We claim:

1. A method for producing an ultra-high density frozen cell bank directly from a population of cultured cells, the method comprising:

a) culturing cells in a perfusion bioreactor to obtain an ultra-high density cell population, wherein said perfusion bioreactor is coupled to a cell retention system comprising an alternating tangential flow filtration system (ATF) comprising a filter, wherein the dissolved oxygen (DO) in the perfusion bioreactor is maintained at ≥30% by setting the rock angle to 10° and the rock speed to 22 rpm for a first time period, manually setting the rock angle to 12° and the rock speed to 25 rpm for a second time period; and

b) adding a cryoprotectant to the ultra-high density cell population to produce an ultra-high density frozen cell bank, wherein the ultra-high density frozen cell bank has a concentration of at least 1.0×10^8 cells/mL and at least 95% post-thaw viability;

wherein no additional concentrating step is performed between culturing the cells and adding the cryoprotectant to the ultra-high density cell population.

2. The method of claim 1, wherein the filter has a surface area of at least 0.08 m^2.

3. The method of claim 2, wherein the filter has a surface area of 0.3 m^2 to 0.5 m^2, 0.5 to 1.0 m^2, 0.7 m^2 to 0.8 m^2, 1.0 m^2 to 2.0 m^2, 2.0 m^2 to 3.0 m^2, 3.0 m^2 to 4.0 m^2, or 4.0 m^2 to 5.5 m^2.

4. The method of any one of claims 1-3, wherein the filter has a pore size selected from the group consisting of 0.7 µm, 1.2 µm, and 7 µm.

5. The method of any one of claims 1-4, wherein the ultra-high density cell population has a cell density selected from the group consisting of 1.0×10^8 cells/mL, 1.1×10^8 cells/mL, 1.2×10^8 cells/mL, 1.3×10^8 cells/mL, 1.4×10^8 cells/mL, 1.5×10^8 cells/mL, 1.6×10^8 cells/mL, 1.7×10^8 cells/mL, 1.8×10^8 cells/mL, 1.9×10^8 cells/mL, and 2.0×10^8 cells/mL.

6. The method of any one of claims 1-5, wherein the step of adding the cryoprotectant comprises adding dimethyl sulphoxide (DMSO) to the ultra-high density cell population at a final concentration of 5% to 10%, vol/vol.

7. The method of any one of claims 1-6, further comprising freezing at least a portion of the ultra-high density cell population in a container appropriate for storage under cryopreservation conditions.

8. The method of claim 7, wherein the container is a vial.

9. The method of claim 8, wherein the ultra-high density frozen cell bank comprises 4.5×10^8 cells/vial.

10. The method of claim 7, wherein the container is a cryobag.

11. The method of claim 10, wherein the ultra-high density frozen cell bank comprises 100×10^8 cells/cryobag.

12. The method of any one of claims 1-11, wherein the ultra-high density frozen cell bank has a cell density of at least 1.1×10^8 cells/mL.

13. The method of any one of claims 1-12, wherein a perfusion rate in the perfusion bioreactor is between 0.02 nL/cell/day and 0.5 nL/cell/day.

14. The method of any one of claims 1-13, wherein a perfusion rate in the perfusion bioreactor is between 0 and 15 reactor volumes per day.

15. The method of any one of claims 1-14, wherein the perfusion bioreactor cell culture has a pH of between 6.8 and 7.2.

16. The method of any one of claims 1-15, wherein the bioreactor is a flexible bag bioreactor.

17. The method of any one of claims 1-16, wherein the cells are mammalian cells.

18. The method of claim 17, wherein the mammalian cells are selected from the group consisting of: CHO, CHO-DBX11, CHO-DG44, CHO-S, CHO-K1, Vero, BHK, HeLa, COS, MDCK, HEK-293, NIH-3T3, W138, BT483, Hs578T, HTB2, BT20, T47D, NSO, CRL7030, HsS78Bst cells, PER.C6, SP2/0-Ag14, and hybridoma cells.

19. The method of any one of claims 1-18, wherein the cells are transfected cells.

20. The method of any one of claims 1-19, wherein the cells express a therapeutic protein.

21. The method of claim 1, wherein:

a) the perfusion bioreactor comprises a flexible bag bioreactor;

b) the filter has a filter surface area of at least 0.08 m^2 and a molecular mass cut off (MWCO) size of at least 50 kDa;

c) the cryoprotectant added to the ultra-high density cell population is DMSO; and

d) the ultra-high density frozen cell bank comprises 5% to 10%, vol/vol DMSO.

22. The method of any one of claims 1-21, wherein the pH and DO of the culture are controlled by automated methods.

23. The method of any one of claims 1-21, wherein the pH and DO of the culture are controlled by non-automated methods.

24. The method of any one of claims 1-23, wherein the ultra-high density cell population is cooled to and maintained at a temperature of 4 °C prior to and during the addition of the cryoprotectant.

25. The method of any one of claims 1-23, wherein the ultra-high density cell population is maintained at a temperature of 20 °C to 26 °C prior and during the addition of the cryoprotectant.

26. The method of any one of claims 1-23, wherein the ultra-high density cell population is maintained at an uncontrolled cold temperature by using an ice water bath prior to and during the addition of the cryoprotectant.

27. The method of any one of claims 1-26, wherein the bioreactor is further rocked at a rock speed of 30 rpm and a rock angle of 12° following the rock speed of 25 rpm and rock angle of 12°.