Claims:

1. A method for producing lentiviral vectors using cells in serum-free suspension culture, wherein the method comprises the following steps:

(a) providing a seed solution of packaging cells, which are packaging cells that grow in suspension;

(b) inoculating the seed solution to a first culture medium in a culture container to obtain a first culture, wherein the first culture medium is a serum-free cell culture medium and the inoculation density is 1×10^6 to 5×10^6 cells/ml and the volume of the first culture medium is 3 to 100 L;

(c) subjecting the first culture to subculture under the set conditions of temperature 30°C to 38°C, dissolved oxygen 35% to 55%, CO_2 concentration 2% to 10% and pH 6.9 to 7.4, monitoring the real-time pH value of the first culture in the subculture process and controlling the concentrations of dissolved oxygen and/or CO_2 based on the real-time pH value, thereby maintaining the pH value in a range of 6.9 to 7.4;

(d) starting a first liquid change operation when a liquid change trigger condition is met, wherein the liquid change trigger condition including:

(s1) real-time pH $\leq$6.9;

(s2) by adjusting the concentrations of oxygen, and/or CO_2, the real-time pH value still shows a downward trend; and

(s3) subculture time $\geq$72 h;

the liquid change operation including: discharging the cell-free supernatant from the culture container, wherein the volume of the culture before discharge of the supernatant is Vq1, the volume of the culture after discharge of the supernatant is Vh1 and the Vq1/Vh1 ratio is 3 to 15; and then replenishing the culture medium to the culture container;

(e) repeating steps (c) and (d) n times, where n is 0, 1, 2 or 3;

(f) performing a transfection operation when a transfection trigger condition is met, the transfection trigger condition including:

(t1) the total cell quantity is $0.05\sim2\times10^{11}$ cells;

(t2) the cell density is $0.5\sim5\times10^6$ cells/ml;

(t3) the cell viability is ≥90%; and

(t4) the total culture time is ≥72 h;

the transfection operation including: mixing one or more plasmids and transfection reagents for the production of the lentiviral vectors and adding them to the culture container, thereby introducing the packaging cells and forming transfected packaging cells;

(g) optionally performing liquid change after transfection;

(h) cultivating the transfected packaging cells under the set conditions of temperature 30℃ to 37℃, dissolved oxygen 35% to 55%, CO_2 concentration 2% to 10% and pH 6.9 to 7.4, monitoring the real-time pH value of the first culture in the subculture process and controlling the concentrations of dissolved oxygen and/or CO_2 based on the real-time pH value, thereby maintaining the pH value in a range of 6.9 to 7.4;

(i) starting a second liquid change operation when a liquid change trigger condition is met,

here, the liquid change trigger condition including:

(s1) real-time pH ≤6.9;

(s2) By adjusting the concentrations of oxygen, and/or CO_2, the real-time pH value still decreases; and

(s3) subculture time ≥72 h;

here, the liquid change operation including: recovering the cell-free virus-containing feed liquid in the culture, wherein the volume of the culture before recovery of the feed liquid is Vq2, the volume of the culture after recovery of the supernatant is Vh2 and the Vq2/Vh2 ratio is 3 to 15;

(j) repeating the steps (h) and (i) m times, where m is 0, 1, 2 or 3;

(k) combining each of the recovered liquids to obtain combined virus-containing supernatant; and

(l) purifying the combined virus-containing supernatant to obtain purified lentiviral vectors;

wherein the culture medium used in each of the above steps is a serum-free cell culture medium.

2. The method according to claim 1, wherein in steps (c) and/or (h), culturing is conducted under a shaking condition.

3. The method according to claim 1, wherein in step (c) and/or (h), the pH value is maintained in the range of 7.0 to 7.35.

4. The method according to claim 1, wherein in steps (d) and/or (i), the Vq1/Vh1 or Vq2/Vh2 ratio is 5 to 10.

5. The method according to claim 1, wherein the total time of the steps (c), (d) and (e) is 72 to 216 h.

6. The method according to claim 1, wherein in step (f), the one or more plasmids include three plasmids or four plasmids.

7. The method according to claim 1, wherein the culture container is a disposable culture container.

8. The method according to claim 1, wherein the method produces 1×10^{12} transducing units (TU) lentiviral vectors.

9. The method according to claim 1, wherein the packaging cells are human embryonic renal epithelial cells.

10. The method according to claim 1, wherein in the step (1), the purification includes: ultrafiltration and chromatography.