FORMULATIONS FOR VIRAL VECTORS

FIELD OF THE INVENTION

[0001] The present disclosure relates generally to formulations comprising viral vectors. The formulations comprise agents that prevent aggregation of the viral vectors providing stable formulations that are easily administered.

BACKGROUND

[0002] Viral vectors are vehicles for delivery of therapeutic nucleic acids in vaccines and gene therapies. To produce viral vectors, production cells are grown and transfected, typically a plasmid. The viral vector is then harvested from the cells and formulated for use. Achieving high vector concentrations without aggregation is a significant technical bottleneck in manufacturing viral vectors.

[0003] Viral particles can form aggregates, which increases their resistance to resist environmental stress and degradation by disinfectants. Aggregation is influenced by cell type and cell-related impurities, the type of virus, biochemical properties of the virus (e.g. virus size and shape, isoelectric point, etc.), physiochemical factors (e.g. pH, ionic strength) as well as operational factors (e.g. process temperature). While research on viral aggregation began in the 1950s, the phenomenon continues to be studied and viewed as one of the main challenges in viral vector manufacturing.

[0004] Viral aggregation affects downstream processing of therapeutics and their suitability for administration. Viral aggregation occurs due to electrostatic and hydrophobic interactions and aggregated virus particles can cause complications in downstream processing, leading to significant vector losses and decreased yields during membrane-based processes, such as filtration, and subsequent purification steps. Furthermore, aggregates impact readouts of virus infectivity that provide an indicator of the final product quality.

SUMMARY

[0005] The present disclosure is directed to a formulation comprising: a viral vector; a buffer; and a globular protein. In some examples, the globular protein is albumin, alpha-fetoprotein, vitamin D-binding protein, afamin a globin protein, alpha globulin, beta globulin, gamma globulin, or combinations thereof. In some examples, the formulation is a liquid. In some examples,

the formulation comprises from about 0.1% to about 5.0% globular protein. In some examples the formulation comprises from about 0.5% to about 2.0% globular protein. In some examples, the formulation comprises from about 0.75% to about 1.5% globular protein. In some examples, the formulation comprises from about 0.8% to about 1.2% globular protein. In some examples, the formulation comprises about 1.0% globular protein.

[0006] The present disclosure is also directed to a formulation comprising: a viral vector; a buffer; and an albumin. In some examples, the albumin is human serum albumin, bovine serum albumin, ovalbumin or lactalbumin. In some examples, the formulation is a liquid. In some examples, the formulation comprises from about 0.1% to about 5.0% albumin. In some examples, the formulation comprises from about 0.5% to about 2.0% albumin. In some examples, the formulation comprises from about 0.75% to about 1.5% albumin. In some examples, the formulation comprises from about 0.8% to about 1.2% albumin. In some examples, the formulation comprises about 1.0% albumin.

[0007] In one aspect, the present disclosure is also directed to a formulation comprising: a viral vector; a buffer; and a polysaccharide. In some examples, the polysaccharide is a glycosaminoglycan. In some examples, the polysaccharide is sodium hyaluronate, heparan, heparan sulfate, heparin, chondroitin, chondroitin sulfate, dermatan, dermatan sulfate, keratan, keratan sulfate, algin, chitosan, chitosan sulfate, dextran, dextran sulfate, or combinations thereof. In some examples, the polysaccharide is sodium hyaluronate. In some examples, the formulation is a liquid. In some examples, the formulation comprises from about 0.01 ng/mL to about 1 mg/mL polysaccharide. In some examples, the formulation comprises from about 0.05 ng/mL to about 0.5 mg/mL polysaccharide. In some examples, the formulation comprises from about 0.1 ng/mL to about 0.3 mg/mL polysaccharide. In some examples, the formulation comprises from about 0.15 ng/mL to about 0.25 mg/mL polysaccharide. In some examples, the formulation comprises about 0.2 ng/mL polysaccharide. In some examples, the formulation comprises from about 0.01 ng/mL to about 1 mg/mL sodium hyaluronate. In some examples, the formulation comprises from about 0.05 ng/mL to about 0.5 mg/mL sodium hyaluronate. In some examples, the formulation comprises from about 0.1 ng/mL to about 0.3 mg/mL sodium hyaluronate. In some examples, the formulation comprises from about 0.15 ng/mL to about 0.25 mg/mL sodium hyaluronate. In some examples, the formulation comprises about 0.2 ng/mL sodium hyaluronate.

[0008] In some examples, the present disclosure also provides formulations comprising both a globular protein and a polysaccharide. In some examples, the present disclosure provides

formulations comprising both albumin and a polysaccharide. In some examples of these formulations, the polysaccharide is sodium hyaluronate.

[0009] In some examples of the formulations herein, the formulation is a liquid. In some examples of the liquid formulation, the formulation comprises from about 2 mM to about 100 mM buffer. In some examples of the liquid formulation, the formulation comprises from about 5 mM to about 50 mM buffer. In some examples of the liquid formulation, the formulation comprises from about 15 mM to about 25 mM buffer. In some examples of the liquid formulation, the formulation comprises about 20 mM buffer.

[0010] In some examples of the formulations herein, the buffer is sodium phosphate, L-histidine, tris, succinate, sodium citrate or a combination thereof.

[0011] In some examples, the formulations herein further comprise a sugar. In some examples of the formulations comprising a sugar, the formulation is a liquid. In some examples of the liquid formulation comprising a sugar, the formulation comprises from about 50 mM to about 500 mM sugar. In some examples of the liquid formulation comprising a sugar, the formulation comprises from about 100 mM to about 400 mM sugar. In some examples of the liquid formulation comprising a sugar, the formulation comprises from about 250 mM to about 350 mM sugar. In some examples of the liquid formulation comprising a sugar, the formulation comprises about 290 mM sugar. In some examples of the formulations comprising a sugar, the sugar is sucrose, lactose, glucose, trehalose, or combinations thereof. In some examples, the sugar is sucrose.

[0012] In some examples, the formulations herein further comprise a surfactant. In some examples of the formulations comprising a surfactant, the formulation is a liquid. In some examples of the liquid formulation comprising a surfactant, the formulation comprises from about 0.01% to about 0.1% surfactant. In some examples of the liquid formulation comprising a surfactant, the formulation comprises from about 0.015% to about 0.025% surfactant. In some examples of the liquid formulation comprising a surfactant, the formulation comprises about 0.02% surfactant. In some examples of the formulations comprising a surfactant, the surfactant is polysorbate 80, polysorbate 20 or Kolliphor P188.

[0013] In some examples, the formulations herein further comprise sodium chloride. In some examples of the formulations comprising sodium chloride, the formulation is a liquid. In some examples of the liquid formulations comprising sodium chloride, the formulation comprises

from about 10 mM to about 500 mM sodium chloride. In some examples of the liquid formulations comprising sodium chloride, the formulation comprises from about 50 mM to about 300 mM sodium chloride. In some examples of the liquid formulations comprising sodium chloride, the formulation comprises from about 100 mM to about 200 mM sodium chloride. In some examples of the liquid formulations comprising sodium chloride, the formulation comprises about 150 mM sodium chloride.

[0014] In some examples of the formulations disclosed herein, the formulation is a freeze-dried solid. In some examples of the freeze dried formulations, the buffer is sodium phosphate, L-histidine, sodium citrate or a combination thereof. In some examples of the freeze dried formulations, the formulations further comprise a sugar. In some examples, the sugar is sucrose, lactose, glucose, trehalose, or combinations thereof. In some examples, the sugar is sucrose. In some examples of the freeze dried formulations, the formulations further comprise a surfactant. In some examples, the surfactant is polysorbate 80, polysorbate 20 or Kolliphor P188. In some examples of the freeze dried formulations, the formulations further comprise sodium chloride.

[0015] In some examples of any of the formulations herein, the formulation has a Z-average of less than or equal to about 50 nm. In some examples, the formulation has a Z-average of less than or equal to about 40 nm. In some examples, the formulation has a Z-average of less than or equal to about 31 nm. In some examples, the formulation has a Z-average of less than or equal to about 25 nm. In some examples, the formulation has a Z-average of less than or equal to about 20 nm.

[0016] In some examples of any of the formulations herein, the formulation has a polydispersity index of less than or equal to about 0.5. In some examples, the formulation has a polydispersity index of less than or equal to about 0.35. In some examples, the formulation has a polydispersity index of less than or equal to about 0.3.

[0017] In some examples of any of the formulations herein, the viral vector is an adeno-associated viral vector, an adenoviral vector, a lentiviral vector, a retroviral vector, a herpes simplex viral vector or a hybrid vector. In some examples, the viral vector is an adenoviral vector. In some examples, the viral vector is an adeno-associated viral vector.

[0018] In some examples of any of the formulations herein, the formulation is formulated for administration to a human.

[0019] In one aspect, the present disclosure also provides a method for reducing aggregation of a viral vector in a formulation, comprising formulating the viral vector in any of the formulations disclosed herein.

[0020] In some examples, the present disclosure also provides a formulation comprising: from about 10 X 10^8 vg/mL to about 10 X 10^{13} vg/mL of a viral vector; from about 5 mM to about 40 mM sodium phosphate; from about and 200 mM to about 400 mM sucrose; and from about 0.1% to about 5.0% of an albumin. In some examples, the albumin is human serum albumin, bovine serum albumin or combinations thereof. In some examples, the formulation comprises from about 10 X 10^9 vg/mL to about 10 X 10^{11} vg/mL of the viral vector. In some examples, the viral vector is an adeno-associated viral vector, an adenoviral vector, a lentiviral vector, a retroviral vector, a herpes simplex viral vector or a hybrid vector.

[0021] In one aspect, the present disclosure also provides a formulation comprising: from about 10 X 10^8 vg/mL to about 10 X 10^{13} vg/mL of a viral vector; from about 5 mM to about 40 mM sodium phosphate; from about and 200 mM to about 400 mM sucrose; and from about 0.05 mg/mL to about 0.4 mg/mL sodium hyaluronate. In some examples, the formulation comprises from about 10 X 10^9 vg/mL to about 10 X 10^{11} vg/mL of the viral vector. In some examples, the viral vector is an adeno-associated viral vector, an adenoviral vector, a lentiviral vector, a retroviral vector, a herpes simplex viral vector or a hybrid vector. In another aspect, the present disclosure provides a method of preparing a viral vector formulation, the method comprising obtaining a composition comprising the viral vector; and adding sodium hyaluronate to the composition to form the formulation, wherein the sodium hyaluronate is added in an amount sufficient to provide a Z-average of less than or equal to about 50 nm. In yet another aspect, the present disclosure provides a method of preparing a viral vector formulation, the method comprising obtaining a composition comprising the viral vector; and adding sodium hyaluronate to the composition to form the formulation, wherein the sodium hyaluronate is added in an amount sufficient to provide a polydispersity index of less than or equal to about 0.5.

BRIEF DESCRIPTION OF DRAWINGS

[0022] The following drawings form part of the present specification and are included to further demonstrate exemplary embodiments of certain aspects of the present invention.

[0023] Figure 1 shows a bar plot of viral genome titers for the impact of DNase I digestion and thermal capsid opening step on the AAV2 titration with qPCR as described in Example 5.1.

[0024] Figure 2 shows a bar plot of AAV2 titer quantification of mixed samples compared to not mixed samples upon 24h storage in Eppendorf tubes as described in Example 5.1.

[0025] Figures 3A and 3B show transmission electron microscopy (TEM) images of AAV2 samples as described in Example 5.1: (A) AAV2 sample with a titer of $1 \cdot 10^{10}$ vg/mL prepared with the standard sample preparation protocol and (B) AAV2 sample with a titer of $1 \cdot 10^{11}$ vg/mL prepared with the modified sample preparation protocol.

[00278] The present further discloses the following items:

1. A formulation comprising:
   a viral vector;
   a buffer; and
   a globular protein.

2. The formulation of item 1, wherein the globular protein is albumin, alpha-fetoprotein, vitamin D-binding protein, afamin, a globin protein, alpha globulin, beta globulin, gamma globulin, or combinations thereof.

3. The formulation of item 1 or 2, wherein the formulation is a liquid.

4. The formulation of item 3, wherein the formulation comprises from about 0.1% to about 5.0% globular protein.

5. The formulation of item 3, wherein the formulation comprises from about 0.5% to about 2.0% globular protein.

6. The formulation of item 3, wherein the formulation comprises from about 0.75% to about 1.5% globular protein.

7. The formulation of item 3, wherein the formulation comprises from about 0.8% to about 1.2% globular protein.

8. The formulation of item 3, wherein the formulation comprises about 1.0% globular protein.

9. A formulation comprising:
   a viral vector;
   a buffer; and
   an albumin.

10. The formulation of item 1, wherein the albumin is human serum albumin, bovine serum albumin, ovalbumin or lactalbumin.

11. The formulation of item 9 or 10, wherein the formulation is a liquid.

12. The formulation of item 11, wherein the formulation comprises from about 0.1% to about 5.0% albumin.

13. The formulation of item 11, wherein the formulation comprises from about 0.5% to about 2.0% albumin.

14. The formulation of item 11, wherein the formulation comprises from about 0.75% to about 1.5% albumin.

15. The formulation of item 11, wherein the formulation comprises from about 0.8% to about 1.2% albumin.

16. The formulation of item 11, wherein the formulation comprises about 1.0% albumin.

17. A formulation comprising:
a viral vector;
a buffer; and
a polysaccharide.

18. The formulation of item 17, wherein the polysaccharide is sodium hyaluronate, heparan, heparan sulfate, heparin, chondroitin, chondroitin sulfate, dermatan, dermatan sulfate, keratan, keratan sulfate, algin, chitosan, chitosan sulfate, dextran, dextran sulfate or combinations thereof.

19. The formulation of item 17, wherein the polysaccharide is sodium hyaluronate.

20. The formulation of any one of items 17-19, wherein the formulation is a liquid.

21. The formulation of item 20, wherein the formulation comprises from about 0.01 ng/mL to about 1 mg/mL polysaccharide.

22. The formulation of item 20, wherein the formulation comprises from about 0.05 ng/mL to about 0.5 mg/mL polysaccharide.

23. The formulation of item 20, wherein the formulation comprises from about 0.1 ng/mL to about 0.3 mg/mL polysaccharide.

24. The formulation of item 20, wherein the formulation comprises from about 0.15 ng/mL to about 0.25 mg/mL polysaccharide.

25. The formulation of item 20, wherein the formulation comprises about 0.2 ng/mL polysaccharide.

26. The formulation of item 20, wherein the formulation comprises from about 0.01 ng/mL to about 1 mg/mL sodium hyaluronate.

27. The formulation of item 20, wherein the formulation comprises from about 0.05 ng/mL to about 0.5 mg/mL sodium hyaluronate.

28. The formulation of item 20, wherein the formulation comprises from about 0.1 ng/mL to about 0.3 mg/mL sodium hyaluronate.

29. The formulation of item 20, wherein the formulation comprises from about 0.15 ng/mL to about 0.25 mg/mL sodium hyaluronate.

30. The formulation of item 20, wherein the formulation comprises about 0.2 ng/mL sodium hyaluronate.

31. The formulation of any one of items 1-8 and 17-30, wherein the formulation comprises both a globular protein and a polysaccharide.

32. The formulation of any one of items 9-30, wherein the formulation comprises both albumin and a polysaccharide.

33. The formulation of item 31 or 32, wherein the polysaccharide is sodium hyaluronate.

34. The formulation of any one of items 1-33, wherein the formulation is a liquid and wherein the formulation comprises from about 2 mM to about 100 mM buffer.

35. The formulation of any one of items 1-33, wherein the formulation is a liquid and wherein the formulation comprises from about 5 mM to about 50 mM buffer.

36. The formulation of any one of items 1-33, wherein the formulation is a liquid and wherein the formulation comprises from about 15 mM to about 25 mM buffer.

37. The formulation of any one of items 1-33, wherein the formulation is a liquid and wherein the formulation comprises about 20 mM buffer.

38. The formulation of any one of items 1-37, wherein the buffer is sodium phosphate, L-histidine, sodium citrate or a combination thereof.

39. The formulation of any one of items 1-38, further comprising a sugar.

40. The formulation of item 18, wherein the formulation is a liquid and wherein the formulation comprises from about 50 mM to about 500 mM sugar.

41. The formulation of item 18, wherein the formulation is a liquid and wherein the formulation comprises from about 100 mM to about 400 mM sugar.

42. The formulation of item 18, wherein the formulation is a liquid and wherein the formulation comprises from about 250 mM to about 350 mM sugar.

43. The formulation of item 18, wherein the formulation is a liquid and wherein the formulation comprises about 290 mM sugar.

44. The formulation of any one of items 39-43, wherein the sugar is sucrose, lactose, glucose, trehalose, or combinations thereof.

45. The formulation of any one of items 39-43, wherein the sugar is sucrose.

46. The formulation of any one of items 1-45, further comprising a surfactant.

47. The formulation of item 46, wherein the formulation is a liquid and wherein the formulation comprises from about 0.01% to about 0.1% surfactant.

48. The formulation of item 25, wherein the formulation is a liquid and wherein the formulation comprises from about 0.015% to about 0.025% surfactant.

49. The formulation of item 25, wherein the formulation is a liquid and wherein the formulation comprises about 0.02% surfactant.

50. The formulation of any one of items 46 to 49, wherein the surfactant is polysorbate 80, polysorbate 20 or Kolliphor P188.

51. The formulation of any one of items 1-49, further comprising sodium chloride.

52. The formulation of item 51, wherein the formulation is a liquid and wherein the formulation comprises from about 10 mM to about 500 mM sodium chloride.

53. The formulation of item 51, wherein the formulation is a liquid and wherein the formulation comprises from about 50 mM to about 300 mM sodium chloride.

54. The formulation of item 51, wherein the formulation is a liquid and wherein the formulation comprises from about 100 mM to about 200 mM sodium chloride.

55. The formulation of item 51, wherein the formulation is a liquid and wherein the formulation comprises about 150 mM sodium chloride.

56. The formulation of any one of items 1, 2, 9, 10 or 17-19, wherein the formulation is a freeze-dried solid.

57. The formulation of item 56, wherein the buffer is sodium phosphate, L-histidine, tris, succinate, sodium citrate or a combination thereof.

58. The formulation of item 56 or 57, further comprising a sugar.

59. The formulation of item 58, wherein the sugar is sucrose, lactose, glucose, trehalose, or combinations thereof.

60. The formulation of item 58, wherein the sugar is sucrose.

61. The formulation of any one of items 56-60, further comprising a surfactant.

62. The formulation of item 61, wherein the surfactant is polysorbate 80, polysorbate 20 or Kolliphor P188.

63. The formulation of any one of items 56-62, further comprising sodium chloride.

64. The formulation of any one of items 1-63, wherein the formulation has a Z-average of less than or equal to about 50 nm.

65. The formulation of any one of items 1-63, wherein the formulation has a Z-average of less than or equal to about 40 nm.

66. The formulation of any one of items 1-63, wherein the formulation has a Z-average of less than or equal to about 31 nm.

67. The formulation of any one of items 1-63, wherein the formulation has a Z-average of less than or equal to about 25 nm.

68. The formulation of any one of items 1-63, wherein the formulation has a Z-average of less than or equal to about 20 nm.

69. The formulation of any one of items 1-68, wherein the formulation has a polydispersity index of less than or equal to about 0.5.

70. The formulation of any one of items 1-68, wherein the formulation has a polydispersity index of less than or equal to about 0.35.

71. The formulation of any one of items 1-68, wherein the formulation has a polydispersity index of less than or equal to about 0.3.

72. The formulation of any one of items 1-71, wherein the viral vector is an adeno-associated viral vector, an adenoviral vector, a lentiviral vector, a retroviral vector, a herpes simplex viral vector or a hybrid vector.

73. The formulation of any one of items 1-72, wherein the viral vector is an adenoviral vector.

74. The formulation of any one of items 1-73, wherein the formulation is formulated for administration to a human.

75. A formulation comprising:

from about 10 X 108 vg/mL to about 10 X 1013 vg/mL of a viral vector;

from about 5 mM to about 40 mM sodium phosphate;

from about and 200 mM to about 400 mM sucrose; and

from about 0.1% to about 5.0% of an albumin.

76. The formulation of item 75, wherein the albumin is human serum albumin, bovine serum albumin or combinations thereof.

77. The formulation of item 75 or 76, comprising from about 10 X 109 vg/mL to about 10 X 1011 vg/mL of the viral vector.

78. The formulation of any one of items 75-77, wherein the viral vector is an adeno-associated viral vector, an adenoviral vector, a lentiviral vector, a retroviral vector, a herpes simplex viral vector or a hybrid vector.

79. A formulation comprising:

from about 10 X 108 vg/mL to about 10 X 1013 vg/mL of a viral vector;

from about 5 mM to about 40 mM sodium phosphate;

from about and 200 mM to about 400 mM sucrose; and

from about 0.05 mg/mL to about 0.4 mg/mL sodium hyaluronate.

80. The formulation of item 79, comprising from about 10 X 109 vg/mL to about 10 X 1011 vg/mL of the viral vector.

81. The formulation of item 79 or 80, wherein the viral vector is an adeno-associated viral vector, an adenoviral vector, a lentiviral vector, a retroviral vector or a hybrid vector.

82. The formulation of any one of items 1 to 81, wherein the viral vector is in a virus particle.

83. The formulation of item 82, wherein the virus particle is an infectious viral particle.

84. A method for reducing aggregation of a viral vector in a formulation, comprising formulating the viral vector in any of the formulations of items 1-83.

83. A method of preparing a viral vector formulation, the method comprising:

a. obtaining a composition comprising the viral vector;

b. adding a globular protein or a polysaccharide to the composition of (a) to form the formulation, wherein the globular protein or a polysaccharide is added in an amount sufficient to provide a Z-average of less than or equal to about 50 nm.

84. The method of item 83, wherein the globular protein is albumin.

85. The method of item 84, wherein the albumin is about 0.1% to about 5.0% of the formulation.

86. The method of item 83, wherein the polysaccharide is sodium hyaluronate

87. The method of item 86, wherein the sodium hyaluronate is about 0.05 mg/mL to about 0.4 mg/mL sodium hyaluronate of the formulation.

88. The method of any one of items 83-87, further comprising storing the formulation for one week or greater.

89. The method of item 88, comprising storing the formulation for greater than one month.

90. The method of any one of items 83-89, wherein the viral vector is in a viral particle.

91. A method of preparing a viral vector formulation, the method comprising:

a. obtaining a composition comprising the viral vector;
b. adding a globular protein or a polysaccharide to the composition of (a) to form the formulation, wherein the globular protein or a polysaccharide is added in an amount sufficient to provide a polydispersity index of less than or equal to about 0.5.

92. The method of item 91, wherein the globular protein is albumin.

93. The method of item 92, wherein the albumin is about 0.1% to about 5.0% of the formulation.

94. The method of item 91, wherein the polysaccharide is sodium hyaluronate

95. The method of item 94, wherein the sodium hyaluronate is about 0.05 mg/mL to about 0.4 mg/mL sodium hyaluronate of the formulation.

96. The method of any one of items 91-95, further comprising storing the formulation for one week or greater.

97. The method of item 96, comprising storing the formulation for greater than one month.

98. The method of any one of items 91-97, wherein the viral vector is in a viral particle.

99. A method of stabilizing a viral vector formulation for long term storage, the method comprising:
a. obtaining a composition comprising the viral vector;
b. adding a globular protein or a polysaccharide to the composition of (a) to form the formulation, wherein the globular protein or a polysaccharide is added in an amount sufficient to provide a polydispersity index of less than or equal to about 0.5;
c. storing the formulation for greater than one week.

100. The method of item 99, wherein the formulation is stored for greater than one month.

101. The method of item 99, wherein the formulation is freeze-dried after adding the globular protein or a polysaccharide to the composition of (a).

102. A formulation comprising:
a viral vector;
a buffer; and
a polysaccharide,

wherein the polysaccharide is sodium hyaluronate.

103. The formulation of item 102, further comprising a globular protein, preferably wherein the globular protein is albumin, alpha-fetoprotein, vitamin D-binding protein, afamin, a globin protein, alpha globulin, beta globulin, gamma globulin, or combinations thereof, and in particular wherein the globular protein is albumin.

104. The formulation of item 103, wherein the formulation is a liquid and wherein the formulation comprises from about 0.1% to about 5.0%, preferably from about 0.5% to about 2.0%, more preferably from about 0.75% to about 1.5%, even more preferably from about 0.8% to about 1.2%, and in particular about 1.0%, globular protein.

105. The formulation of any one of items 102-104, further comprising a sugar, preferably wherein the sugar is sucrose, lactose, glucose, trehalose, or combinations thereof, and in particular wherein the sugar is sucrose or trehalose.

106. The formulation of item 105, wherein the formulation is a liquid and wherein the formulation comprises from about 50 mM to about 500 mM, preferably from about 100 mM to about 400 mM, more preferably from about 250 mM to about 350 mM, and in particular about 290 mM, sugar.

107. The formulation of any one of items 102-106, further comprising a surfactant, preferably wherein the surfactant is polysorbate 80, polysorbate 20 or Kolliphor P188, and in particular polysorbate 80.

108. The formulation of item 107, wherein the formulation is a liquid and wherein the formulation comprises from about 0.01% to about 0.1%, preferably from about 0.015% to about 0.025%, and in particular about 0.02% surfactant.

109. The formulation of any one of items 102-108, wherein the formulation is a liquid and wherein the formulation comprises from about 0.01 ng/mL to about 1 mg/mL, preferably from about 0.05 ng/mL to about 0.5 mg/mL, more preferably from about 0.1 ng/mL to about 0.3 mg/mL, even more preferably from about 0.15 ng/mL to about 0.25 mg/mL, and in particular about 0.2 ng/mL, sodium hyaluronate and/or
wherein the formulation comprises from about 2 mM to about 100 mM, preferably from about 5 mM to about 50 mM , more preferably from about 15 mM to about 25 mM, and in particular about 20 mM, buffer.

110. The formulation of any one of items 102, 103, 105, or 107, wherein the formulation is a freeze-dried solid, preferably wherein the buffer is sodium phosphate, L-histidine, tris, succinate, sodium citrate or a combination thereof.

111. The formulation of any one of items 102-110, wherein the viral vector is an adeno-associated viral vector, an adenoviral vector, a lentiviral vector, a retroviral vector, a herpes simplex viral vector or a hybrid vector, and in particular wherein the viral vector is an adeno-associated viral vector and/or
wherein the buffer is sodium phosphate, L-histidine, tris, succinate, sodium citrate or a combination thereof.

112. A formulation comprising:

a viral vector;

a buffer;

a globular protein; and

a sugar, wherein the sugar is sucrose, lactose, glucose, trehalose, or combinations thereof.

113. The formulation of item 112, further comprising a polysaccharide, preferably wherein the polysaccharide is sodium hyaluronate, heparan, heparan sulfate, heparin, chondroitin, chondroitin sulfate, dermatan, dermatan sulfate, keratan, keratan sulfate, algin, chitosan, chitosan sulfate, dextran, dextran sulfate or combinations thereof, and in particular wherein the polysaccharide is sodium hyaluronate.

114. The formulation of item 113, wherein the formulation is a liquid and wherein the formulation comprises from about 0.01 ng/mL to about 1 mg/mL, preferably from about 0.05 ng/mL to about 0.5 mg/mL, more preferably from about 0.1 ng/mL to about 0.3 mg/mL, even more preferably from about 0.15 ng/mL to about 0.25 mg/mL, and in particular about 0.2 ng/mL, polysaccharide.

115. The formulation of any one of items 112-114, further comprising a surfactant, preferably wherein the surfactant is polysorbate 80, polysorbate 20 or Kolliphor P188, and in particular polysorbate 80.

116. The formulation of item 115, wherein the formulation is a liquid and wherein the formulation comprises from about 0.01% to about 0.1%, preferably from about 0.015% to about 0.025%, and in particular about 0.02%, surfactant.

117. The formulation of any one of items 112-116, wherein the globular protein is albumin, alpha-fetoprotein, vitamin D-binding protein, afamin, a globin protein, alpha globulin, beta globulin, gamma globulin, or combinations thereof, preferably albumin.

118. The formulation of any one of items 112-117, wherein the formulation is a liquid and wherein the formulation comprises from about 0.1% to about 5.0%, preferably from about 0.5% to about 2.0%, more preferably from about 0.75% to about 1.5%, even more preferably from about 0.8% to about 1.2%, and in particular about 1.0%, globular protein and/or
wherein the formulation comprises from about 2 mM to about 100 mM, preferably from about 5 mM to about 50 mM , more preferably from about 15 mM to about 25 mM , and in particular about 20 mM, buffer and/or
wherein the formulation comprises from about 50 mM to about 500 mM, preferably from about 100 mM to about 400 mM, more preferably from about 250 mM to about 350 mM, and in particular about 290 mM, sugar.

119. The formulation of any one of items 112-118, wherein the viral vector is an adeno-associated viral vector, an adenoviral vector, a lentiviral vector, a retroviral vector, a herpes simplex viral vector or a hybrid vector, and in particular wherein the viral vector is an adeno-associated viral vector, and/or
wherein the sugar is sucrose or trehalose, and/or
wherein the buffer is sodium phosphate, L-histidine, tris, succinate, sodium citrate or a combination thereof.

120. The formulation of item 112, 113, 115, 117, or 119, wherein the formulation is a freeze-dried solid, preferably wherein the buffer is sodium phosphate, L-histidine, tris, succinate, sodium citrate or a combination thereof.

121. A formulation comprising:
a viral vector;
a buffer;
polysorbate 80; and
a sugar, wherein the sugar is sucrose, lactose, glucose, trehalose, or combinations thereof.

122. The formulation of item 121, further comprising a polysaccharide and/or globular protein and/or a surfactant and/or wherein the formulation is a freeze-dried solid.

123. A method for reducing aggregation of a viral vector in a formulation, comprising formulating the viral vector in any of the formulations of claims 102 to 122.

124. A method of preparing a viral vector formulation, the method comprising:

a. obtaining a composition comprising the viral vector;

b. adding sodium hyaluronate to the composition of (a) to form the formulation, wherein the sodium hyaluronate is added in an amount sufficient to provide a Z-average of less than or equal to about 50 nm.

125. A method of preparing a viral vector formulation, the method comprising:

a. obtaining a composition comprising the viral vector;

b. adding a globular protein to the composition of (a) to form the formulation, wherein the globular protein is added in an amount sufficient to provide a Z-average of less than or equal to about 50 nm.

126. A method of preparing a viral vector formulation, the method comprising:

a. obtaining a composition comprising the viral vector;

b. adding sodium hyaluronate to the composition of (a) to form the formulation, wherein the sodium hyaluronate is added in an amount sufficient to provide a polydispersity index of less than or equal to about 0.5.

127. A method of preparing a viral vector formulation, the method comprising:

a. obtaining a composition comprising the viral vector;

b. adding a globular protein to the composition of (a) to form the formulation, wherein the globular protein is added in an amount sufficient to provide a polydispersity index of less than or equal to about 0.5.

128. A formulation comprising:

a viral vector;

a buffer; and

a polysaccharide,

wherein the polysaccharide is sodium hyaluronate.

129. The formulation of item 128, further comprising a globular protein, preferably wherein the globular protein is albumin, alpha-fetoprotein, vitamin D-binding protein, afamin, a globin

protein, alpha globulin, beta globulin, gamma globulin, or combinations thereof, and in particular wherein the globular protein is albumin.

130. The formulation of item 129, wherein the formulation is a liquid and wherein the formulation comprises from about 0.1% to about 5.0%, preferably from about 0.5% to about 2.0%, more preferably from about 0.75% to about 1.5%, even more preferably from about 0.8% to about 1.2%, and in particular about 1.0%, globular protein.

131. The formulation of any one of items 128-130, further comprising a sugar, preferably wherein the sugar is sucrose, lactose, glucose, trehalose, or combinations thereof, and in particular wherein the sugar is sucrose or trehalose.

132. The formulation of item 131, wherein the formulation is a liquid and wherein the formulation comprises from about 50 mM to about 500 mM, preferably from about 100 mM to about 400 mM, more preferably from about 250 mM to about 350 mM, and in particular about 290 mM, sugar.

133. The formulation of any one of items 128-132, further comprising a surfactant, preferably wherein the surfactant is polysorbate 80, polysorbate 20 or Kolliphor P188, and in particular polysorbate 80.

134. The formulation of item 133, wherein the formulation is a liquid and wherein the formulation comprises from about 0.01% to about 0.1%, preferably from about 0.015% to about 0.025%, and in particular about 0.02%, surfactant.

135. The formulation of any one of items 128-134, wherein the formulation is a liquid.

136. The formulation of item 135, wherein the formulation comprises from about 0.01 ng/mL to about 1 mg/mL preferably from about 0.05 ng/mL to about 0.5 mg/mL, more preferably from about 0.1 ng/mL to about 0.3 mg/mL, even more preferably from about 0.15 ng/mL to about 0.25 mg/mL, and in particular about 0.2 ng/mL, sodium hyaluronate.

137. The formulation of any one of items 128-136, wherein the formulation is a liquid and wherein the formulation comprises from about 2 mM to about 100 mM, preferably from about 5 mM to about 50 mM , more preferably from about 15 mM to about 25 mM, and in particular about 20 mM, buffer.

138. The formulation of any one of items 128-137, wherein the buffer is sodium phosphate, L-histidine, tris, succinate, sodium citrate or a combination thereof, preferably sodium phosphate, L-histidine, sodium citrate or a combination thereof.

139. The formulation of any one of items 128-138, further comprising sodium chloride.

140. The formulation of item 139, wherein the formulation is a liquid and wherein the formulation comprises from about 10 mM to about 500 mM, preferably from about 50 mM to about 300 mM, more preferably from about 100 mM to about 200 mM, and in particular about 150 mM, sodium chloride.

141. The formulation of item 128, 129, 131, 133, 138, or 139, wherein the formulation is a freeze-dried solid.

142. The formulation of item 141, wherein the buffer is sodium phosphate, L-histidine, tris, succinate, sodium citrate or a combination thereof.

143. The formulation of item 141 or 142, further comprising a sugar, preferably wherein the sugar is sucrose, lactose, glucose, trehalose, or combinations thereof, and in particular wherein the sugar is sucrose or trehalose.

144. The formulation of any one of items 141-143, further comprising a surfactant, preferably wherein the surfactant is polysorbate 80, polysorbate 20 or Kolliphor P188.

145. The formulation of any one of items 141-144, further comprising sodium chloride.

146. The formulation of any one of items 128-145, wherein the formulation has a Z-average of less than or equal to about 50 nm, preferably of less than or equal to about 40 nm, more preferably of less than or equal to about 31 nm, even more preferably of less than or equal to about 25 nm, and in particular of less than or equal to about 20 nm.

147. The formulation of any one of items 128-146, wherein the formulation has a polydispersity index of less than or equal to about 0.5, preferably of less than or equal to about 0.35, and in particular of less than or equal to about 0.3.

148. The formulation of any one of items 128-147, wherein the viral vector is an adeno-associated viral vector, an adenoviral vector, a lentiviral vector, a retroviral vector, a herpes

simplex viral vector or a hybrid vector, and in particular wherein the viral vector is an adeno-associated viral vector.

149. A formulation comprising:

from about 10 X 10^8 vg/mL to about 10 X 10^{13} vg/mL of a viral vector;

from about 5 mM to about 40 mM sodium phosphate;

from about and 200 mM to about 400 mM sucrose; and

from about 0.05 mg/mL to about 0.4 mg/mL sodium hyaluronate.

150. A method for reducing aggregation of a viral vector in a formulation, comprising formulating the viral vector in any of the formulations of items 1-149.

151. A method of preparing a viral vector formulation, the method comprising:

a. obtaining a composition comprising the viral vector;

b. adding sodium hyaluronate to the composition of (a) to form the formulation, wherein the sodium hyaluronate is added in an amount sufficient to provide a Z-average of less than or equal to about 50 nm.

152. A method of preparing a viral vector formulation, the method comprising:

a. obtaining a composition comprising the viral vector;

b. adding sodium hyaluronate to the composition of (a) to form the formulation, wherein the sodium hyaluronate is added in an amount sufficient to provide a polydispersity index of less than or equal to about 0.5.

153. A formulation comprising:

a viral vector;

a buffer;

a globular protein; and

a sugar, wherein the sugar is sucrose, lactose, glucose, trehalose, or combinations thereof.

154. The formulation of item 153, further comprising a polysaccharide, preferably wherein the polysaccharide is sodium hyaluronate, heparan, heparan sulfate, heparin, chondroitin, chondroitin sulfate, dermatan, dermatan sulfate, keratan, keratan sulfate, algin, chitosan, chitosan sulfate, dextran, dextran sulfate or combinations thereof, and in particular wherein the polysaccharide is sodium hyaluronate.

155. The formulation of item 154, wherein the formulation is a liquid and wherein the formulation comprises from about 0.01 ng/mL to about 1 mg/mL, preferably from about 0.05 ng/mL to about 0.5 mg/mL, more preferably from about 0.1 ng/mL to about 0.3 mg/mL, even more preferably from about 0.15 ng/mL to about 0.25 mg/mL, and in particular about 0.2 ng/mL, polysaccharide.

156. The formulation of any one of items 153-155, further comprising a surfactant, preferably wherein the surfactant is polysorbate 80, polysorbate 20 or Kolliphor P188, and in particular polysorbate 80.

157. The formulation of item 156, wherein the formulation is a liquid and wherein the formulation comprises from about 0.01% to about 0.1%, preferably from about 0.015% to about 0.025%, and in particular about 0.02% surfactant.

158. The formulation of any one of items 153-157, wherein the globular protein is albumin, alpha-fetoprotein, vitamin D-binding protein, afamin, a globin protein, alpha globulin, beta globulin, gamma globulin, or combinations thereof, preferably albumin.

159. The formulation of any one of items 153-158, wherein the formulation is a liquid and wherein the formulation comprises from about 0.1% to about 5.0%, preferably from about 0.5% to about 2.0%, more preferably from about 0.75% to about 1.5%, even more preferably from about 0.8% to about 1.2%, and in particular about 1.0%, globular protein.

160. The formulation of any one of items 153-159, wherein the formulation is a liquid and wherein the formulation comprises from about 2 mM to about 100 mM, preferably from about 5 mM to about 50 mM , more preferably from about 15 mM to about 25 mM , and in particular about 20 mM, buffer.

161. The formulation of any one of items 153-160, wherein the buffer is sodium phosphate, L-histidine, tris, succinate, sodium citrate or a combination thereof, preferably sodium phosphate, L-histidine, sodium citrate or a combination thereof.

162. The formulation of any one of items 153-161, wherein the formulation is a liquid and wherein the formulation comprises from about 50 mM to about 500 mM, preferably from about 100 mM to about 400 mM, more preferably from about 250 mM to about 350 mM, and in particular about 290 mM, sugar.

163. The formulation of any one of items 153-162, further comprising sodium chloride.

164. The formulation of item 163, wherein the formulation is a liquid and wherein the formulation comprises from about 10 mM to about 500 mM, preferably from about 50 mM to about 300 mM, more preferably from about 100 mM to about 200 mM, and in particular about 150 mM, sodium chloride.

165. The formulation of any one of items 153-164, wherein the sugar is sucrose or trehalose.

166. The formulation of item 153, 154, 156, 158, 161, 163, or 165, wherein the formulation is a freeze-dried solid.

167. The formulation of item 166, wherein the buffer is sodium phosphate, L-histidine, tris, succinate, sodium citrate or a combination thereof.

168. The formulation of item 166 or 167, further comprising a sugar, preferably wherein the sugar is sucrose, lactose, glucose, trehalose, or combinations thereof, and in particular wherein the sugar is sucrose.

169. The formulation of any one of items 166-168, further comprising a surfactant, preferably wherein the surfactant is polysorbate 80, polysorbate 20 or Kolliphor P188.

170. The formulation of any one of items 166-169, further comprising sodium chloride.

171. The formulation of any one of items 153-170, wherein the formulation has a Z-average of less than or equal to about 50 nm, preferably of less than or equal to about 40 nm, more preferably of less than or equal to about 31 nm, even more preferably of less than or equal to about 25 nm, and in particular of less than or equal to about 20 nm.

172. The formulation of any one of items 153-171, wherein the formulation has a polydispersity index of less than or equal to about 0.5, preferably of less than or equal to about 0.35, more preferably of less than or equal to about 0.3.

173. The formulation of any one of items 153-172, wherein the viral vector is an adeno-associated viral vector, an adenoviral vector, a lentiviral vector, a retroviral vector, a herpes simplex viral vector or a hybrid vector, and in particular wherein the viral vector is an adeno-associated viral vector.

174. A formulation comprising:

from about $10 \text{ X } 10^8$ vg/mL to about $10 \text{ X } 10^{13}$ vg/mL of a viral vector;

from about 5 mM to about 40 mM sodium phosphate;

from about and 200 mM to about 400 mM sucrose; and

from about 0.1% to about 5.0% of an albumin.

175. A method for reducing aggregation of a viral vector in a formulation, comprising formulating the viral vector in any of the formulations of items 153-174.

176. A method of preparing a viral vector formulation, the method comprising:

a. obtaining a composition comprising the viral vector;

b. adding a globular protein to the composition of (a) to form the formulation, wherein the globular protein is added in an amount sufficient to provide a Z-average of less than or equal to about 50 nm.

177. A method of preparing a viral vector formulation, the method comprising:

a. obtaining a composition comprising the viral vector;

b. adding a globular protein to the composition of (a) to form the formulation, wherein the globular protein is added in an amount sufficient to provide a polydispersity index of less than or equal to about 0.5.

178. A formulation comprising:

a viral vector;

a buffer;

polysorbate 80; and

a sugar, wherein the sugar is sucrose, lactose, glucose, trehalose, or combinations thereof.

179. The formulation of item 178, further comprising a globular protein, preferably wherein the globular protein is albumin, alpha-fetoprotein, vitamin D-binding protein, afamin, a globin protein, alpha globulin, beta globulin, gamma globulin, or combinations thereof, more preferably wherein the globular protein is albumin, and in particular wherein the albumin is human serum albumin, bovine serum albumin, ovalbumin or lactalbumin.

180. The formulation of item 179, wherein the formulation is a liquid and wherein the formulation comprises from about 0.1% to about 5.0%, preferably from about 0.5% to about 2.0%, more preferably from about 0.75% to about 1.5%, even more preferably from about 0.8% to about 1.2%, and in particular about 1.0%, globular protein.

181. The formulation of any one of items 178-180, further comprising polysaccharide, preferably wherein the polysaccharide is sodium hyaluronate, heparan, heparan sulfate, heparin, chondroitin, chondroitin sulfate, dermatan, dermatan sulfate, keratan, keratan sulfate, algin, chitosan, chitosan sulfate, dextran, dextran sulfate or combinations thereof, and in particular wherein the polysaccharide is sodium hyaluronate.

182. The formulation of item 181, wherein the formulation is a liquid and wherein the formulation comprises from about 0.01 ng/mL to about 1 mg/mL, preferably from about 0.05 ng/mL to about 0.5 mg/mL, more preferably from about 0.1 ng/mL to about 0.3 mg/mL, even more preferably from about 0.15 ng/mL to about 0.25 mg/mL, and in particular about 0.2 ng/mL, polysaccharide.

183. The formulation of any one of items 178-182, wherein the formulation is a liquid and wherein the formulation comprises from about 2 mM to about 100 mM, preferably from about 5 mM to about 50 mM, more preferably from about 15 mM to about 25 mM, and in particular about 20 mM, buffer.

184. The formulation of any one of items 178-183, wherein the buffer is sodium phosphate, L-histidine, tris, succinate, sodium citrate or a combination thereof, preferably sodium phosphate, L-histidine, sodium citrate or a combination thereof.

185. The formulation of any one of items 178-184, further comprising a sugar, preferably wherein the sugar is sucrose, lactose, glucose, trehalose, or combinations thereof, and in particular wherein the sugar is sucrose or trehalose.

186. The formulation of any one of items 178-185, wherein the formulation is a liquid and wherein the formulation comprises from about 50 mM to about 500 mM, preferably from about 100 mM to about 400 mM, more preferably from about 250 mM to about 350 mM, and in particular about 290 mM, sugar.

187. The formulation of any one of items 178-186, wherein the formulation is a liquid and wherein the formulation comprises from about 0.01% to about 0.1%, preferably from about 0.015% to about 0.025%, and in particular about 0.02%, polysorbate 80.

188. The formulation of any one of items 178-187, further comprising an additional surfactant, preferably wherein the additional surfactant is cetyltrimethylammonium bromide.

189. The formulation of any one of items 178-188, further comprising sodium chloride.

190. The formulation of item 189, wherein the formulation is a liquid and wherein the formulation comprises from about 10 mM to about 500 mM, preferably from about 50 mM to about 300 mM, more preferably from about 100 mM to about 200 mM, and in particular about 150 mM, sodium chloride.

191. The formulation of any one of items 178, 179, 181, 184, 185, 188, or 189, wherein the formulation is a freeze-dried solid.

192. The formulation of item 191, wherein the buffer is sodium phosphate, L-histidine, tris, succinate, sodium citrate or a combination thereof.

193. The formulation of item 191 or 192, further comprising a sugar, preferably wherein the sugar is sucrose, lactose, glucose, trehalose, or combinations thereof, and in particular wherein the sugar is sucrose.

194. The formulation of any one of items 191-193, further comprising a surfactant, preferably wherein the surfactant is polysorbate 80, polysorbate 20 or Kolliphor P188.

195. The formulation of any one of items 191-194, further comprising sodium chloride.

196. The formulation of any one of items 178-195, wherein the formulation has a Z-average of less than or equal to about 50 nm, preferably of less than or equal to about 40 nm, more preferably of less than or equal to about 31 nm, even more preferably of less than or equal to about 25 nm, and in particular of less than or equal to about 20 nm.

197. The formulation of any one of items 178-196, wherein the formulation has a polydispersity index of less than or equal to about 0.5, preferably of less than or equal to about 0.35, and in particular of less than or equal to about 0.3.

198. The formulation of any one of items 178-197, wherein the viral vector is an adeno-associated viral vector, an adenoviral vector, a lentiviral vector, a retroviral vector, a herpes simplex viral vector or a hybrid vector, and in particular wherein the viral vector is an adeno-associated viral vector.

199. A method for reducing aggregation of a viral vector in a formulation, comprising formulating the viral vector in any of the formulations of items 1-198.

200. A method of preparing a viral vector formulation, the method comprising:

a. obtaining a composition comprising the viral vector and polysorbate 80;

b. adding a globular protein or a polysaccharide to the composition of (a) to form the formulation, wherein the globular protein or the polysaccharide is added in an amount sufficient to provide a Z-average of less than or equal to about 50 nm.

201. The method of item 200, wherein the globular protein is albumin.

202. A method of preparing a viral vector formulation, the method comprising:

a. obtaining a composition comprising the viral vector and polysorbate 80;

b. adding a globular protein or a polysaccharide to the composition of (a) to form the formulation, wherein the globular protein or the polysaccharide is added in an amount sufficient to provide a polydispersity index of less than or equal to about 0.5.

WHAT IS CLAIMED IS:

1. A formulation comprising:
a viral vector;
a buffer; and
a polysaccharide,

wherein the polysaccharide is sodium hyaluronate.

2. The formulation of claim 1, further comprising a globular protein, preferably wherein the globular protein is albumin, alpha-fetoprotein, vitamin D-binding protein, afamin, a globin protein, alpha globulin, beta globulin, gamma globulin, or combinations thereof, and in particular wherein the globular protein is albumin.

3. The formulation of claim 2, wherein the formulation is a liquid and wherein the formulation comprises from about 0.1% to about 5.0%, preferably from about 0.5% to about 2.0%, more preferably from about 0.75% to about 1.5%, even more preferably from about 0.8% to about 1.2%, and in particular about 1.0%, globular protein.

4. The formulation of any one of claims 1-3, further comprising a sugar, preferably wherein the sugar is sucrose, lactose, glucose, trehalose, or combinations thereof, and in particular wherein the sugar is sucrose or trehalose.

5. The formulation of claim 4, wherein the formulation is a liquid and wherein the formulation comprises from about 50 mM to about 500 mM, preferably from about 100 mM to about 400 mM, more preferably from about 250 mM to about 350 mM, and in particular about 290 mM, sugar.

6. The formulation of any one of claims 1-5, further comprising a surfactant, preferably wherein the surfactant is polysorbate 80, polysorbate 20 or Kolliphor P188, and in particular polysorbate 80.

7. The formulation of claim 6, wherein the formulation is a liquid and wherein the formulation comprises from about 0.01% to about 0.1%, preferably from about 0.015% to about 0.025%, and in particular about 0.02%, surfactant.

8. The formulation of any one of claims 1-7, wherein the formulation is a liquid.

9. The formulation of claim 8, wherein the formulation comprises from about 0.01 ng/mL to about 1 mg/mL preferably from about 0.05 ng/mL to about 0.5 mg/mL, more preferably from about 0.1 ng/mL to about 0.3 mg/mL, even more preferably from about 0.15 ng/mL to about 0.25 mg/mL, and in particular about 0.2 ng/mL, sodium hyaluronate.

10. The formulation of any one of claims 1-9, wherein the formulation is a liquid and wherein the formulation comprises from about 2 mM to about 100 mM, preferably from about 5 mM to about 50 mM, more preferably from about 15 mM to about 25 mM, and in particular about 20 mM, buffer.

11. The formulation of any one of claims 1-10, wherein the buffer is sodium phosphate, L-histidine, tris, succinate, sodium citrate or a combination thereof, preferably sodium phosphate, L-histidine, sodium citrate or a combination thereof.

12. The formulation of any one of claims 1-11, further comprising sodium chloride.

13. The formulation of claim 12, wherein the formulation is a liquid and wherein the formulation comprises from about 10 mM to about 500 mM, preferably from about 50 mM to about 300 mM, more preferably from about 100 mM to about 200 mM, and in particular about 150 mM, sodium chloride.

14. The formulation of any one of claim 1, 2, 4, 6, 11, or 12, wherein the formulation is a freeze-dried solid.

15. The formulation of claim 14, wherein the buffer is sodium phosphate, L-histidine, tris, succinate, sodium citrate or a combination thereof.

16. The formulation of claim 14 or 15, further comprising a sugar, preferably wherein the sugar is sucrose, lactose, glucose, trehalose, or combinations thereof, and in particular wherein the sugar is sucrose or trehalose.

17. The formulation of any one of claims 14-16, further comprising a surfactant, preferably wherein the surfactant is polysorbate 80, polysorbate 20 or Kolliphor P188.

18. The formulation of any one of claims 14-17, further comprising sodium chloride.

19. The formulation of any one of claims 1-18, wherein the formulation has a Z-average of less than or equal to about 50 nm, preferably of less than or equal to about 40 nm, more

preferably of less than or equal to about 31 nm, even more preferably of less than or equal to about 25 nm, and in particular of less than or equal to about 20 nm.

20. The formulation of any one of claims 1-19, wherein the formulation has a polydispersity index of less than or equal to about 0.5, preferably of less than or equal to about 0.35, and in particular of less than or equal to about 0.3.

21. The formulation of any one of claims 1-20, wherein the viral vector is an adeno-associated viral vector, an adenoviral vector, a lentiviral vector, a retroviral vector, a herpes simplex viral vector or a hybrid vector, and in particular wherein the viral vector is an adeno-associated viral vector.

22. A formulation comprising:

from about $10 \text{ X } 10^8$ vg/mL to about $10 \text{ X } 10^{13}$ vg/mL of a viral vector;

from about 5 mM to about 40 mM sodium phosphate;

from about and 200 mM to about 400 mM sucrose; and

from about 0.05 mg/mL to about 0.4 mg/mL sodium hyaluronate.

23. A method for reducing aggregation of a viral vector in a formulation, comprising formulating the viral vector in any of the formulations of claims 1-22.

24. A method of preparing a viral vector formulation, the method comprising:

a. obtaining a composition comprising the viral vector;

b. adding sodium hyaluronate to the composition of (a) to form the formulation, wherein the sodium hyaluronate is added in an amount sufficient to provide a Z-average of less than or equal to about 50 nm.

25. A method of preparing a viral vector formulation, the method comprising:

a. obtaining a composition comprising the viral vector;

b. adding sodium hyaluronate to the composition of (a) to form the formulation, wherein the sodium hyaluronate is added in an amount sufficient to provide a polydispersity index of less than or equal to about 0.5.