[0009] In further embodiments, the dry powder inhalation system comprises a dry powder inhalation device or inhaler with or without a cartridge, and a pharmaceutical formulation comprising an active ingredient or active agent for pulmonary delivery. In some embodiments, powder delivery is to the deep lung, including, to the alveolar region, and in some of these embodiments, one or more active agents are delivered to the lungs and absorbed into the pulmonary circulation for systemic delivery. The system can also comprise a dry powder inhaler with or without a unit dose cartridge, and a drug delivery formulation comprising, for example, a pharmaceutically acceptable carrier or substance, for example, a diketopiperazine and an active ingredient such as small molecules, peptides, polypeptides and proteins, including insulin, oxyntomodulin, oxytocin, peptide YY, parathyroid hormone, glucagon-like peptide 1 and the like. In alternate embodiments, the pharmaceutically acceptable carriers and/or excipients, including polyethylene glycol, polyvinylpyrrolidone, saccharides, oligosaccharides, polysaccharides, including lactose, trehalose, mannose, mannitol, sorbitol, and the like; amino acids including, leucine, lysine, isoleucine, trileucine, arginine, cysteine, cystine, histidine and methionine; and/or derivatives thereof.

[0009a] In one aspect, there is provided a dry powder inhaler comprising:

a) a first element comprising a mouthpiece;

b) a second element comprising a container; and

c) at least two rigid air conduits;

wherein one of the at least two rigid air conduits in use is configured to have a deflector or stem to direct dry powder movement within a powder container.

[0010] In one exemplary embodiment, a dry powder inhaler is provided comprising: a) a first element comprising a mouthpiece; b) a second element comprising a container; and c) at least two rigid air conduits; wherein one of the at least two rigid air conduits in use is configured to have a deflector or stem to direct powder movement within a powder container in a substantially U-shaped configuration from an air intake port through a container void and through a dispensing or air exit port to reach a second airflow conduit in the mouthpiece of the inhaler prior to delivery to a user. In this an other embodiments herewith the dry powder inhaler comprises a predetermined air flow balance distribution in use through the air conduit through the powder container and through the air conduit in the mouth piece. The inhaler system also comprises high resistance air flow pathways as described below.

[0011] In one embodiment, the dry powder inhaler comprises a housing, a moveable member, and a mouthpiece, wherein the moveable member is operably configured to move a container from a powder containment position to a powder dosing position. In this and

and peripheral nervous system conditions and disorders and prophalactic use such as vaccinations. In one embodiment, the inhalation system comprises a kit comprising at least one of each of the components of the inhalation system for treating the disease or disorder.

[0033a] In one aspect, there is provided a method of delivering a dry powder to a subject comprising administering to said subject an effective amount of an amorphous powder medicament using the dry powder inhaler as described herein.

[0034] In one embodiment, there is provided a method for the effective delivery of a formulation to the blood stream of a subject, comprising an inhalation system comprising an inhaler including a cartridge containing a formulation comprising a diketopiperazine, wherein the inhalation system delivers a powder plume comprising diketopiperazine microparticles having a volumetric median geometric diameter (VMGD) ranging from about 2.5 μm to 10 μm. In an example embodiment, the VMGD of the microparticles can range from about 2 μm to 8 μm. In an example embodiment, the VMGD of the powder particles can be from 4 μm to about 7 μm in a single inhalation of the formulation of fill mass ranging between 3.5 mg and 10 mg of powder. In this and other embodiments, the inhalation system delivers greater than about 90% of the dry powder formulation from the cartridge.

[0035] In another embodiment, there is provided a dry powder inhaler comprising: a) a mouthpiece configured to deliver a dry powder to a subject by oral inhalation; b) a container housing , and c) rigid air conduits extending between the container housing and the mouthpiece and configured to communicate with ambient air; wherein the dry powder inhaler is configured to emit greater than 75% of a dry powder as powder particles from a container oriented in the container housing in a single inhalation and the powder particles emitted have a volumetric median geometric diameter (VMGD) of less than about 5 microns, when a user inhales through the mouthpiece to generate a peak inspiratory pressure of about 2 kPa within two seconds and an area under the curve (AUC) within 1 second for a pressure versus time curve of at least about 1.0, 1.1 or 1.2 kPa*sec. In another embodiment, the AUC within 1 second for a pressure versus time curve is between about 1.0 and about 15 kPa*sec.

[0036] In some embodiments, there is also provided a method of delivering a dose of a dry powder medication using a high resistance dry powder inhaler comprising, providing a high resistance dry powder inhaler containing a dose of a dry powder medicament and inhaling from the inhaler with sufficient force (or effort) to reach a peak

We claim:

1. A dry powder inhaler comprising:

a) a first element comprising a mouthpiece;

b) a second element comprising a container; and

c) at least two rigid air conduits;

wherein one of the at least two rigid air conduits in use is configured to have a deflector or stem to direct dry powder movement within a powder container.

2. The dry powder inhaler of claim 1 having a resistance value to airflow ranging from about 0.065 (√kPa)/liter per minute to about 0.200 (√kPa)/liter per minute.

3. The dry powder inhaler of claim 1, wherein the dry powder is a formulation for oral inhalation and comprises an amount from about 1 mg to about 50 mg of the dry powder.

4. The dry powder inhaler of claim 1, wherein the dry powder comprises a diketopiperazine or a pharmaceutically acceptable salt thereof.

5. The dry powder inhaler of claim 4, 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, malonyl, oxalyl and glutaryl.

6. The ~~method~~ dry powder inhaler of claim 5, wherein the diketopiperazine is bis-3,6-(N-fumaryl-4-aminobutyl)-2,5-diketo-diketopiperazine.

7. The dry powder inhaler of claim 3, wherein the dry powder comprises a drug or an active agent.

8. The dry powder inhaler of claim 7, wherein active agent is an endocrine hormone, vaccines, small molecules, including anti-asmatics, vasodilators, vasoconstrictors, muscle relaxants, neurotransmitter agonist or antagonists, and the like