WHAT IS CLAIMED IS:

1. A method of purifying full adeno-associated virus (AAV) capsids from a concentrated AAV fraction comprising empty AAV capsids and full AAV capsids, comprising:

(i) loading into a zonal rotor a) the concentrated AAV fraction and b) at least two sugar solutions, each of which has a different sugar concentration and each of which comprises a sugar at a concentration equivalent to a sucrose concentration ranging from about 45% (w/w) to about 65% (w/w) sucrose,

(ii) operating an ultracentrifuge comprising the zonal rotor in batch mode, whereupon a sugar gradient is formed,

(iii) obtaining a fraction of the sugar gradient to obtain an AAV fraction wherein at least or about 60% of the AAV particles in the AAV fraction are full AAV capsids,

wherein (A) the volume of the sugar solutions is greater than or equal to about 50% of the volume of the zonal rotor, (B) the total volume of the sugar solutions and the AAV fraction is less than or equal to the volume of the zonal rotor, (C) the ratio of the volume of the sugar solutions to the volume of the AAV fraction is less than or equal to one, or (D) a combination thereof.

2. The method of claim 1, wherein each sugar solution comprises a sugar at a concentration equivalent to a sucrose concentration ranging from about 50% (w/w) to about 60% (w/w) sucrose.

3. The method of claim 1 or claim 2, wherein each sugar solution comprises a sugar at a concentration equivalent to a sucrose concentration ranging from about 55% (w/w) to about 60% (w/w) sucrose.

4. The method of claim 1 or claim 2, wherein at least one of the sugar solutions comprises sugar at a concentration equivalent to a sucrose concentration greater than about 50% (w/w) sucrose.

5. The method of any one of claims 1-4, wherein at least one of the sugar solutions comprises sugar at a concentration equivalent to a sucrose concentration greater than about 55% (w/w) sucrose.

6. The method of any one of claims 1-5, wherein at least one of the sugar solutions comprises sugar at a concentration equivalent to a sucrose concentration ranging from about 60% (w/w) to about 65% (w/w) sucrose.

7. The method of any one of claims 1, 2, or 4-6, wherein one sugar solution comprises a sugar at a concentration equivalent to a sucrose concentration ranging from about 52% (w/w) to about 58% (w/w) sucrose, wherein a second sugar solution comprises a sugar at a concentration equivalent to a sucrose concentration ranging from about 57% (w/w) to about 63% (w/w) sucrose, and optionally wherein a third sugar solution comprises a sugar at a concentration equivalent to a sucrose concentration ranging from about 47% (w/w) to about 53% (w/w) sucrose.

8. The method of any one of claims 1-7, wherein two sugar solutions are loaded into the zonal rotor.

9. The method of any one of claims 1, 2, or 4-8, wherein two sugar solutions are loaded into the zonal rotor and wherein one sugar solution comprises a sugar at a concentration equivalent to a sucrose concentration ranging from about 52% (w/w) to about 58% (w/w) sucrose and a second sugar solution comprises a sugar at a concentration equivalent to a sucrose concentration ranging from about 57% (w/w) to about 63% (w/w) sucrose.

10. The method of any one of claims 1-7, wherein at least three sugar solutions are loaded into the zonal rotor.

11. The method of any one of claims 1-7 or 10, wherein three sugar solutions are loaded into the zonal rotor.

12. The method of any one of claims 1, 2, 4-7, 10, or 11, wherein three sugar solutions are loaded into the zonal rotor and wherein one sugar solution comprises a sugar at a concentration equivalent to a sucrose concentration ranging from about 47%

(w/w) to about 53% (w/w) sucrose, a second sugar solution comprises a sugar at a concentration equivalent to a sucrose concentration ranging from about 52% (w/w) to about 58% (w/w) sucrose, and a third sugar solution comprises a sugar at a concentration equivalent to a sucrose concentration ranging from about 57% (w/w) to about 63% (w/w) sucrose.

13. The method of any one of claims 1, 2, or 4-12, wherein in step (i), the concentrated AAV fraction is loaded before a sugar solution comprising a sugar at a concentration equivalent to a sucrose concentration ranging from about 52% (w/w) to about 58% (w/w) sucrose, and wherein the sugar solution comprising a sugar at a concentration equivalent to a sucrose concentration ranging from about 52% (w/w) to about 58% (w/w) sucrose is loaded before a sugar solution comprising a sugar at a concentration equivalent to a sucrose concentration ranging from about 57% (w/w) to about 63% (w/w) sucrose.

14. The method of any one of claims 1, 2, 4-7, or 10-13, wherein in step (i), the concentrated AAV fraction is loaded before a sugar solution comprising a sugar at a concentration equivalent to a sucrose concentration ranging from about 47% (w/w) to about 53% (w/w) sucrose, wherein the sugar solution comprising a sugar at a concentration equivalent to a sucrose concentration ranging from about 47% (w/w) to about 53% (w/w) sucrose is loaded before a sugar solution comprising a sugar at a concentration equivalent to a sucrose concentration ranging from about 52% (w/w) to about 58% (w/w) sucrose, and wherein the sugar solution comprising a sugar at a concentration equivalent to a sucrose concentration ranging from about 52% (w/w) to about 58% (w/w) sucrose is loaded before a sugar solution comprising a sugar at a concentration equivalent to a sucrose concentration ranging from about 57% (w/w) to about 63% (w/w) sucrose.

15. The method of any one of claims 1-14, wherein each sugar solution is loaded in the zonal rotor at equal volumes.

16. The method of any one of claims 1-14, wherein the sugar solution with the smallest sugar concentration is loaded in the zonal rotor at a volume which is twice the volume of at least one of the other sugar solutions in the zonal rotor.

17. The method of any one of claims 1-14 or 16, wherein the sugar solution with the smallest sugar concentration is loaded in the zonal rotor at a volume which is at least the volume of all other sugar solutions combined in the zonal rotor.

18. The method of claim 1-14, 16, or 17, wherein the sugar solution with the smallest sugar concentration is loaded in the zonal rotor at a volume which is at least twice the volume of the sugar solution with the largest sugar concentration, optionally, wherein the volume of the sugar solution with the largest sugar concentration is equal to the volume of the sugar solution with the intermediate sugar concentration.

19. The method of any one of claims 1-14 or 16-18, wherein at least two sugar solutions are loaded into the zonal rotor, wherein the sugar solution with the smallest sugar concentration is loaded in the zonal rotor at a volume which is at least twice the volume of at least one other sugar solution in the zonal rotor.

20. The method of any one of claims 1-19, wherein at least two sugar solutions are loaded into the zonal rotor, wherein the sugar solution with the smallest sugar concentration is loaded in the zonal rotor at a volume which is the same volume of at least one other sugar solution in the zonal rotor.

21. The method of any one of claim 1-20 wherein the sugar solution with the smallest sugar concentration is loaded in the zonal rotor at a volume which is half the volume of the concentrated AAV fraction.

22. The method of any one of claims 1-21, where in the ratio of the volume of the total sugar gradient to the volume of the AAV fraction loaded in the zonal rotor is from about 1:1 to about 1:5.

23. The method of any one of claims 1-22, wherein the AAV fraction comprises a buffered solution.

24. The method of claim 23, wherein the buffered solution comprises TrisHCl and NaCl.

25. The method of claim 24, wherein the TrisHCl is at a concentration of about 20 to about 50 mM and the NaCl is at a concentration of about 150 mM to about 900 mM.

26. The method of any one of claims 23-25, wherein the buffered solution has a pH of about 7.4 to about 9.0.

27. The method of any one of claims 23-26, wherein the buffered solution comprises 45-55% (w/w) ethylene glycol.

28. The method of any one of the previous claims, wherein each sugar solution comprises a disaccharide or trisaccharide.

29. The method of claim 28, wherein the disaccharide comprises sucrose, maltose, lactose, and combinations thereof.

30. The method of any one of the previous claims, wherein each sugar solution comprises sucrose.

31. The method of any one of the previous claims, wherein each of the sugar solutions further comprises TrisHCl and NaCl.

32. The method of claim 31, wherein the TrisHCl is at a concentration of about 20 to about 50 mM and the NaCl is at a concentration of about 150 mM to about 500 mM.

33. The method of claim 31 or claim 32, wherein the buffered solution has a pH of about 7.4 to about 8.5.

34. The method of any one of the previous claims, comprising operating the ultracentrifuge at a first rotational speed of less than 10,000 rpm for less than 60 minutes, and at a second rotational speed within the range of about 30,000 to about 40,000 rpm for at least 4 hours.

35. The method of any one of the previous claims, comprising operating the ultracentrifuge at a first rotational speed of less than 10,000 rpm for less than 60 minutes, and at a second rotational speed within the range of about 30,000 to about 40,000 rpm for at least 12 hours.

36. The method of claim 34 or claim 35, wherein the first rotational speed is about 3,000 rpm to about 6,000 rpm, optionally, about 4,000 rpm.

37. The method of claim 34 or claim 36, wherein the second rotational speed is about 35,000 rpm and optionally is maintained for about 4 to about 6 hours.

38. The method of any one of claims 34-36, wherein the second rotational speed is maintained for at least about 16 hours or at least 20 hours.

39. The method of any one of claims 34-36 or 38, wherein the second rotational speed is about 35,000 rpm and optionally is maintained for about 16 to about 20 hours.

40. The method of any one of the previous claims, wherein the concentrated AAV fraction loaded into the zonal rotor comprises at least 1 x 10^{12} AAV capsids per mL.

41. The method of any one of the previous claims, comprising harvesting a supernatant from a cell culture comprising HEK293 cells transfected with a triple plasmid system.

42. The method of claim 41, comprising harvesting the supernatant about 3 to about 5 days after transfection of the HEK293 cells or when the cell culture has a cell density of greater than or about 5x10^{6} cells/mL and has a cell viability of greater than 50%.

43. The method of claim 41 or claim 42, comprising filtering the harvested supernatant via depth filtration.

44. The method of claim 43, comprising filtering the harvested supernatant through a filter comprising cellulose and perlites and having a minimum permeability of about 500 L/m^2.

45. The method of claim 43, comprising filtering the harvested supernatant through a filter with a minimum pore size of about 0.2 μm.

46. The method of any one of the previous claims, comprising (i) applying an AAV fraction to an anion exchange (AEX) chromatography column under conditions that allow for the AAV to flow through the AEX chromatography column and (ii) collecting the flow-through comprising the AAV.

47. The method of claim 46, wherein the AAV fraction is applied to the AEX chromatography column with a loading buffer comprising about 100 mM to about 150 mM NaCl, optionally, wherein the pH of the loading buffer is about 8 to about 9.

48. The method of claim 47, wherein the loading buffer comprises about 115 mM to about 130 mM NaCl, optionally, wherein the loading buffer comprises about 120 mM to about 125 mM NaCl.

49. The method of any one of the previous claims, comprising concentrating an AAV fraction using an ultra/diafiltration system.

50. The method of claim 49, comprising concentrating an AAV fraction using an ultra/diafiltration system before, after, or before and after a step comprising applying an AAV fraction to an anion exchange (AEX) chromatography column under conditions that allow for the AAV to flow through the AEX chromatography column.

51. The method of any one of the previous claims, wherein host cell proteins are removed.

52. The method of claim 51, wherein the host cell proteins are HSP70 and/or LDH.

53. The method of any one of the previous claims, further comprising inactivating lipid enveloped viruses of an AAV fraction with a solvent and/or detergent.

54. The method of any one of the previous claims, further comprising nanofiltration of an AAV fraction to remove viruses greater than 35 nm.

55. The method of any one of the previous claims, further comprising a polish step comprising performing AEX chromatography with a column comprising tentacle gel.

56. A method of producing an AAV product comprising (i) transfecting host cells with three plasmids, (ii) collecting a supernatant of a cell culture comprising the transfected host cells, and (iii) carrying out a method in accordance with any one of claims 1-55.

57. The method of claim 56, wherein the steps of the method occur in the order as shown in Figure 1.

58. The method of any one of the previous claims, comprising testing an AAV fraction via an AAV-specific ELISA.

59. The method of claim 58, wherein the method does not include a step of measuring potency via quantitative PCR.

60. The method of claim 58 or claim 59, wherein the AAV specific ELISA is a sandwich ELISA specific for AAV.

61. The method of any one of the previous claims, wherein the method comprises a first sugar solution comprising a sugar at a concentration equivalent to a sucrose concentration of about 55%, a second sugar solution comprising a sugar at a concentration equivalent to a sucrose concentration of about 60%, and optionally a third sugar solution comprising a sugar at a concentration equivalent to a sucrose concentration of about 50%.

62. The method of any one of the previous claims, wherein AAV is AAV1, AAV2, AAV3, AAV4, AAV5, AAV6, AAV7, AAV8, AAV9, or AAV10

63. The method of any one of the previous claims, wherein AAV is AAV8.

64. An AAV product produced by a method according to any one of claims 1-63.

65. A pharmaceutical composition comprising an AAV product produced by a method according to any one of claims 1-63.