NICOTINE POWDER INHALER

This disclosure relates to nicotine powder inhalers, where the nicotine powder is delivered at low air flow rates.

Dry powder inhalers (DPI) are known and are used to treat respiratory diseases by delivering a dry powder comprising a pharmaceutical, in aerosol form through inhalation to the patients' airways. For delivery deep into the lungs, particles in the range of 1 to 5 micrometers are required. In pharmaceutical dry powders, the active pharmaceutical ingredient (API) is agglomerated on the surface of larger carrier particles, e.g. lactose, and DPI's therefore operate complex mechanisms to ensure such agglomerates disperse, break up or disaggregate before the API can be inhaled deep into the lungs. Pharmaceutical dry powders containing lactose as a carrier are typically in the range of 20 to 100 micrometers. Existing DPI's for example first "grind" or de-agglomerate the dry powder or impact the larger particles of the dry powder to result in the aforementioned particle size range.

DPI's rely on the force of the patients' inhalation to entrain the powder from the device to subsequently break-up the powder into particles that are small enough to enter the lungs. Sufficiently high inhalation rates are required to ascertain correct dosing and complete disaggregation of the powder. Typically a large amount of API remains attached on the surface of the carrier and is deposited in the upper airways due to incomplete de-aggregation of the powder. Inhalation rates of existing DPI's are usually in the range of 40-120 liters/min (L/min). Existing DPI's are therefore only suitable for delivering dry powders to users in a manner that is different from the inhalation rate associated with smoking articles.

It would be desirable to provide a nicotine powder inhaler that can deliver nicotine powder to a user at inhalation or air flow rates that are close to or within conventional smoking regime inhalation or air flow rates. It would be desirable to provide a nicotine powder inhaler that is a similar size and configuration as a conventional cigarette. It would be desirable to provide a nicotine powder inhaler that can provide a metered dose of nicotine and an optional simultaneous delivery of a second active ingredient.

Summary

In an aspect, the present disclosure provides a nicotine powder inhaler comprising: a body extending between a mouthpiece portion and a distal end portion; an airflow channel extending between the mouthpiece portion and a distal end portion; a nicotine powder receptacle comprising a dose of nicotine powder and disposed along the airflow channel, the nicotine powder comprising nicotine salt; wherein the dose of nicotine powder can be inhaled into lungs of a user at an inhalation rate of less than about 5 L/min.

In another aspect, the present disclosure provides a method of inhaling nicotine into lungs of a user: inhaling air through the nicotine powder inhaler as disclosed herein at a flow rate of less than about 2 L/min to deliver powder nicotine into lungs of a user.

Detailed Disclosure of Embodiments

Nicotine powder inhalers of the invention described herein can be utilized to deliver nicotine to a user at inhalation or air flow rates that are within conventional smoking regime inhalation or air flow rates. The nicotine powder inhalers can provide a predictable and metered

CLAIMS:

1. A nicotine powder inhaler comprising:
a body extending between a mouthpiece portion and a distal end portion;
an airflow channel extending between the mouthpiece portion and a distal end portion;
a nicotine powder receptacle comprising a dose of nicotine powder and disposed along the airflow channel, the nicotine powder comprising nicotine salt;
wherein the dose of nicotine powder can be inhaled into lungs of a user at an inhalation rate of less than about 5 L/min.

2. The nicotine powder inhaler according to claim 1, wherein the nicotine powder receptacle is configured to receive a capsule containing nicotine powder.

3. The nicotine powder inhaler according to claim 2, further comprising opposing piercing elements configured to pierce the received capsule and fluidly connect the nicotine powder with the airflow channel.

4. The nicotine powder inhaler according to any one of the preceding claims, wherein the airflow channel extends linearly along the body from the distal end portion to the mouthpiece portion.

5. The nicotine powder inhaler according to any one of the preceding claims, wherein the nicotine powder is nicotine bitartrate, nicotine salicylate, nicotine fumarate, nicotine mono-pyruvate, or nicotine hydrochloride.

6. The nicotine powder inhaler according to any one of the preceding claims, wherein at least about 90 wt% of the nicotine powder has a particle size of about 10 micrometers or less.

7. The nicotine powder inhaler according to any one of the preceding claims, further comprising a swirl generator element configured to induce rotational movement in the airflow from the airflow channel.

8. The nicotine powder inhaler according to any one of the preceding claims, further comprising a second airflow channel extending between the mouthpiece portion and a distal end portion and a second powder receptacle and disposed along the second airflow channel.

9. The nicotine powder inhaler according to claim 8, further comprising a third airflow channel extending between the mouthpiece portion and a distal end portion and a third powder receptacle disposed along the third airflow channel.

10. The nicotine powder inhaler according to any one of the preceding claims, further comprising dose of a second active agent.

11. The nicotine powder inhaler according to any one of claims 9 to 10, further comprising an outlet channel in fluid connection and combing the airflow channel, the second airflow channel and the third airflow channel.

12. The nicotine powder inhaler according to claim 11, further comprising a swirl generator element configured to induce rotational movement in the airflow from the airflow channel, the second airflow channel and the third airflow channel.

13. The nicotine powder inhaler according to claim 12, wherein the swirl generator is in fluid connection between the airflow, second, and third channels and the outlet channel and the outlet channel mixes the airflow from the airflow, second, and third channels.

14. A method of inhaling nicotine into lungs of a user:
inhaling air through the nicotine powder inhaler according to any one of claims 1 to 13 at a flow rate of less than about 2 L/min to deliver powder nicotine into lungs of a user.

15. A method according to claim 14, further comprises inhaling a second active agent with the nicotine powder through the nicotine powder inhaler according to any one of claims 1

to 13 at a flow rate of less than about 2 L/min to deliver the powder nicotine and second active agent into lungs of a user.