CLAIMS

What is claimed is:

1. A recombinant enzyme having human and non-human primate IgM specific protease activity and human and non-human primate IgG specific protease activity, and comprising a sequence having at least 80% identity to the sequence set forth in SEQ ID NO:17, SEQ ID NO:18, SEQ ID NO:20, or SEQ ID NO:21.
2. The recombinant enzyme of Claim 1, wherein the recombinant enzyme cleaves human IgM at the heavy chain at the interdomain region between constant domains Cμ2 and Cμ3, and/or wherein the recombinant enzyme cleaves human or non-human primate IgG below the hinge region, thereby separating the Cμ2 and Cμ3 domains from the Cμ1 domain.
3. The recombinant enzyme of Claim 1 or Claim 2,

   wherein the IgM specific protease activity occurs between position 350 and position 365 of the IgM of SEQ ID NO:105, and/or

   wherein the IgG specific protease activity occurs between positions 116 through 122 of the IgG of SEQ ID NO:106, positions 112 through 118 of the IgG of SEQ ID NO:107, positions 163 through 169 of the IgG of SEQ ID NO:108, positions 113 through 119 of IgG of SEQ ID NO:109, or any combination thereof.
4. The recombinant enzyme of any one of Claims 1 –3, wherein the IgM specific protease activity occurs at the sequence of SEQ ID NO:110 of the IgM molecule, and

   wherein the IgG specific protease activity occurs at the sequence of SEQ ID NO:111, SEQ ID NO:112, SEQ ID NO:113, SEQ ID NO:114, or any combination thereof of a human IgG molecule.
5. A recombinant enzyme having human and non-human primate IgM specific protease activity, and comprising a sequence having at least 80% identity to the sequence set forth in SEQ ID NO:11, SEQ ID NO:12, SEQ ID NO:14, or SEQ ID NO:15.
6. The recombinant enzyme of Claim 5, wherein the recombinant enzyme cleaves the heavy chain at the interdomain region between constant domains Cμ2 and Cμ3 of human or non-human primate IgM.
7. The recombinant enzyme of Claim 5 or Claim 6, wherein the IgM specific protease activity occurs between position 350 and position 365 of the IgM of SEQ ID NO:105, or

   wherein the IgM specific protease activity occurs at the sequence of SEQ ID NO:110 of an IgM molecule.
8. An isolated nucleic acid molecule comprising a codon-optimized nucleic acid sequence encoding the recombinant enzyme of any one of the preceding claims.

9. The isolated nucleic acid molecule of Claim 8 comprising (i) the sequence set forth in SEQ ID NO:63 or SEQ ID NO:64; (ii) the sequence set forth in SEQ ID NO:66 or SEQ ID NO:67; (iii) the sequence set forth in SEQ ID NO:57 or SEQ ID NO:58; or (iv) the sequence set forth in SEQ ID NO:60 or SEQ ID NO:61.
10. A pharmaceutical formulation, comprising: the recombinant enzyme of any one of Claims 1 – 7.
11. The pharmaceutical formulation of Claim 10 for use in reducing the level of circulating IgM or the levels of circulating IgM and IgG in a subject.
12. The pharmaceutical formulation for use of Claim 11, wherein the reduction of the level of circulating IgM or the levels of circulating IgM and IgG is transient.
13. The pharmaceutical formulation for use of Claim 12, wherein the transient reduction of the level of circulating IgM or the levels of circulating IgM and IgG persists about 6 hours, about 12 hours, about 18 hours, about 24 hours, about 36 hours, about 2 days, about 3 days, about 4 days, about 5 days, about 6 days, about 7 days, about 10 days, about 2 weeks, or more than 2 weeks.
14. The pharmaceutical formulation for use of any one of Claims 11 –13, wherein (i) the subject has received, is receiving, or will receive a recombinant product, (ii) the subject has received, is receiving, or will receive enzyme replacement therapy or protein replacement therapy, (iii) the subject has received, is receiving, or will receive one or more transplanted organs, (iv) the subject has an autoimmune disease or disorder, or (v) the subject has received, is receiving, or will receive gene therapy.
15. The pharmaceutical formulation for use of Claim 14, wherein the recombinant product comprises (i) an encoded transgene product, or (ii) a therapeutic protein or a therapeutic enzyme.