

## 中文摘要

本研究採用已發表之亞熱帶各時段/季節不同粒徑氣懸真菌量測濃度和氣象數據資料，並結合以相對溼度與生物氣膠氣動直徑和氣懸真菌濃度的函數關係之吸濕成長因子為基礎的不同粒徑室內/室外比模式與區塊理論肺部模式，描述自然通風住家中氣懸真菌濃度室內/室外/人體暴露之關聯性。研究推導指出室內氣懸真菌最大濃度產生之粒徑範圍為 0.65~2.5  $\mu\text{m}$ ，夏季室外氣懸真菌幾何平均粒徑為  $2.58 \pm 0.37 \mu\text{m}$ ，室內則減低為  $1.91 \pm 0.12 \mu\text{m}$ ；而冬季室外為  $2.79 \pm 0.32 \mu\text{m}$ ，室內則減低為  $1.73 \pm 0.10 \mu\text{m}$ 。較高的室內氣懸真菌濃度發生在凌晨 2 點與晚上 8 點，兩時段 50 百分位數值在夏季分別為 699 和 626  $\text{CFU m}^{-3}$ ，在冬季則為 138 和 99  $\text{CFU m}^{-3}$ 。在無室內污染源之情況下，夏季氣懸真菌濃度室內/室外比為 0.29~0.58，較冬季之 0.12~0.16 高。夏季肺部各區塊氣懸真菌濃度肺部/室內比，由高至低依序為鼻腔區之 0.7 ~ 0.8、氣管/支氣管區之 0.41~0.60、細微支氣管區之 0.12~0.40 和肺泡區之 0.01~0.24。最高沈積劑量發生在夏季晚上 11 點至凌晨 5 點間，肺泡區塊 95 百分位數沈積劑量為 4600  $\text{CFU}$ ，其中沈降速率為  $0.22 \text{CFU s}^{-1}$ 。

**關鍵詞：**氣懸真菌；自然通風；溼度；吸濕；生物氣膠；沈降

## Abstract

By using the published temporal/seasonal and particle size distribution of outdoor airborne fungi data and meteorological information in the subtropical climate, we characterized the airborne fungal concentration indoor/outdoor/personal exposure relationships in a wind-induced naturally ventilated residence. We applied a size-dependent indoor/ outdoor ratio model coupled with a compartmental lung model based on a hygroscopic growth factor as a function of relative humidity on aerodynamic diameter of bioaerosol and concentration of fungal spores. We estimated that the maximum concentrations of indoor airborne fungi occurred in the size range of 0.65 – 2.5  $\mu\text{m}$ . The average geometric mean diameters of airborne fungi decreased from outdoor  $2.58 \pm 0.37$  to indoor  $1.91 \pm 0.12$   $\mu\text{m}$  in summer, whereas decreased from outdoor  $2.79 \pm 0.32$  to indoor  $1.73 \pm 0.10$   $\mu\text{m}$  in winter. The higher indoor airborne fungal concentrations occurred in early morning and late afternoon in which median values were 699 and 626 CFU  $\text{m}^{-3}$  in summer as well as 138 and 99 CFU  $\text{m}^{-3}$  in winter, respectively, at 2 a.m. and 8 p.m. In the absence of indoor sources, summer has higher mean indoor/outdoor ratios of airborne fungal concentration (0.29 – 0.58) than that in winter (0.12 – 0.16). Lung region of extrathoracic (ET) has higher fungal concentration lung/indoor ratios (0.7 – 0.8) than that in bronchial (BB) (0.41 – 0.60), bronchiolar (bb) (0.12 – 0.40), and alveolar-interstitial (AI) (0.01 – 0.24) regions. The highest airborne fungal deposition dose (95<sup>th</sup>-percentile is 4600 CFU) occurred in 23:00 – 05:00 in summer in region AI with 95<sup>th</sup>-percentile fungal deposition rate of 0.22 CFU  $\text{s}^{-1}$ .

**Keywords:** Bioaerosol; Humidity; Airborne fungus; Deposition; Hygroscopic; Natural ventilation