EnquBio

Physiologically Relevant In Vitro Airway Modeling for Respiratory Disease Research

OVERVIEW

Air-liquid interface (ALI) culture models recreate the key characteristics of the respiratory tract in vitro. In ALI culture, the apical surface of normal human bronchial epithelial (NHBE) cells is exposed to air while the basal side is nourished by liquid medium — driving differentiation into a mature pseudostratified, mucociliary epithelium that closely mimics the in vivo airway. This 3D architecture enables superior physiological relevance compared to conventional 2D culture, with enhanced morphology, barrier function, and intercellular interactions.

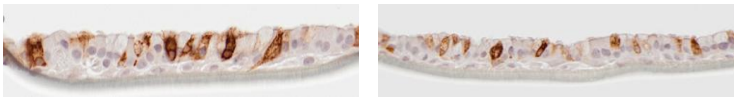
PLATFORM & MODEL DEVELOPMENT

Model Characteristics

- NHBE primary bronchial epithelial cells grown on porous membrane inserts
- Basal surface in contact with nutrient medium; apical surface exposed to air
- Differentiation into pseudostratified ciliated epithelium: 3–4 weeks
- Model remains stable in vitro for up to 2 months
- Contains mucus-producing goblet cells (MUC5AC+) and ciliated cells (Acetyl-α-tubulin+)
- Validated by IHC for key mucociliary differentiation markers

IHC Validation — Day 28 Post-Differentiation

MUC5AC *Goblet cells / mucus production*



Acetyl-α-Tubulin *Ciliated cells*



Fig. 1. NHBE cells form pseudostratified epithelia containing MUC5AC+ goblet cells and Acetyl-α-tubulin+ ciliated cells (Day 28).

DISEASE APPLICATIONS & PLATFORM CAPABILITIES

Asthma & Allergic Airway Disease

Th2 cytokine (IL-4/IL-13) stimulation; goblet cell hyperplasia; MUC5AC upregulation; CCL26 chemokine release

Chronic Obstructive Pulmonary Disease (COPD)

Mucociliary dysfunction; barrier disruption; inflammatory mediator profiling

Cystic Fibrosis

CFTR modulator testing; mucus viscosity and ion transport studies

Respiratory Infections

Viral and bacterial pathogen challenge; host-pathogen interaction studies

Drug Delivery & Inhalation Toxicology

Inhaled compound deposition; ciliotoxicity; epithelial permeability

Inflammatory Mechanism Studies

Cytokine/chemokine profiling; epithelial remodeling; periostin expression

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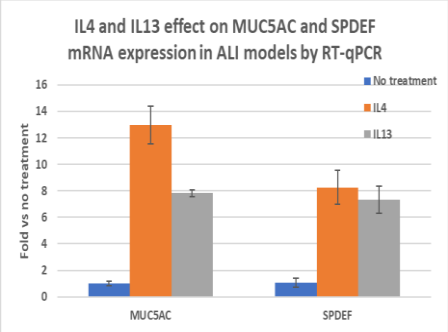
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Representative Data – Th2 Cytokine Stimulation in NHBE ALI Model

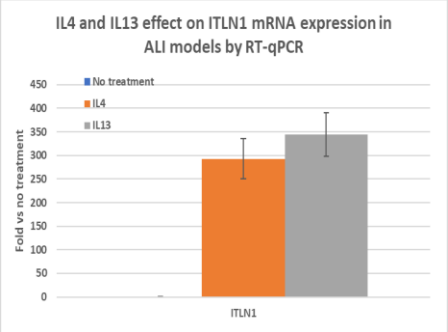
IL-4 and IL-13 drive hallmark features of allergic airway disease in vitro

In the NHBE ALI model, stimulation with the Th2 cytokines IL-4 and IL-13 reproduces the hallmark features of allergic airway diseases such as asthma — including goblet cell hyperplasia, mucus overproduction, inflammatory chemokine release, and epithelial remodeling. The data below demonstrate the model's sensitivity and pharmacological utility for studying these mechanisms.

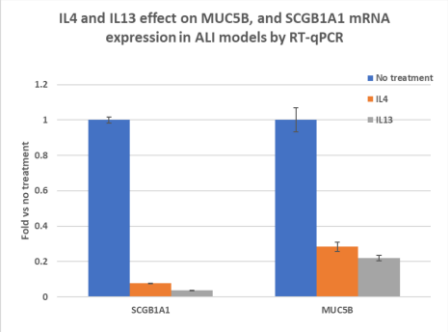
Gene Expression Analysis (RT-qPCR)



MUC5AC & SPDEF upregulated — goblet cell & mucus gene induction

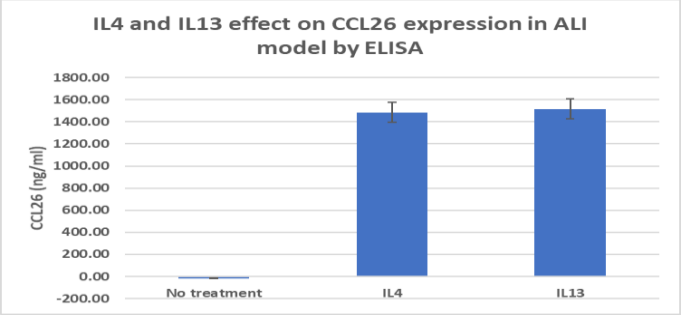


ITLN1 strongly upregulated — innate immune lectin response

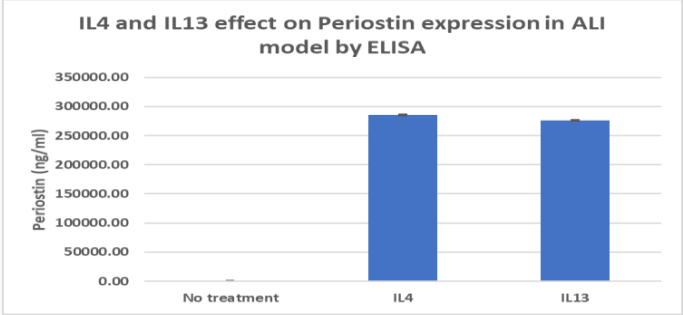


SCGB1A1 & MUC5B downregulated — loss of anti-inflammatory markers

Protein Secretion Analysis (ELISA) — Epithelial Remodeling Markers



CCL26 secretion markedly increased by IL-4 & IL-13 — key asthma chemokine (>1400 ng/mL)



Periostin elevated by IL-4 & IL-13 — epithelial remodeling and TGF-β pathway activation

EnquBio ALI Model — Available Services

- Custom NHBE ALI model development
- Gene expression by RT-qPCR & RNA-seq
- Th2/Th1 cytokine stimulation studies
- Protein secretion profiling (ELISA, MSD)
- Drug efficacy & anti-inflammatory testing
- IHC/IF for airway cell markers
- Mucociliary differentiation characterization
- Inhalation toxicology screening

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