Determination of airborne bacteria and fungi in the laboratories of a university

Noppadon Muangsue, Piyawan Amimanan*

Department of Medical Technology, School of Allied Health Science, University of Phayao, Phayao Province 56000

* Correspondence to: amimananp@hotmail.com

Abstract

Air quality of indoor environmental is an important factor affect to health of people. The aim of the study was to determine amount and types of airborne bacteria and fungi in the laboratories of a university. The open plate technique was used to collect samples in the morning and afternoon for 3 weeks. The result showed that the average amounts of bacteria and fungi were 67.6 to 340.5 and 69.6 to 370.8 CFU/dm^2/h, respectively. The evaluations of the index of microbial air contamination (IMA) were fair to very poor. However, the concentrations of airborne bacteria and fungi were not higher than proposed air quality index. Therefore, air quality of university laboratories had good hygienic standard. Type of bacteria and fungi were found to include *Micrococcus* spp., gram negative bacilli, *Bacillus* spp., *Penicillium* spp., *Curvularia* spp., *Rhizopus* spp. and *Cladosporium* spp., respectively.

Keywords: Bacteria, fungi, university's laboratory, air quality

Introduction

Air quality of indoor environmental is an important factor affect to health of people. [1] One of the factors to effect of indoor air quality is the contamination of microorganism which includes bacteria, fungi and viruses. Moreover, high concentration of microorganisms in the air can be allergenic disease. [2] The isolated airborne bacteria and fungi found the contamination in laboratory rooms, [3] libraries, [1,2] hospitals [4] and schools [5] include *Staphylococcus* spp., *Microcccus* spp.*, Bacillus* spp., *Serratia* spp., *Penicillium* spp., *Aspergillus* spp., *Rhizopus* spp., *Cladosporium* spp., *Fusarium* spp. and *Curvularia* spp. [1-5] which these microorganisms associate with allergy and asthma. [2,6] The objective of the study was to determine amount and types of bacteria and fungi which contaminate in clinical laboratory rooms of a university, and evaluate the air quality.

Material and method

Airborne bacteria and fungi were collected in various laboratory rooms of medical technology department, school of allied health science, Phayao University, including microbiology, chemistry, hematology and immunology laboratory using the open plate technique. The Petri dish 9 cm in diameter that contain plate count agar (PCA) and Sabouraud's dextrose agar (SDA) to collect bacteria and fungi, respectively. The both plate were left open to air and placed at six positions in each laboratory. The sampling height was 1 m above the floor and 1 m away from the wall for 1 h. The samples were collected twice a day at 9 a.m. and 2 p.m. for

3 weeks. After exposure the samples were incubated at 37°C at 48 h for bacteria and at 25°C at 5 to 7 days for fungi.

The amount of bacteria and fungi colonies were counted and calculated the number of colony forming unit (CFU)/plate/h. Bacteria were identified by microscopic examination (gram stain) and biochemical test. Fungi were identified morphological characteristic of the vegetative mycelium under light microscope.

The numbers of CFU/plate/h of bacteria and fungi were calculated the number of $CFU/dm^2/h$ to compare with the index of microbial air contamination classes (IMA class). [7] **(Table 1)**

Table 1 The index of microbial air contamination

IMA class	$CFU/dm^2/h$	performance
0-5	0-9	very good
6-25	0-39	good
26-50	40-84	fair
51-75	85-124	poor
≥76	≥125	very poor

Quantitative data was reported as mean. Statistical analyses were performed using the SPSS software (version17.0) (SPSS Corporation; Chicago, IL). Differences between two groups were determined by t-test, whereas comparisons among more than two groups were performed by ANOVA. The *p*-values of less than 0.05 were considered statistically significant.

Results

The average amounts of airborne bacteria and fungi were 67.6-340.5 $CFU/dm^2/h$ **(Table 2)** and 69.6-370.8 $CFU/dm^2/h$ **(Table 3)**, respectively. The evaluations of the Index of IMA of airborne bacteria and fungi in all laboratories were fair to very poor. Those concentrations of airborne bacteria and fungi compare with air quality index of Malaysia [8] were not exceed 500 CFU/m^3 for bacteria and 1000 CFU/m^3 for fungi which as the good quality air. The comparison of amount of airborne bacteria and fungi in during time and between the laboratories were no statistically significant difference (*p*>0.05). **(Table 2 and 3)** The most isolated airborne bacteria were *Micrococcus* spp., Gram negative bacilli (non-pathogenic bacteria) and *Bacillus* spp., respectively. The greatest number of airborne fungi was *Penicillium* spp., followed by *Curvularia* spp., *Rhizopus* spp. and *Cladosporium* spp., respectively.

Table 2 Amount of airborne bacteria of clinical laboratory rooms

	Sampling time	Mean (colony)	$CFU/dm^2/h$	IMA	Air quality index (≤500 CFU/m^3)*	During time (*p*-value)	Between rooms (*p*-value)
Microbiology	9 to 10 a.m.	57.7	90.7	poor	Pass	0.667	0.290
	2 to 3 p.m.	43.3	68.0	fair	Pass		0.217
Chemistry	9 to 10 a.m.	216.7	340.5	very poor	Pass	0.499	0.290
	2 to 3 p.m.	123.7	194.4	very poor	Pass		0.217
Hematology	9 to 10 a.m.	43.0	67.6	fair	Pass	0.655	0.290
	2 to 3 p.m.	73.0	114.7	poor	Pass		0.217
Immunology	9 to 10 a.m.	175.7	276.1	very poor	Pass	0.926	0.290
	2 to 3 p.m.	184.3	289.6	very poor	Pass		0.217

* air pollution index of Malaysia (industry code of practice on indoor air quality 2010)

Table 3 Amount of airborne fungi of clinical laboratory rooms

Sampling time		Airborne fungi					
		Mean	CFU/dm^2/h	IMA	Air quality index	During time	Between rooms
		(colony)			($\leq$1,000 CFU/m^3)*	(*p*-value)	(*p*-value)
Microbiology	9 to 10 a.m.	236.0	370.8	very poor	pass	0.232	0.721
	2 to 3 p.m.	44.3	69.6	fair	pass		0.410
Chemistry	9 to 10 a.m.	151.7	238.4	very poor	pass	0.635	0.721
	2 to 3 p.m.	118.3	185.9	very poor	pass		0.410
Hematology	9 to 10 a.m.	179.0	281.3	very poor	pass	0.121	0.721
	2 to 3 p.m.	62.3	97.9	poor	pass		0.410
Immunology	9 to 10 a.m.	125.7	197.5	very poor	pass	0.377	0.721
	2 to 3 p.m.	60.3	94.8	poor	pass		0.410

* air pollution index of Malaysia (industry code of practice on indoor air quality 2010)

Discussion

The concentrations of airborne bacteria and fungi measured in the laboratories were not higher than proposed air quality index ($\leq$500 CFU/m^3 for bacteria and $\leq$1000 CFU/m^3 for fungi). [8] The result showed that all rooms had good hygienic standard. Moreover, the amount of airborne bacteria and fungi were not depending on the period of time and type of clinical laboratory rooms. The microbial isolates included three bacteria (*Micrococcus* spp., Gram negative bacilli (non-pathogenic bacteria) and *Bacillus* spp.) and four fungi (*Penicillium* spp., *Curvularia* spp., *Rhizopus* spp. and *Cladosporium* spp.). The data were according to several reports that demonstrated these microbial were isolated in laboratory and indoor environment. [1-4,9]   The most isolated bacteria were *Micrococcus* spp. that found human skin and mucosa. [1] Thus, bacterial contamination in airborne derived from human presence. [1] The *Penicillium* spp., and *Cladosporium* spp. were recognized as opportunistic pathogens for humans and often associated with allergy and asthma. [1,3]

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