

Claims

1. An isolated non-naturally occurring recombinant human immunodeficiency virus (HIV) envelope (Env) protein wherein the amino acid at position 658 is chosen from the group consisting of Val, Ile, Phe, Met, and Ala; wherein the numbering of the positions is according to the numbering in gp160 of HIV-1 isolate HXB2 as shown in SEQ ID NO: 1.
2. The recombinant HIV Env protein of claim 1, wherein the amino acid at position 658 is Val.
3. The recombinant HIV Env protein of claim 1, wherein the amino acid at position 658 is Ile.
4. An isolated non-naturally occurring recombinant human immunodeficiency virus (HIV) envelope (Env) protein wherein the amino acid at position 658 is chosen from the group consisting of Val, Ile, Phe, Met, Ala, and Leu, the recombinant HIV Env protein further comprising one or more of the following amino acid residues: (i) Phe, Leu, Met, or Trp, at position 651; (ii) Phe, Ile, Met, or Trp, at position 655; (iii) Asn or Gln, at position 535; (iv) Val, Ile or Ala at position 589; (v) Phe or Trp, at position 573; (vi) Ile at position 204; and/or (vii) Phe, Met, or Ile, at position 647; wherein the numbering of the positions is according to the numbering in gp160 of HIV-1 isolate HXB2 as shown in SEQ ID NO: 1.
5. The recombinant HIV Env protein of claim 4, comprising Val at position 658 and Ile at position 655.
6. The recombinant HIV Env protein of claim 4, comprising Val at position 658 and Phe at position 651.
7. The recombinant HIV Env protein of claim 4, comprising at least two of the amino acid residues of (i) to (vii).
8. The recombinant HIV Env protein of claim 1, wherein the HIV Env protein is a clade A, B, or C HIV Env protein.
9. An isolated non-naturally occurring recombinant human immunodeficiency virus (HIV) envelope (Env) protein wherein the amino acid at position 658 is chosen from the group consisting of Val, Ile, Phe, Met, Ala, and Leu, the recombinant HIV Env protein further comprising Cys at positions 501 and 605 or Pro at position 559 or Cys at positions 501 and 605 and Pro at position 559, wherein the numbering of the positions is according to the numbering in gp160 of HIV-1 isolate HXB2 as shown in SEQ ID NO: 1.
10. An isolated non-naturally occurring recombinant human immunodeficiency virus (HIV) envelope (Env) protein wherein the amino acid at position 658 is chosen from the group consisting of Val, Ile, Phe, Met, Ala, and Leu, the recombinant HIV Env protein further comprising one or more of the following: (viii) Gln, Glu, Ile, Met, Val, Trp, or Phe, at position 588; (ix) Lys at position 64 or Arg at position 66 or Lys at position 64 and Arg at position 66; (x) Trp at position 316; (xi) Cys at both positions 201 and 433; (xii) Pro at position 556 or 558 or at both positions 556 and 558; (xiii) replacement of the loop at amino acid positions 548-568 (HR1-

loop) by a loop having 7-10 amino acids; (xiv) Gly at position 568, or Gly at position 569, or Gly at position 636, or Gly at both positions 568 and 636, or Gly at both positions 569 and 636; and/or (xv) Tyr at position 302, or Arg at position 519, or Arg at position 520, or Tyr at position 302 and Arg at position 519, or Tyr at position 302 and Arg at position 520, or Tyr at position 302 and Arg at both positions 519 and 520, wherein the numbering of the positions is according to the numbering in gp160 of HIV-1 isolate HXB2 as shown in SEQ ID NO: 1.

11. The recombinant HIV Env protein of claim 1, further comprising a mutation in a furin cleavage sequence of the HIV Env protein.

12. The recombinant HIV Env protein of claim 1, being a gp140 or gp160 protein.

13. A composition comprising the recombinant HIV Env protein of claim 1, and a pharmaceutically acceptable carrier.

14. The recombinant HIV Env protein of claim 4, being a gp140 or gp160 protein.

15. A composition comprising the recombinant HIV Env protein of claim 4, and a pharmaceutically acceptable carrier.

16. The recombinant HIV Env protein of claim 4, wherein the HIV Env protein is a clade A, B, or C HIV Env protein.

17. The recombinant HIV Env protein of claim 9, being a gp140 or gp160 protein.

18. A composition comprising the recombinant HIV Env protein of claim 9, and a pharmaceutically acceptable carrier.

19. The recombinant HIV Env protein of claim 9, wherein the HIV Env protein is a clade A, B, or C HIV Env protein.

20. The recombinant HIV Env protein of claim 10, being a gp140 or gp160 protein.

21. A composition comprising the recombinant HIV Env protein of claim 10, and a pharmaceutically acceptable carrier.

22. The recombinant HIV Env protein of claim 10, wherein the HIV Env protein is a clade A, B, or C HIV Env protein.