WHAT IS CLAIMED IS:

1. A fumaryl diketopiperazine (FDKP) composition comprising a trans isomer content of about 45% to about 65%.

2. The FDKP composition according to claim 1, wherein said trans isomer content is from about 50% to about 65%.

3. The FDKP composition according to claim 1, wherein said trans isomer content is from about 53% to about 63%.

4. Fumaryl diketopiperazine (FDKP) microparticles comprising the FDKP composition of claim 1.

5. FDKP microparticles according to claim 4, wherein said trans isomer content is from about 50% to about 65%.

6. FDKP microparticles according to claim 4, wherein said trans isomer content is from about 53% to about 63%.

7. FDKP microparticles according to claim 4, further comprising a drug or an active agent.

8. FDKP microparticles according to claim 7, wherein said drug or active agent is a peptide or protein.

9. FDKP microparticles according to claim 8, wherein said peptide is an endocrine hormone.

10. FDKP microparticles according to claim 9, wherein said endocrine hormone is insulin, parathyroid hormone, calcitonin, glucagon, glucagon-like peptide 1, oxyntomodulin, an analog or active fragment of said endocrine hormone.

11. The microparticles of claim 4, wherein the drug is present in an amount greater than 0.01 wt% of the microparticles.

12. A dry powder comprising the microparticles of claim 4.

13. A dry powder comprising the microparticles of claim 7.

14. A method of treating an endocrine-related disease or disorder comprising administering to a person in need thereof a dry powder formulation comprising fumaryl diketopiperazine (FDKP) microparticles comprising an FDKP trans isomer content of about 45% to about 65% and an endocrine hormone suitable to treat said disease or disorder.

15. The method of claim 14, wherein the endocrine hormone is insulin, parathyroid hormone, calcitonin, glucagon, glucagon-like peptide 1, oxyntomodulin, or an analog of said endocrine hormone.

16. The method of claim 14, wherein the endocrine-related disease is diabetes.

17. A method of making microparticles suitable for pulmonary administration as a dry powder comprising:

a) synthesizing an FDKP compound having an FDKP trans isomer content of about 45% to about 65%;

b) dissolving the FDKP compound in a solution having a basic pH to form an FDKP solution;

c) providing a solution of a volatile acid, and

d) mixing the solutions together in a high-shear mixer to produce said microparticles in a suspension.

18. The method of claim 17, further comprising determining the trans isomer content of the FDKP.

19. The method of claim 18, wherein the step of determining the trans isomer content of the FDKP is performed using high pressure liquid chromatography.

20. The method of claim 17, further comprising mixing said microparticles with a solution comprising a drug.

21. The method of claim 17, wherein the drug is an endocrine hormone.

22. The method of claim 21, wherein the drug is insulin, parathyroid hormone, calcitonin, glucagon, glucagon-like peptide 1, oxyntomodulin, or an analog of said drug.

23. A method for synthesizing a diketopiperazine having a trans isomer content of about 45% to about 65% comprising:

a) saponifying an ester of a diketopiperazine in a mixture of water and a water-miscible solvent at a basic pH; and

b) recrystallizing the diketopiperazine in a reaction mixture comprising trifluoroacetic acid and glacial acid at a resultant ratio ranging from about 0.4 to about 0.7.

24. The method of claim 23, wherein the water-miscible solvent is an alcohol, tetrahydrofuran, dioxane, and acetonitrile.

25. The method of claim 24, wherein the alcohol is methanol, ethanol, or isopropanol.

26. The method of claim 25, wherein the methanol is in a water:methanol ratio ranging from 1:1 to about 3:1.

27. The method of claim 23, further comprising the step of determining the trans isomer content of the diketopiperazine.

28. The method of claim 23, wherein the diketopiperazine is of the formula 2,5-diketo-3,6-bis(N-X-4-aminobutyl)piperazine, wherein X is selected from the group consisting of fumaryl, succinyl, maleyl, and glutaryl.

29. The method of claim 23, wherein the diketopiperazine is 2,5-diketo-3,6-bis(N-fumaryl-4-aminobutyl)piperazine.

30. The method of claim 23, wherein the reaction mixture in the recrystallizing step is held for a period of about 4 hours or greater than 4 hours.

WHAT IS CLAIMED IS:

1. A method of making microparticles suitable for pulmonary administration as a dry powder comprising: a) dissolving a fumaryl diketopiperazine (FDKP) composition having an FDKP trans isomer content of about 45% to about 65% in a solution having a basic pH to form an FDKP solution; b) providing a solution of a volatile acid, and c) mixing the solutions together in a high-shear mixer to produce said microparticles in a suspension.

2. The method of claim 1, further comprising determining the trans isomer content of the FDKP.

3. The method of claim 2, wherein the step of determining the trans isomer content of the FDKP is performed using high pressure liquid chromatography.

4. The method of claim 1, further comprising mixing said microparticles with a solution comprising a drug.

5. The method of claim 1, wherein the drug is an endocrine hormone.

6. The method of claim 5, wherein the drug is insulin, parathyroid hormone, calcitonin, glucagon, glucagon-like peptide 1, oxyntomodulin, or an analog of said drug.

7. A method for synthesizing a diketopiperazine having a trans isomer content of about 45% to about 65% comprising: a) saponifying an ester of a diketopiperazine in a mixture of water and a water-miscible solvent at a basic pH; and b) recrystallizing the diketopiperazine in a reaction mixture comprising trifluoroacetic acid and glacial acid at a resultant ratio ranging from about 0.4 to about 0.7.

8. The method of claim 7, wherein the water-miscible solvent is an alcohol, tetrahydrofuran, dioxane, and acetonitrile.

9. The method of claim 8, wherein the alcohol is methanol, ethanol, or isopropanol.

10. The method of claim 9, wherein the methanol is in a watetтmethanol ratio ranging from 1:1 to about 3:1.

11. The method of claim 7, further comprising the step of determining the trans isomer content of the diketopiperazine.

12. The method of claim 7, wherein the diketopiperazine is of the formula 2,5-diketo-3,6-bis(N-X-4-aminobutyl)piperazine, wherein X is selected from the group consisting of fumaryl, succinyl, maleyl, and glutaryl.

13. The method of claim 7, wherein the diketopiperazine is 2,5-diketo-3,6-bis(N-fumaryl-4-aminobutyl)piperazine.

14. The method of claim 7, wherein the reaction mixture in the recrystallizing step is held for a period of about 4 hours or greater than 4 hours.