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Investigating Cascade Impactor Performance using a Modified 3D Printed Induction Port

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Abstract

Based on a computer tomographic scan of a human trachea, a modified induction port (mIP), for use with the Next Generation Cascade Impactor, was manufactured using 3D printing technology. Standard United States Pharmacopoeia IP (USPIP) was compared to the mIP and a 3D printed version of the USPIP (USP3DIP) by analyzing different types of commercial salbutamol formulations for inhalation. Increased retention of particles in the mIP was found analyzing a pMDI formulation, leading to a decrease in the FPF from 28.8±2.0% to 14.2±1.2%, which correlates better to *in vivo* deposition data from literature. Increased deposition was found to be based on geometrical factors only. The impact of surface related effects was investigated by a) comparing results obtained with the USPIP and USP3DIP (all formulations) and b) generating another model IP (USP3DSEIP) with a surface area equivalent to the mIP but maintaining the geometry of the USPIP (pMDI only). USPIP, USP3DIP, and USP3DSEIP were found to perform equivalently. The impact of different geometries on airflow velocities in the USPIP and mIP was assessed using a computational fluid dynamics (CFD) model. Conclusively, this study shows that replacing the USP IP by the mIP can provide additional information in formulation assessment and in *in vitro / in vivo* correlation, when applied on

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