

Effects of Polystyrene Micro- and Nanoplastic Particles on Mucin Expression in Primary Human Nasal Epithelial Cells

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1. Abstract / Summary

Micro- and nanoplastics (MnPs) are emerging airborne pollutants with potential effects on respiratory health.

This project investigated how particle size, concentration and exposure time affect MUC5AC and MUC5B expression in primary human nasal epithelial cells.

Differentiated pHNECs were exposed to PS100 and PS700 particles under ALI conditions, and mucins were quantified by ELISA.

PS100 induced more pronounced changes in mucin expression than PS700, particularly after prolonged exposure.

These findings suggest that particle size and exposure time influence mucus-associated epithelial responses.

2. Introduction

Micro- and nanoplastics (MnPs) are increasingly recognized as airborne pollutants that can be inhaled and deposited throughout the respiratory tract [1]. Particle size influences both deposition and biological interactions with airway epithelial cells [2].

Airway mucus represents an essential defense mechanism by trapping inhaled particles and supporting mucociliary clearance [3]. MUC5AC and MUC5B are the major gel-forming airway mucins [4]. While MUC5B contributes to physiological mucociliary clearance, MUC5AC is strongly associated with inflammatory and environmental stress responses [4,5].

However, little is known about how inhaled MnPs affect mucin expression under physiologically relevant exposure conditions.

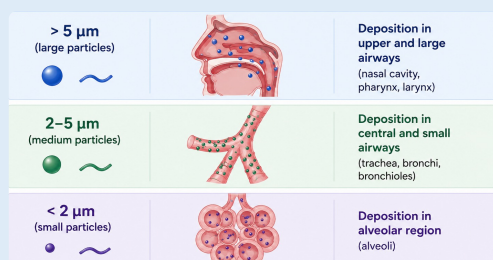


Figure 1: Size-dependent deposition of inhaled particles. Own illustration (Jeandupeux, 2026).

3. Aim and Research Questions

To investigate how particle size, concentration and exposure time affect MUC5AC and MUC5B expression in pHNECs cultured under ALI conditions.

- Do polystyrene micro- and nanoplastics alter MUC5AC and MUC5B expression?
- Does particle size influence the epithelial response?
- Do concentration and exposure time affect the observed responses?

4. Methods and Materials

Differentiated pHNECs were cultured under air-liquid interface (ALI) conditions and exposed using the VITROCELL Cloud system.

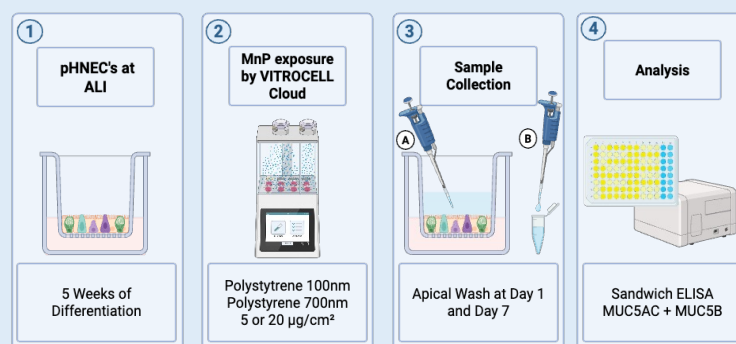


Figure 2 Methods procedure, own illustration (Jeandupeux, 2026).

5. Results

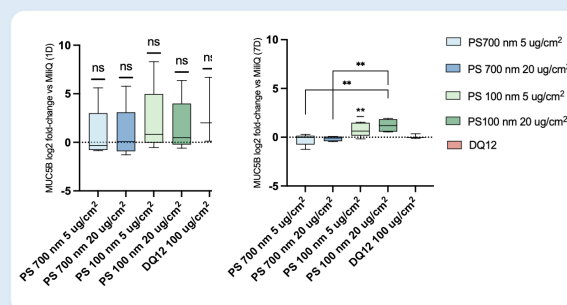


Figure 3. MUC5B expression after PS particle exposure. Data from Jeandupeux (2026); graph adapted by Rendlova (2026).

MUC5B

PS100 significantly increased MUC5B after 7 days at both concentrations ($p < 0.01$), whereas PS700 showed no significant effect.

MUC5AC

PS700 increased MUC5AC after 7 days at $20 \mu\text{g}/\text{cm}^2$ ($p < 0.01$). PS100 decreased MUC5AC after 1 day at $5 \mu\text{g}/\text{cm}^2$ ($p < 0.05$).

MUC5B/MUC5AC ratio

PS100 significantly increased the ratio at both concentrations on day 1 and at $5 \mu\text{g}/\text{cm}^2$ on day 7. No significant changes were observed for PS700.

6. Discussion / Conclusion

Particle size and exposure time were more influential than particle dose. PS100 nanoparticles induced more pronounced changes in mucin expression than PS700 particles.

The stronger response to PS100 may be related to the higher surface-area-to-volume ratio of smaller particles and their potentially greater interaction with mucus and airway epithelial cells.

Conclusion: Smaller polystyrene particles may have a greater potential to influence airway mucus homeostasis than larger particles. The biological significance of these changes remains unclear and requires further investigation.

References

- Vailionytė et al. (2025).
- Huang et al. (2022).
- Hill et al. (2022).
- Ma et al. (2018).
- Fahy & Dickey (2010).

Figures

- Figure 1: Deposition size, own illustration (Jeandupeux, 2026).
Figure 2: Methods procedure, own illustration (Jeandupeux, 2026).
Figure 3. MUC5B expression after PS particle exposure. Data from Jeandupeux (2026); graph adapted by Rendlova (2026).