

## A Laboratory Study on Pathogenic Fungi Carried by Flowers in an Infectious Disease Ward

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### Abstract

This article addressed the pathogenic fungus distributions on the flowers which were placed in the infectious disease ward. 10 strains of flowers were randomly chosen from the visitors from 30th November 2009 to 6th January 2010. Samples were collected from different parts of the flowers on day 1 and day 8 from the collection. 76 samples were divided into 2 groups (38 samples each group) which were collected on Day 1 and Day 8. 66 of 76 (86.8%) were pathogenic fungus positive. Monilia (24.5%), demalaceous fungi (14.5%) and Rhodotheca sp (13.2%) were the top 3 pathogenic fungus in the 318 positive colonies. In the 33 comparing samples (day 1 and day 8), 6 samples were consistent and 23 were inconsistent ( $P < 0.01$ ). The rest 4 samples were pending. It is not recommended for visitor to bring flowers in the ID ward as there were high risk of pathogenic fungus in the flowers, especially for those patients who were suffering immunosuppressed in the ward.

**Keywords:** Pathogenic Fungus, Flower, ID ward

### Introduction

Flowers have ever been shown in studies to bring about a positive mood. It also brightened the room and served as a constant reminder of how much you care. Visitors always brought flowers when they visited patients in the hospital.

The flowers were placed to improve the environment in the hospital [1]. However, Tormo Molina insisted pathogens were found in the vase of flowers which was placed in the ward in the 1970s. The flowers may be contaminated with variety of pathogenic and non-pathogenic microorganisms during the time of growing and transporting [2-5]. When the flowers were placed in the ward, they may be contaminated by the air pollution surface of the tables or beds [6]. In some studies, the concentrations of Aspergillus and Penicillium spore were much higher in the ward than outside. To examine if any pathogens can be found on the flowers in the ward, fungus cultures were taken from the different parts of flowers.

### Methods

#### Materials

From 30th Nov 2009 to 6th Jan 2010, 10 strains of flower were randomly chosen from the visitors who brought the flowers to visit the

patients in ID ward. The patients stayed in the ID ward from one week to three months. These patients were major diagnosed with unknown fever and central nervous system infection. There were 4 patients located in each room. The flowers were placed in the rooms and the windows were kept open 1 hour twice per day (AM and PM). The room temperature maintained at 18-22 °C with humidity of 35-45%.

#### Sampling

Each bunch of flower was taken picture. Samples were collected by sterile scissors from different parts of the flowers, such as petals, floral leaf, stems, flower roots (or mud, root nutrient solution). The sampling process was sterilized to avoid any contamination. The samples were sent to mycology laboratory with half an hour of collection. The 2<sup>nd</sup> samples were collected from the same bunch of flower which was placed at a designated area in the ward on Day 8. Total 76 samples were collected in this study (Table 1).

No.	Flowers	Sampling parts	Sampling amount	
			Day 1	Day 8
1	Water lily, black-naped oriole	Flower petal, core, stem, root, nutrient solution	5	5

2	Carnation, White lily, auxiliary flowers	Flower root, leaf, petal, core, stem, nutrient solution	6	6
3	Water lily, baby's breath	Flower petal, core, stem, root, nutrient solution	5	5
4	Water lily, baby's breath	Flower petal, core, stem, root, nutrient solution	5	5
5	Water lily, black-naped oriole	Flower petal, core, stem, root, nutrient solution	5	5
6	Rose	Flower petal, leaf, root, nutrient solution	4	4
7	Money plant	Flower leaf, root, nutrient solution	3	3
8	Water lily, black-naped oriole	Flower petal, core, leaf, stem, root, nutrient solution	5	5
Total			38	38

**Table 1:** The details of flower sample collection

### Statistical analysis

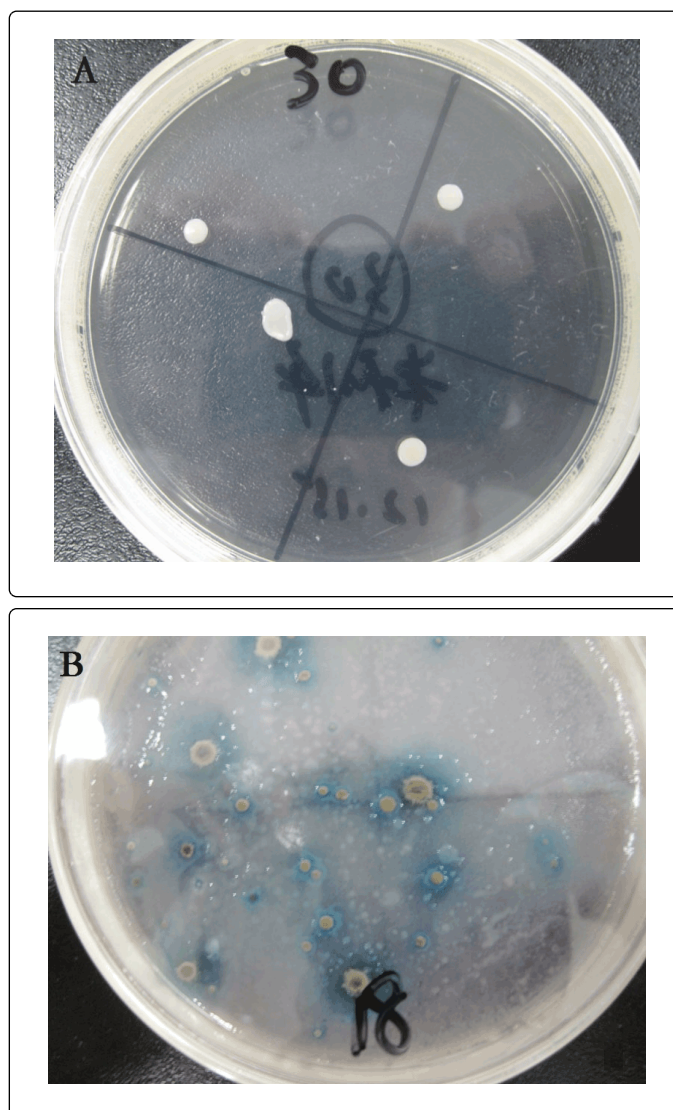
The data analysis was done by SPSS 13.0 software. Enumeration data were compared using chi square test or Fisher's exact test and significance was inferred for  $P < 0.05$ .

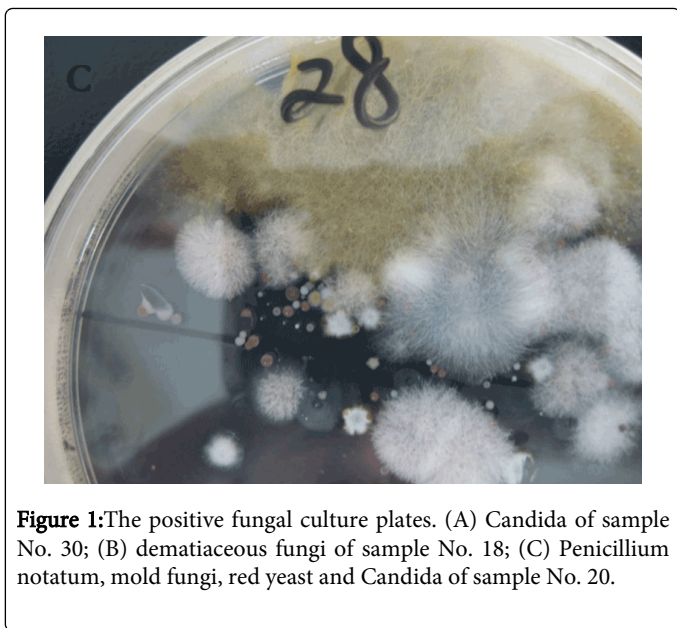
### Results

Seventy-six samples were divided into 2 groups (38 samples each group) which were collected on Day 1 and Day 8. 66 of 76 (86.8%) were pathogenic fungi positive. In the 318 positive colonies from the 66 samples, 78 were *Candida* (Figure 1A), 46 were dematiaceous fungi (Figure 1B), 42 were red yeast (Figure 1C), 34 were aspergilla including *Aspergillus flavus*, *Aspergillus fumigatus* and *Aspergillus niger*, 24 were mold fungi (Figure 1C), 18 were fusarium, 12 were *Penicillium notatum* and 64 underdetermined. There were no significantly difference of strain proportion of fungus cultures on day 1 and day 8 ( $\chi^2=7.11$ ,  $P > 0.05$ ; Table 2). In 10 negative culture samples, 7 were collected from flower cores, 2 were from leaves and 1 was from petal.

Fungi	Positive results at Day 1	Positive results at Day 8	Total
<i>Candida</i>	36 (46.2%)	42 (53.8%)	78
Dematiaceous fungi	25 (54.3%)	21 (45.7%)	46
Red yeast	26 (61.9%)	16 (38.1%)	42
Aspergilla	22 (64.7%)	12 (35.3%)	34
Mold fungi	11 (45.8%)	13 (54.2%)	24
Fusarium	10 (55.6%)	8 (44.4%)	18
<i>Penicillium notatum</i>	5 (41.7%)	7 (58.3%)	12
Underdetermined	29 (45.3%)	35 (54.7%)	64
Total	164 (51.6%)	154 (48.4%)	318

**Table 2:** The fungi culture results at day 1 and day 8.





**Figure 1:**The positive fungal culture plates. (A) *Candida* of sample No. 30; (B) dematiaceous fungi of sample No. 18; (C) *Penicillium notatum*, mold fungi, red yeast and *Candida* of sample No. 20.

There were 33 paired samples among the 76 flower samples on Day 1 and Day 8. 6 pairs were consistent, 23 pairs were inconsistent ( $\chi^2=38.11$ ,  $P<0.01$ ; Table 3), and 4 pairs were pending. The proportions of culture positive of *Candida* were 24.6% and 35.9% on day 1 and day 8 in the paired samples. The proportions of culture positive of *Candida* were 24.6% and 35.9% on day 1 and day 8 in the paired samples. The proportions of culture positive of *Candida* were 24.6% and 35.9% at day 1 and day 8 in the paired samples. Red yeast were 21.7% and 18.0% and dematiaceous fungi were 20.3% and 15.4%, respectively.

Sampling time point	Samples	Fungi culture results	
		Consistent	Inconsistent
Day 1	29	0	29
Day 8	29	23	6

**Table 3:** The comparison of fungi culture results at day 1 and day 8.

## Discussion

There were limited studies and research regarding at pathogens which were carried by flowers placed in the ward in the world. This study aimed to investigate pathogenic fungi on different parts of flowers in the ward. This article could contribute for infection control especially for those suffering immunosuppressed patient group in the hospital.

In this study, 66 of 76 (86.8%) were pathogenic fungus positive. The major fungus was *Candida* (24.5%), dematiaceous fungi and red yeast [7,8]. In the 10 negative culture samples, 7 were from flower cores. It indicated that the pathogens suspended indoor air and drooped down on the surface of flowers. The predominant microorganisms including fungi and bacteria, such as *Staphylococcus aureus*, *Bacillus cereus* and *Acinetobacter* could be detected in the indoor air in the ward such as *Staphylococcus aureus*, *Bacillus cereus* and *Acinetobacter* could be detected in the indoor air in the wards [9]. Segvić et al found that *Cladosporium*, *Penicillium* and *Alternaria* were common fungus which can be detected in the air [10]. In addition, Lugauskas et al monitored the concentrations and distributions of fungus species and suggested that *Aspergillus*, *Cladosporium*, *Alternaria* and *Aureobasidium pullulans* could be used as air pollution assessment standard [11]. The flower core was in the deep center of the flowers and it was considered as the most "clean" part of the flowers. While the samples from the stems, roots and nutrient solutions were fungus positive 100%, it indicated fungus were easy to grow in the high nutritive substances.

There were similar constituent fungus between on Day 1 and Day 8. However, the results of the paired samples showed that 23 of 33 (69.7%) fungus colonies changed when the samples at different time. It indicated the time may impact the pathogenic fungus species. It recommended the impact of the fungus species carried by flowers need further investigations.

## Conclusions

The patients who received broad-spectrum antibiotics, deep venous catheterization or immunosuppressive treatment were at high risk of fungus infections in the ID ward. It is important to identify the infection sources for infection control and protect the patients from nosocomial infections [12]. It is not recommended for the visitors bring the flowers to visit the patients based on this study.

## Acknowledgment

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## Conflict of Interest

The authors declare no conflicts of interest.

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