Claims

1. A dry powder composition comprising a long-chain RNA molecule comprising at least 30 nucleotides in a complex with a cationic or polycationic compound, wherein said dry powder:
(i) has a residual moisture content of less than 7% (w/w); and

(ii) comprises a plurality of particles having a median particle size, in a volume weighted distribution of the composition, in a range from 1 μm and 20 μm.

2. The dry powder composition according to claim 1, wherein the average sphericity of the particles in the composition is in a range from 0.7 to 1.0.

3. The dry powder composition according to claim 1, wherein the composition has a residual moisture content of 5% (w/w) or less.

4. The dry powder composition according to claim 1, wherein the long-chain RNA molecule is present in the form of a free long-chain RNA molecule, or in the form of a complex comprising the long-chain RNA molecule.

5. The dry powder composition according to claim 1, wherein the long-chain RNA molecule is in a complex with a cationic or polycationic lipid.

6. The dry powder composition according to claim 1, wherein the long-chain RNA molecule is a single-stranded RNA molecule.

7. The dry powder composition according to claim 1, wherein the long-chain RNA molecule comprises at least one open reading frame (ORF) encoding a protein or a peptide.

8. The dry powder composition according to claim 7, wherein the long-chain RNA molecule is an mRNA molecule.

9. The dry powder composition according to claim 7, wherein the long-chain RNA molecule comprises at least 200 nucleotides.

10. The dry powder composition according to claim 9, wherein the long-chain RNA molecule comprises at least one modification.

11. The dry powder composition according to claim 9, wherein the dry powder composition comprises at least one excipient.

12. The dry powder composition according to claim 9, wherein the dry powder is made by a method of spray-drying.

13. The dry powder composition according to claim 12, wherein the method of spray-drying comprises the steps of:

(a) providing a liquid comprising the long-chain RNA molecule to be spray-dried; and

(b) spray-drying the liquid of step (a) with a spray-drying device having a drying gas inlet and a drying gas outlet, wherein the drying gas has a temperature at the inlet of at least 85° C., wherein the drying gas has a temperature at the outlet of at least 50° C.

14. The dry powder composition according to claim 11, wherein the at least one excipient selected from a cryoprotectant, a lyoprotectant, and a bulking agent.

15. The dry powder composition according to claim 13, wherein the liquid of step (a) comprises a spray-drying-compatible solvent.

16. The dry powder composition according to claim 13, wherein the liquid of step (a) is atomized and a droplet resulting from the atomization of the liquid is characterized by a mass median aerodynamic diameter of 300 nm to 200 μm.

17. The dry powder composition according to claim 13, wherein the liquid of step (a) further comprises a suspending agent and/or osmolality of about 200 mosmol/l to about 400 mosmol/l.

18. A pharmaceutical composition comprising the dry powder composition according to claim 9.

19. The pharmaceutical composition according to claim 18, further comprising at least one pharmaceutically acceptable excipient.

20. The pharmaceutical composition according to claim 18, wherein the dry powder is formulated for administration by inhalation.

21. The pharmaceutical composition according to claim 18, wherein the dry powder is formulated for pulmonary delivery.

22. The dry powder composition according to claim 9, wherein upon reconstitution of the dry powder in a suitable solvent, the complexed long-chain RNA molecule is present in the solvent in the form of nanoparticles having a size of about 50 to 500 nm.

23. The dry powder composition according to claim 14, wherein the at least one excipient comprises a free carbohydrate.

24. The dry powder composition according to claim 23, wherein the at least one excipient comprises lactose, sucrose or trehalose.

25. The dry powder composition according to claim 9, wherein the long-chain RNA molecule is 500 to 20,000 nucleotides in length.