IOCTO 2025 Conference
The 2nd International Online Conference on Toxics
08–10 September 2025 | Online
MDPI

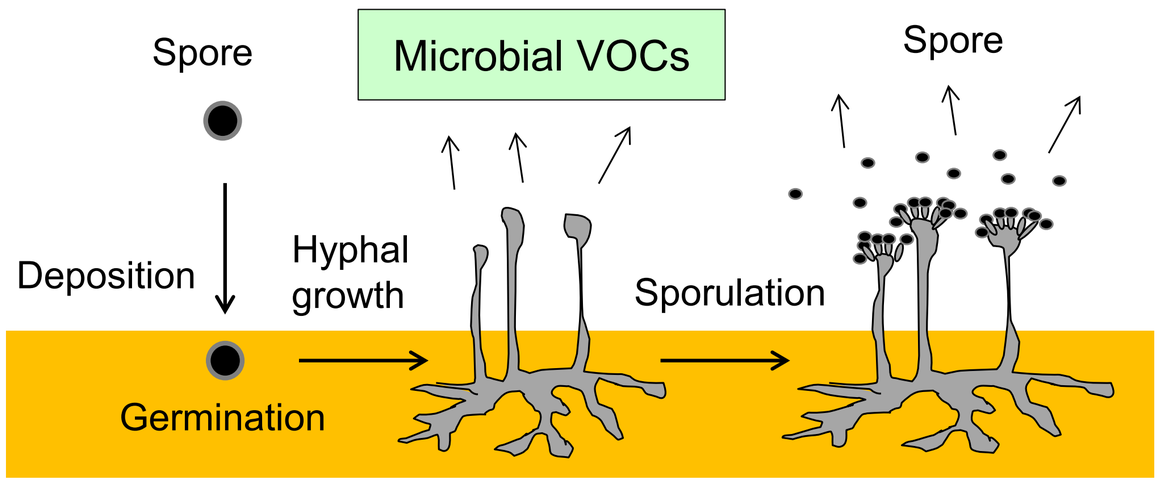
Volatile organic compounds in indoor air of residences of fungus-related allergic airway disease patients

○Yoshika SEKINE 1*, Daisuke SATO 1 , Yoshiki SHIRAISHI 2, Kazuhiro HARADA 3, Fumitoshi OGINO 3, Tsuyoshi OGUMA 4 and Koichiro ASANO 4

1 Department of Chemistry, Graduate School of Science, Tokai University, E-mail: yoshika@tokai.ac.jp
2 Department of Clinical Pharmacology, Tokai University School of Medicine
3 Research and Development, Duskin Co., Ltd.
4 Division of Pulmonary Medicine, Department of Medicine, Tokai University School of Medicine

INTORODUCTION & AIM

Allergic bronchopulmonary mycosis (ABPM) is an allergic airway disorder caused by fungal colonization within the respiratory tract [1]. Although pharmacological treatment can lead to temporary remission, the recurrence rate remains high. Therefore, controlling fungal contamination in residential environments is considered essential for both the prevention and management of ABPM and/or other fungus-related allergic airway diseases. The aim of this study was to assess the state of fungal contamination in indoor environments through the observation of volatile organic compounds (VOCs).



METHOD

Two survey visits were conducted during the autumn seasons of 2020 and 2021 at 17 residences of patients diagnosed with fungus-related allergic airway diseases. VOCs in indoor air of living rooms were collected using a passive flux sampler [2] over a 24-hour period in principle. Following samplings, collection amounts of VOCs were subsequently quantified by Gas chromatography – Mass Spectrometry (GC-MS) after solvent extraction and converted to indoor air concentrations using theoretical sampling rates [3].

Passive flux sampler deployed in indoor air of a living room

$$\frac{w}{t} = D \cdot \frac{A}{L} \cdot (C - C_s)$$

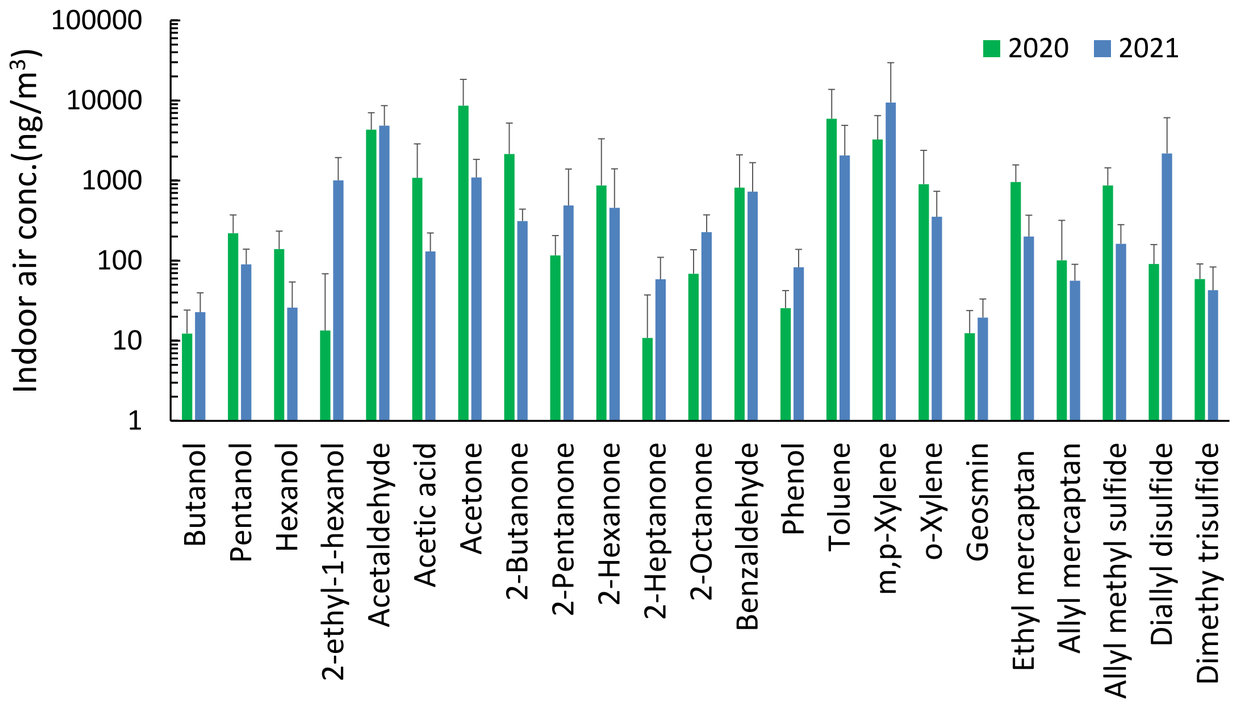
Sampling rate (m^3/h)

W: Collection amount (ng), *t*: Sampling duration (h)
A: Cross-section area of diffusion path (m^2)
L: Diffusion path length (m), *D*: Diffusion coefficient (m^2/h)
C: Concentration of VOCs in air (ng/m^3)
C_s: Concentration near the trapping media (= 0 ng/m^3)

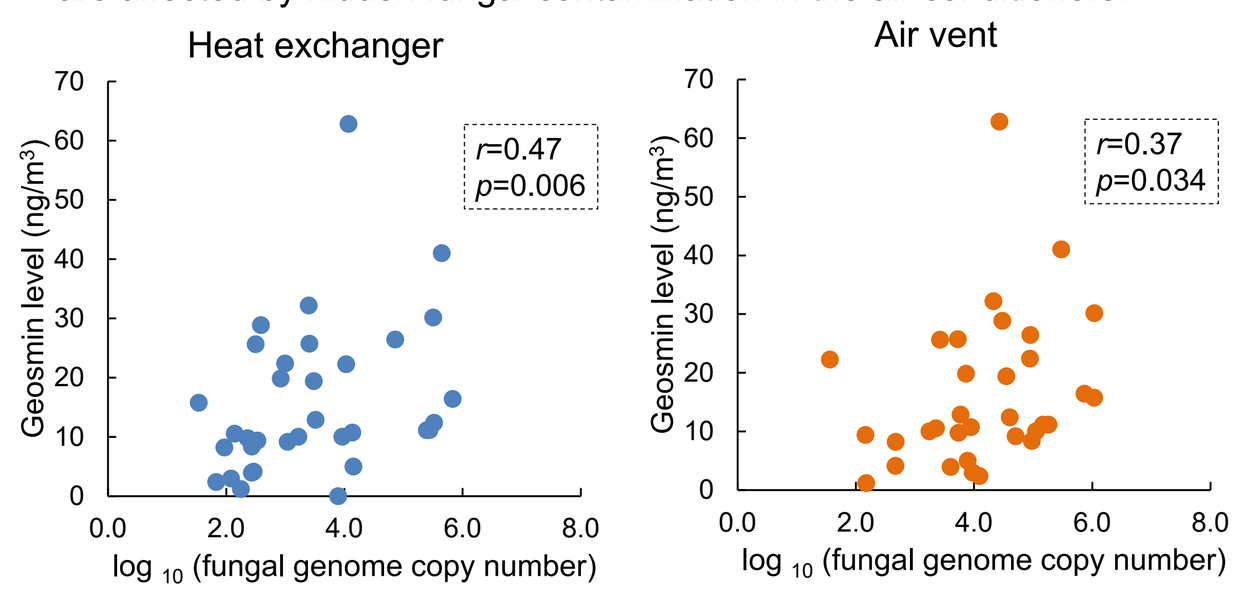
RESULTS & DISCUSSION

Indoor air concentrations of 23 types of VOCs were obtained, considering their possible origins from building materials, microorganisms and the human body. Among the VOCs, toluene and xylene (petrochemicals) were detected at relatively higher levels, whereas geosmin and phenol (likely of microbial origin) were present at lower levels. Meanwhile, consistent trends were not observed in the levels or compositions of VOCs among the 17 residences.

Geosmin
19700-21-1



The VOC concentrations were then compared with the fungal contamination inside air conditioners components such as filter, heat exchanger, blower fan and air vent, installed in the respective living rooms [4]. Indoor air concentration of geosmin, which has a distinctive earthy odor, showed significant correlations with fungal contamination detected on the heat exchanger and air vent. No significant correlations were observed for the other VOCs. This suggests that geosmin levels are affected by hidden fungal contamination in the air conditioners.



CONCLUSION

Geosmin in indoor air may serve as an indicator of hidden fungal contamination within air conditioner components, which potentially cause fungus-related allergic airway diseases.

ACKNOWLEDGEMENT

This study was supported by the Research Grants on Allergic Disease and Immunology (grant numbers 21ek0410055 and 22ek0410097) from the Japan Agency for Medical Research and Development Agency.

REFERENCES

[1] Denning D. W. et al., Med. Mycol. 51(2), 361(2013), [2] Sekine, Y., Oikawa, D., Sci. Rep. 13:9471(2023), [3] Sekine, Y. et al. Clean Tech. 32(12), 53(2022) [4] Shiraishi, Y. et al. Indoor Air, 8984619 (2023)