

Influence of the opening size on the air velocity through the capsule in the capsule based DPI's

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A number of single dose capsule-based dry powder inhaler devices contain prefilled capsules that are perforated by a needle to release powder. The patient breath actuation releases the contained powder through the generated openings. In the current work, we attempt to understand the relation between the air flow, powder emission and opening size of differently lubricated capsules.

To calculate the size of the openings, gelatine capsules (n=3) with different external lubricants were pierced using Plastiapne RS01 device with one needle from each side and assessed using DSLR camera and ImageJ software. The gas flow through the device was simulated using computational fluid dynamics (CFD), at a flow rate of 60 l/min, considering a perfect rotational motion of the capsule. Aerodynamic performance of the capsules filled with 1 wt% Budesonide and 99 wt% Inhalac 230 was assessed using Fast Screening Impactor.

The capsules opening size varied depending on the presence and type of the external lubricant and largely influenced the air velocity within the capsule. Slightly higher powder retention in the capsule with smaller opening size was observed, however, the total emitted dose (ED) for a given blend was not largely influenced by the opening size.

CFD simulation was proven to be a powerful tool to predict changes in air velocity through different opening sizes. Experimentally, these changes did not have a drastic effect on the ED of the formulation studied. However, using carrier free formulations, the ED is expected to be strongly affected by the air velocity inside the capsule.