AeroLung – High-throughput *in vitro* exposure system for lung models on IFlowPlate384

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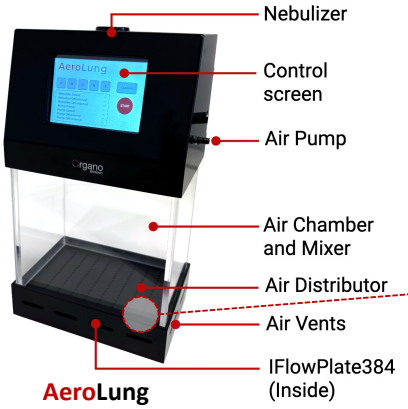
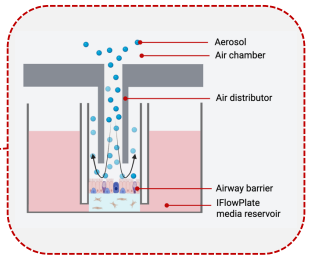
Introduction

Inhalation therapy targets the lung epithelium via aerosols, but most in vitro assays use submerged cultures, which are not physiologically accurate. Air-liquid interface models better mimic lung conditions, yet scalable and efficient exposure systems are limited. We developed ***AeroLung***, a system for uniform, high-throughput aerosol delivery across an ***IFlowPlate384***, exposing up to 128 lung tissues. It uses a pump and air distributor for consistent deposition and offers programmable control for precise, spatially targeted dosing. AeroLung enables reproducible inhalation studies under near-physiological conditions.

AeroLung Setup



AeroLung generates a fine aerosol by oscillating a piezoelectric mesh that atomizes any liquid formulation or particle suspension. A peristaltic pump then creates a steady downward airflow, driving the droplets toward a air distributor that contains an array of nozzles that precisely align with the wells of a IFlowPlate384. Each nozzle has a fixed inner diameter of 1mm and protrude into the IFlowPlate wells to ensure a localized delivery of aerosol with controlled dose at the apical surface of the airway epithelial air-liquid interface.

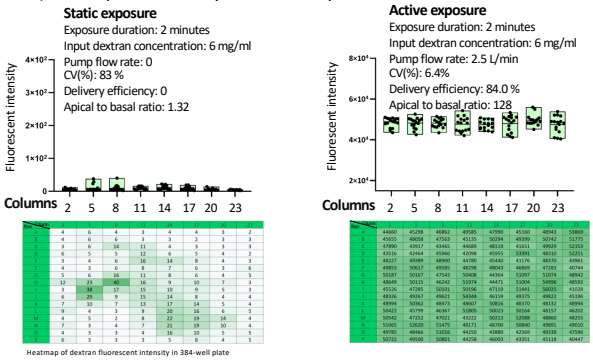


AeroLung key features

- Even distribution of aerosols across an entire IFlowPlate384
- Simultaneous aerosol delivery to 128 tissues
- Programable automated exposure protocol
- Spatially controlled delivery to apical side of epithelial barrier
- Adjustable aerosol exposure dosages
- Spatially controlled delivery to selected columns
- Aerosol concentration gradient across one IFlowPlate from single or multiple exposures

Static vs active exposure

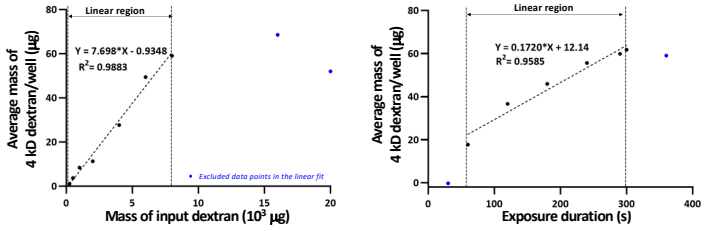
Airflow significantly improved aerosol delivery efficiency, uniformity (CV%), and apical delivery in active exposure.



Regulating aerosol exposure dosage

Dextran delivery to each well can be controlled by adjusting the dextran input concentration in a fixed 2-minute exposure.

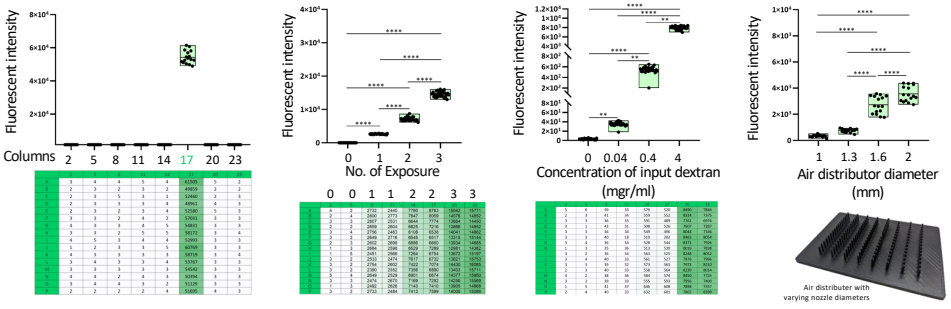
Dextran delivery to individual wells can be modulated by varying the exposure duration while maintaining a constant dextran input concentration of 8 mg/mL.



Regulating aerosol spatial delivery

Customizable air distributer allowed targeted aerosol deposition to specific plate columns.

Dextran gradient was produced either by applying multiple exposures to selected columns, by changing the concentration of input dextran, or in a single exposure using an air distributor featuring nozzles of varying diameters.



Conclusion

Our results demonstrate that the AeroLung system enables uniform and efficient aerosol delivery across the high-throughput IFlowPlate384 platform, with precise control over exposure dose and spatial distribution. This system offers a practical solution for high-throughput inhalation drug screening applications.

Reference

[1] Lenz, Anke-Gabriele, et al., American journal of respiratory cell and molecular biology, 2014.