We claim:

1. An adherent cell culture bioreactor comprising a substrate for adherent cell culture and a pump able to provide a constant-rate output of cell culture media of less than 50 mL of media per 1,800 cells per day, the substrate providing at least 400 m^2 of surface area for adherent cell culture, the bioreactor configured to contain at least about 20 liters of cell culture media.

2. The adherent cell culture bioreactor of claim 1, the pump able to provide a minimum constant-rate output of not more than 16.7 mL of media per 1,800 cells per day.

3. A recombinant polypeptide produced by culturing adherent producer cells in the adherent cell bioreactor of claim 1.

4. The recombinant polypeptide of claim 3, where the polypeptide comprises virus.

5. The recombinant polypeptide of claim 4, where the virus comprises a viral capsid containing a non-viral transgene.

6. A method for culturing adherent cells on a substrate comprising:

   a. obtaining the bioreactor of claim 1, and then

   b. adding to the bioreactor cell culture media and cells, and then

   c. culturing the cells in adherent mode on the substrate, while circulating the cell culture media about the cells at a rate of less than 50 mL of media per 1,800 cells per day.

7. An adherent cell culture bioreactor providing a substrate for adherent cell growth and configured to contain cell culture media and having a pump able to pump said media, the pump configured to be able to provide a constant-rate output of media at an output volume of less than 50 mL media per m^2 substrate area per day, the bioreactor configured to contain at least 20 liters of cell culture media.

8. The adherent cell culture bioreactor of claim 7, the substrate providing at least 60 m^2 of surface area for adherent cell culture.

9. The adherent cell culture bioreactor of claim 8, the substrate providing at least 400 m^2 of surface area for adherent cell culture.

10. The adherent cell culture bioreactor of claim 7, wherein the pump is connected to the substrate via a tube having an interior diameter sized to accommodate the pump output volume of fluid without the formation of air bubbles inside the tube.

11. A recombinant polypeptide produced by culturing adherent producer cells in the adherent cell bioreactor of claim 7.

12. The recombinant polypeptide of claim 11, where the polypeptide comprises virus.

13. The recombinant polypeptide of claim 12, where the virus comprises a viral capsid containing a non-viral transgene.

14. A method for culturing adherent cells on a substrate comprising:

a. obtaining the bioreactor of claim 7, and then

b. adding to the bioreactor cell culture media and cells, and then

c. culturing the cells in adherent mode on the substrate, while circulating the cell culture media about the cells at a rate of less than 50 mL of media per m^2 substrate area per day.

15. The method of claim 14, the substrate providing at least 60 m^2 of surface area for adherent cell culture.

16. The method of claim 15, the substrate providing at least 400 m^2 of surface area for adherent cell culture.

17. The method of claim 14, the bioreactor configured to contain at least 20 liters of cell culture media.

18. A method comprising:

a. obtaining an adherent cell culture bioreactor having a substrate for adherent cell culture and a first sampling tube having an input end and an output end, the input end of the first sampling tube in communication with the substrate whereby liquid can flow from the substrate into the input end of the first sampling tube, through the first sampling tube and exit the bioreactor at the output end of the first sampling tube, and a second sampling tube having an input end and an output end, the input end of the second sampling tube in communication with the substrate

whereby liquid can flow from the substrate into the input end of the second sampling tube, through the second sampling tube and exit the bioreactor at the output end of the second sampling tube; and then

b. adding cell culture media to the bioreactor, seeding cells into the bioreactor and culturing cells adherent to the substrate, and

c. flowing the cell culture media through the first sampling tube, and then

d. removing from the first sampling tube output end at least one removed portion of cell culture media; and then

e. permanently sealing the first sampling tube without returning into the output end of the sampling tube a material amount of the removed portion of cell culture media, and then

f. flowing the cell culture media through the second sampling tube, and then

g. removing from the second sampling tube output end a second removed portion of cell culture media; and then

h. permanently sealing the second sampling tube without returning into the output end of the second sampling tube a material amount of the removed cell culture media.

19. The method of claim 18, wherein the bioreactor is configured to contain at least 20 liters of cell culture media.

20. The method of claim 18, the substrate providing at least 60 m^2 of surface area for adherent cell culture.

21. The method of claim 20, the substrate providing at least 400 m^2 of surface area for adherent cell culture.

22. The method of claim 18, wherein (b) the cells adherent to the substrate express a recombinant polypeptide.

23. The recombinant polypeptide produced by the method of claim 22.

24. The recombinant polypeptide of claim 23, where the polypeptide comprises virus.

25. The recombinant polypeptide of claim 24, where the virus comprises a viral capsid containing a non-viral transgene.

26. An adherent cell culture bioreactor comprising:

a. a substrate for adherent cell culture in flowable communication with at least two pairs of closable sampling tubes, whereby cell culture media can flow from the substrate through each sampling tube, and whereby each sampling tube may be aseptically closed after cell culture media flows from the substrate through the sampling tube, to prevent further media flow through the sampling tube; and

b. at least one of each pair of sampling tubes configured to be aseptically attached to a detachable sampling container; and

c. a second pair of closable sampling tubes, at least one of the second pair of sampling tubes configured to be aseptically attached to a detachable sampling container.

27. The bioreactor of claim 26, configured to contain at least 20 liters of cell culture media.

28. The bioreactor of claim 26, further comprising a third pair of closable sampling tubes, at least one of the third pair of sampling tubes configured to be aseptically attached to a detachable sampling container.

29. The bioreactor of claim 26, the substrate providing at least 60 m^2 of surface area for adherent cell culture.

30. The bioreactor of claim 29, the substrate providing at least 400 m^2 of surface area for adherent cell culture.

31. A recombinant polypeptide produced by the bioreactor of claim 26.

32. The recombinant polypeptide of claim 31, where the polypeptide comprises virus.

33. The recombinant polypeptide of claim 32, where the virus comprises a viral capsid containing a non-viral transgene.

34. An adherent cell culture bioreactor vessel having a substrate for adherent cell culture and a pump able to provide a constant-rate output of cell culture

media sufficient to exchange the cell culture media in the vessel less than once every 3 ½ days.

35. The adherent cell culture bioreactor of claim 34, the pump able to provide a constant-rate output of cell culture media sufficient to exchange the cell culture media in the vessel less than once every 4 ½ days.

36. The adherent cell culture bioreactor of claim 34, the substrate providing at least 60 m^2 of surface area for adherent cell culture.

37. The adherent cell culture bioreactor of claim 36, the substrate providing at least 400 m^2 of surface area for adherent cell culture.

38. The adherent cell culture bioreactor of claim 34, configured to contain at least 20 liters of cell culture media.

39. A recombinant polypeptide produced by culturing adherent producer cells in the adherent cell bioreactor of claim 34.

40. The recombinant polypeptide of claim 39, where the polypeptide comprises virus.

41. The recombinant polypeptide of claim 40, where the virus comprises a viral capsid containing a non-viral transgene.

42. A method for culturing adherent cells on a substrate comprising:

a. obtaining the bioreactor of claim 34, and then

b. adding to the bioreactor cell culture media and cells, and then

c. culturing the cells in adherent mode on the substrate, while circulating the cell culture media about the cells at a rate of less than 50 mL of media per 1,800 cells per day.

43. A method for culturing adherent cells on a substrate comprising:

a. obtaining an adherent cell culture bioreactor vessel having a substrate for adherent cell culture and a pump able to provide a constant-rate output of cell culture media sufficient to exchange the cell culture media in the vessel less than once every 3 ½ days, and then

b. adding to the bioreactor cell culture media and cells, and then

c. culturing the cells in adherent mode on the substrate, while circulating the cell culture media about the cells at a rate of less than 50 mL of media per 1,800 cells per day, the substrate providing at least 400 m^2 of surface area for adherent cell culture.

44. The method of claim 42, the bioreactor configured to contain at least 20 liters of cell culture media.