CLAIMS

1. A plurality of microparticles having diameters ranging from 2 μm to 70 μm, as determined by microflow imaging (MFI), comprising a VEGF-Trap protein particle core of 2 μm to 12 μm in diameter, as determined by MFI, and a biodegradable polymer cortex, wherein (a) the protein particle core consists of VEGF-Trap, (b) the biodegradable polymer cortex comprises polyorthoester (POE), poly (lactic acid) (PLA), or poly-D,L-lactide-co-glycolide (PLGA), and (c) the VEGF-Trap is released at a rate of 0.01 mg per week to 0.30 mg per week in an aqueous environment over the course of at least 60 days.

2. The plurality of microparticles of claim 1, wherein the VEGF-Trap consists of a dimer of a polypeptide comprising the amino acid sequence SEQ ID NO:1

3. The plurality of microparticles of claim 1 or claim 2 for use in a method of treating an ocular disease.

4. A method of manufacturing a composition comprising a VEGF-Trap protein and a biodegradable polymer selected from the group consisting of POE, PLA, and PLGA, the method comprising the steps of:

a. obtaining a VEGF-Trap protein particle by spray drying a solution comprising the VEGF-Trap protein;

b. suspending the protein particle in a solution comprising the polymer and a solvent; and

c. removing the solvent,

wherein a particle having an average diameter of 15 μm is formed comprising the protein coated with the polymer.

5. The method of claim 4, wherein the protein particle is obtained by spray drying a solution comprising the protein.

6. The method of claim 4, wherein the spray drying is performed by dual-nozzle sonication, single-nozzle sonication, or electrospray.

7. The method of claim 6, wherein the solvent is evaporated by creating a dispersion of the protein suspension of step (b) by spray drying.

CLAIMS

1. A method of manufacturing an extended release pharmaceutical composition comprising a protein particle coated with a biodegradable polymer, said method comprising:

a. atomizing an aqueous solution comprising a protein;

b. applying heat to the atomized aqueous solution to form a population of protein particles;

c. suspending said population of protein particles in an organic solution comprising a biodegradable polymer and an organic solvent; and

d. spray drying the suspension to form a population of protein polymer microparticles.

2. The method of claim 1, wherein each protein particle of said population of protein particles comprises less than 3% (w/w) water.

3. The method of claim 1, wherein said biodegradable polymer is polyorthoester (POE) or ethyl cellulose (EC).

4. The method of claim 3, wherein said organic solvent is ethyl acetate.

5. The method of claim 1, wherein said protein is a receptor-Fc-fusion protein or an antibody.

6. The method of claim 5, wherein said protein is a VEGF-Trap.

7. The method of claim 1, wherein said spray drying the suspension (d) comprises atomizing said suspension and then applying heat to the atomized suspension at a temperature greater than the flash point of said organic solvent to evaporate said organic solvent to form said population of protein polymer microparticles.

8. The method of claim 7, wherein the median diameter of said population of protein polymer microparticles is about 15 microns to about 30 microns.

9. The method of claim 1, wherein each protein particle of said population of protein particles has a diameter of about 2 microns to about 14 microns.

10. A method of providing an extended release coating for a pharmaceutical protein comprising:

a. atomizing an aqueous solution comprising a protein;

b. applying heat at a temperature greater than the boiling point of water to the atomized aqueous solution to form a population of protein microparticles;

c. coating each protein microparticle of said population protein microparticles with a biodegradable polymer to form a population of protein polymer microparticles.

11. The method of claim 10, wherein said population of protein microparticles is dry.

12. The method of claim 11, wherein said population of protein microparticles comprises less than 3% water.

13. The method of claim 10, wherein said aqueous solution comprises about 10 mg/mL – 100 mg/mL of said protein.

14. The method of claim 10, wherein said aqueous solution further comprises about 1 % and 20% (w/v) sucrose.

15. The method of claim 10, wherein said aqueous solution further comprises about 0.05% and 5% (w/v) of polysorbate.

16. The method of claim 10, wherein said aqueous solution further comprises about 5 mM to 50 mM of phosphate.

17. The method of claim 10 further comprising combining an organic solvent, said biodegradable polymer to a concentration of between about 10 mg/mL and 300 mg/mL, and said population of protein microparticles to a concentration of between about 10 mg/mL and 100 mg/mL to form a slurry; and spray drying said slurry to form said plurality of protein polymer microparticles at step (c).

18. A method of manufacturing a pharmaceutical powder, said method comprising:

a. atomizing a solution comprising water and a protein; and

b. applying heat to said atomized solution to form said pharmaceutical powder.

19. The method of claim 18, wherein said pharmaceutical powder is not subjected to lyophilization.

20. The method of claim 18 further comprising combining said pharmaceutical powder with an organic polymer solution; and spray drying the combination to form a coated pharmaceutical powder.

21. The method of claim 18, wherein said protein is an antibody or a receptor-Fc-fusion protein.

22. The method of claim 18, wherein said polymer is ethyl cellulose or polyorthoester.

23. A method of manufacturing an extended release pharmaceutical composition comprising a protein particle coated with a biodegradable polymer, said method comprising:

a. atomizing an aqueous solution comprising:

i. about 25 mg/mL–50 mg/mL of a protein,

ii. about 5 mM-50 mM phosphate,

iii. about 1%-20% (w/v) sucrose, and

iv. about 0.05%-5% (w/v) polysorbate;

b. applying heat to said atomized aqueous solution at a temperature greater than the boiling point of water to form a plurality of dry protein particles without lyophilization;

c. combining:

i. ethyl acetate,

ii. about 50 mg/mL of said plurality of dry protein particles, and

iii. about 50 mg/mL-100 mg/mL of ethyl cellulose or 50 mg/mL – 250 mg/mL polyorthoester to form a suspension; and

d. atomizing said suspension; and

e. applying heat to said atomized suspension at a temperature greater than the flash point of ethyl acetate to form a plurality of protein polymer microparticles.

24. The method of claim 23, wherein said protein is an antibody or a receptor-Fc-fusion protein.

25. The method of claim 23, wherein said aqueous solution comprises about 25 mg/mL or about 50 mg/mL VEGF-Trap, about 10 mM phosphate, about 2% sucrose, and about 0.1% polysorbate, at a pH of about 6.2.