[31.** A host cell comprising a nucleic acid molecule comprising a nucleotide sequence encoding the heavy chain, or an antigen-binding portion thereof, and a nucleic acid molecule comprising a nucleotide sequence encoding the light chain, or an antigen-binding portion thereof, of a monoclonal antibody that specifically binds to human MAdCAM, wherein said antibody comprises the heavy chain CDR1, CDR2 and CDR3 amino acid sequences of SEQ ID NO: 34 and the light chain CDR1, CDR2 and CDR3 amino acid sequences of SEQ ID NO: 36.]

**[32.** A method for producing a monoclonal antibody or an antigen-binding portion thereof that specifically binds to human MAdCAM, comprising culturing the host cell according to claim 31 under suitable conditions and recovering said antibody or antigen-binding portion.]

**[33.** An isolated nucleic acid molecule comprising a nucleotide sequence encoding the light chain or an antigen-binding portion, of a monoclonal antibody that specifically binds to human MAdCAM, wherein said light chain comprises the light chain variable domain amino acid sequence in SEQ ID NO: 36.]

**[34.** A vector comprising the nucleic acid molecule according to claim 33.]

**[35.** An isolated cell line comprising the nucleic acid molecule according to claim 33.]

**[36.** A host cell comprising the vector according to claim 34.]

**[37.** An isolated nucleic acid molecule comprising a nucleotide sequence encoding the heavy chain or an antigen-binding portion, of a monoclonal antibody that specifically binds

to human MAdCAM, wherein said heavy chain comprises the heavy chain variable domain amino acid sequence in SEQ ID NO: 34.]

**[38.** A vector comprising the nucleic acid molecule according to claim 37.]

**[39.** An isolated cell line comprising the nucleic acid molecule according to claim 37.]

**[40.** A host cell comprising the vector according to claim 38.]

**[41.** The host cell of claim 40, further comprising a vector comprising a nucleic acid molecule comprising a nucleotide sequence encoding the light chain or an antigen-binding portion, of a monoclonal antibody that specifically binds to human MAdCAM, wherein said light chain comprises the light chain variable domain amino acid sequence in SEQ ID NO: 36.]

**[42.** A method for producing a monoclonal antibody or an antigen-binding portion thereof that specifically binds to human MAdCAM, comprising culturing the host cell according to claim 41 under suitable conditions and recovering said antibody or antigen-binding portion.]

**43.** An isolated nucleic acid molecule comprising a nucleotide sequence encoding amino acid residues 21 to 239 in SEQ ID NO: 36, *wherein the nucleotide sequence comprises nucleotides 61-720 of SEQ ID NO: 35.*

**44.** A vector comprising the nucleic acid molecule according to claim 43.

**45.** An isolated cell line comprising the nucleic acid molecule according to claim 43.

**46.** A host cell comprising the vector according to claim 44.

**[47.** An isolated nucleic acid molecule comprising a nucleotide sequence encoding amino acid residues 20 to 469 in SEQ ID NO: 34.]

**[48.** A vector comprising the nucleic acid molecule according to claim 47.]

**[49.** An isolated cell line comprising the nucleic acid molecule according to claim 47.]

**[50.** A host cell comprising the vector according to claim 48.]

**[51.** The host cell of claim 50, further comprising a vector comprising a nucleic acid molecule comprising a nucleotide sequence encoding amino acid residues 21 to 239 in SEQ ID NO: 36.]

**[52.** A method for producing a monoclonal antibody or an antigen-binding portion thereof that specifically binds to human MAdCAM, comprising culturing the host cell according to claim 51 under suitable conditions and recovering said antibody or antigen-binding portion.]

\* \* \* \* \*



UNITED STATES PATENT AND TRADEMARK OFFICE  
**CERTIFICATE OF CORRECTION**

PATENT NO. : RE45,847 E  
APPLICATION NO. : 14/219900  
DATED : January 19, 2016  
INVENTOR(S) : Pullen et al.

Page 1 of 1

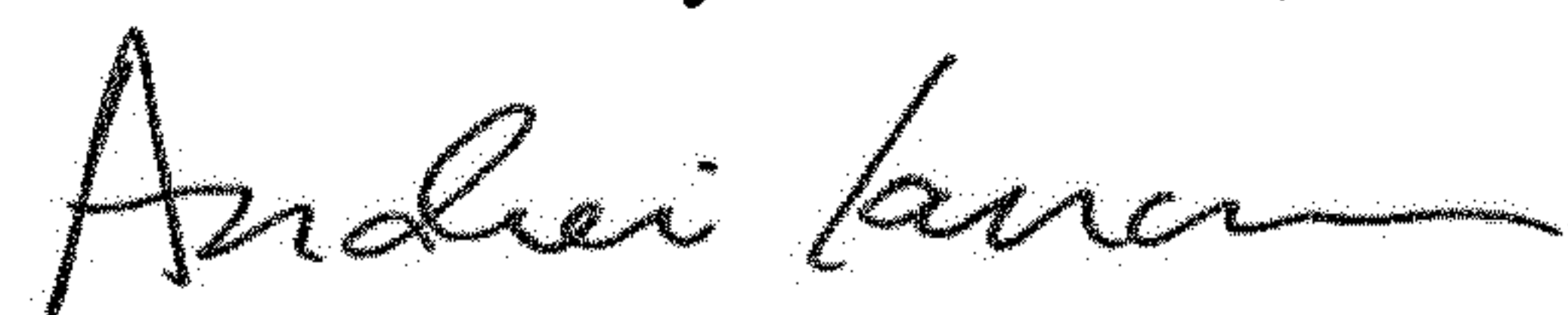
It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Specification

At Column 1, replace Lines 12-16 (approx.) and the portion of Line 17 (approx.) that includes "11/484,247, filed Jul. 10, 2006," with the following:

*--NOTICE: More than one reissue application has been filed for the reissue of U.S. Patent No. 7,932,372 B2. The reissue applications are U.S. Reissue Patent Application Serial No. 14/219,900 (the present application), filed on March 19, 2014, now U.S. Reissue Patent No. RE45,847 E, issued January 19, 2016, which is a continuation reissue application of U.S. Reissue Patent Application Serial No. 13/871,913, filed on April 26, 2013, now abandoned, which is a reissue application of U.S. Patent Application Serial No. 11/484,247, filed on July 10, 2006, now U.S. Patent No. 7,932,372 B2, issued April 26, 2011,--*

Signed and Sealed this  
Twentieth Day of October, 2020



Andrei Iancu  
Director of the United States Patent and Trademark Office