CLAIMS

We claim:

1. An isolated antibody or antigen-binding fragment thereof that specifically bind human and cynomolgus monkey serum transferrin protein and protein A resin, wherein the isolated antibody can be purified by a protein A column and used for half-life extension fragments for short half-life proteins or fragments, and wherein the isolated antibody comprises:

(a) a complementarity determining region (CDR)1 having an amino acid sequence of SEQ ID NO: 46, a CDR2 having an amino acid sequence of SEQ ID NO: 136, and a CDR3 having an amino acid sequence of SEQ ID NO: 226; or

(b) a CDR1 having an amino acid sequence of SEQ ID NO: 62, a CDR2 having an amino acid sequence of SEQ ID NO: 152, and a CDR3 having an amino acid sequence of SEQ ID NO: 242.

2. The isolated antibody or antigen-binding fragment thereof of claim 1, wherein said antibody or antigen-binding fragment thereof is a single domain antibody (sdAb).

3. The isolated antibody or antigen-binding fragment thereof of claim 2, comprising an amino acid sequence at least 95% identical to a sequence selected from the group consisting of SEQ ID NO: 355, 353, 316, 356, 358, 357, 359, 360, 332, and 354.

4. The isolated antibody or antigen-binding fragment thereof of any one of claims 1-3, comprising an amino acid sequence at least 95% identical to the amino acid sequence of AS01274 (QVQLVESGGGLVQPGGSLRLSCVASGSIASIATMAWYRQAPGQQRELVAGITRGGSTKYADSVKGRFTISRDNAKNTLYLQMNSLKPDDTAVYYCTDYSRKYYQDYWGQGTQVTVSS (SEQ ID NO: 316)) or AS01299 (QVQLVESGGGLVQPGGSLRLSCAASGSIFSIATMAWYRQAPGKQRELVAGITRSGSTNYRDSVKGRFTISRDNAKNTMYLQMNSLKPEDTAVYYCTDYSSRYYHDYWGQGTQVTVSS (SEQ ID NO: 332)) or AS01299VH3a (EVQLVESGGGLVQPGGSLRLSCAASGSIFSIATMAWYRQAPGKGLELVAGITRSGSTNYRDSVKGRFTISRDNSKNTMYLQMNSLRAEDTAVYYCTDYSSRYYHDYWGQGTLVTVSS (SEQ ID NO: 354)) or AS01299VH3a-A49 (EVQLVESGGGLVQPGGSLRLSCAASGSIFSIATMAWYRQAPGKGLELVSGITRSGSTNY

RDSVKGRFTISRDNSKNTMYLQMNSLRAEDTAVYYCTDYSSRYYHDYWGQGTLVTVS
S (SEQ ID NO: 356)) or AS01299VH3a-L47
(EVQLVESGGGLVQPGGSLRLSCAASGSIFSIATMAWYRQAPGKGLEWVAGITRSGSTN
YRDSVKGRFTISRDNSKNTMYLQMNSLRAEDTAVYYCTDYSSRYYHDYWGQGTLVTV
SS (SEQ ID NO: 357)) or AS01299VH3a-M78
(EVQLVESGGGLVQPGGSLRLSCAASGSIFSIATMAWYRQAPGKGLELVAGITRSGSTNY
RDSVKGRFTISRDNSKNTLYLQMNSLRAEDTAVYYCTDYSSRYYHDYWGQGTLVTVSS
(SEQ ID NO: 358)) or AS01299VH4
(EVQLVESGGGLVQPGGSLRLSCAASGSIFSIATMAWYRQAPGKGLELVSGITRSGSTNY
RDSVKGRFTISRDNSKNTLYLQMNSLRAEDTAVYYCTDYSSRYYHDYWGQGTLVTVSS
(SEQ ID NO: 359)) or AS01299VH4-L47
(EVQLVESGGGLVQPGGSLRLSCAASGSIFSIATMAWYRQAPGKGLEWVSGITRSGSTNY
RDSVKGRFTISRDNSKNTLYLQMNSLRAEDTAVYYCTDYSSRYYHDYWGQGTLVTVSS
(SEQ ID NO: 360)).

5. The isolated antibody or antigen-binding fragment thereof of any one of claims 1-4, having a dissociation constant (K_D) of 10^{-7} M or less.

6. The isolated antibody or antigen-binding fragment thereof of any one of claims 1-5, wherein the transferrin is a human transferrin or a cynomolgus monkey transferrin.

7. The isolated antibody or antigen-binding fragment thereof of any one of claims 1-6, wherein the isolated antibody or antigen-binding fragment thereof specifically binds human and cynomolgus monkey serum transferrin protein and protein A resin, wherein the isolated antibody or antigen-binding fragment thereof can be purified by a protein A column and used for half-life extension for short half-life proteins or fragments.

8. A polypeptide comprising the isolated antibody or antigen-binding fragment thereof according to any one of claims 1-7.

9. A fusion protein comprising the isolated antibody or antigen-binding fragment thereof according to any one of claims 1-7, a target protein, and optionally a linker, wherein the isolated antibody or antigen-binding fragment thereof is fused to the carboxyl-terminus or amino-terminus of the target protein, and the linker optionally separates the isolated antibody or antigen-binding fragment thereof and the carboxyl-terminus or amino-terminus of the target protein.

10. The fusion protein according to claim 9, wherein the fusion protein is capable of being purified by protein A resin.

11. An isolated nucleic acid sequence encoding the isolated antibody or antigen-binding fragment thereof of any one of claims 1-7, the polypeptide of claim 8 or the fusion protein of claim 9.

12. A composition comprising an effective amount of the fusion protein of claim 9 and transferrin.

13. An *in vitro* method of increasing the half-life of a target protein in the fusion protein of claim 9 or 10, the *in vitro* method comprising exposing the fusion protein to transferrin in cynomolgus monkey serum to thereby increase the half-life of the target protein in the fusion protein.

14. An *in vitro* method of producing the fusion protein of claim 9 or 10, comprising:

(a) obtaining an expression vector encoding the fusion protein;

(b) introducing the expression vector into a cell to obtain a recombinant cell;

(c) growing the recombinant cell under conditions to allow expression of the fusion protein; and

(d) obtaining the fusion protein from the recombinant cell or its supernatant.

15. An *in vitro* method for increasing the half-life of a target protein, the method comprising:

(1) obtaining a fusion protein, wherein the fusion protein comprises the isolated antibody or antigen-binding fragment thereof according to any one of claims 1-7, a target protein, and optionally a linker, wherein the isolated antibody or antigen-binding fragment thereof is fused to the carboxyl-terminus or amino-terminus of the target protein, and the linker optionally separates the isolated antibody or antigen-binding fragment thereof and the carboxyl-terminus or amino-terminus of the target protein, and

(2) exposing the fusion protein to transferrin,

wherein the transferrin increases the half-life of the target protein in the fusion protein compared to the target protein alone.

16. The *in vitro* method of claim 15, wherein the exposing step comprises administering the fusion protein to a serum comprising the transferrin of cynomolgus monkey.

17. An *in vitro* system for increasing the half-life of a target protein, the system comprising:

(a) a first nucleotide sequence encoding the isolated antibody or antigen-binding fragment thereof according to any one of claims 1-7, and optionally a second nucleotide sequence encoding a linker, wherein the first and second nucleotide sequences are operably linked;

(b) a host cell; and

(c) the transferrin.