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Orthophenylphenol in healthcare environments: a trial related to a new administration method and a review of the literature*

Alicem TEKİN[1,], Tuba DAL[1], Caferi Tayyar SELÇUK[2], Özcan DEVECİ[3], Recep TEKİN[3], Mahmut METE[1], Saim DAYAN[3], Salih HOŞOĞLU[3]**

[1]Department of Medical Microbiology, Faculty of Medicine, Dicle University, Diyarbakır, Turkey
[2]Department of Plastic and Reconstructive Surgery, Faculty of Medicine, Dicle University, Diyarbakır, Turkey
[3]Department of Infectious Diseases, Faculty of Medicine, Dicle University, Diyarbakır, Turkey

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Aim: To investigate antibacterial and antifungal effectiveness of orthophenylphenol (Fumispore, LCB, La Salle, France) with a new administration method in healthcare environments.

Materials and methods: This study was performed in 3 units of the Dicle University Hospital. Surface swab and ambient air samples were collected just before the application of Fumispore and 6 h later. All samples were inoculated onto plate count agar and Sabouraud dextrose agar. The total aerobic colony count (ACC) was determined by using the standard method based on quantitative bacterial measurement.

Results: In total, 30 surface swabs and 6 ambient air samples were collected. The mean values of the total ACC were determined on surface swabs: 12.1 colony CFU/cm2 for total microorganisms and 2.9 CFU/cm2 for fungi before application, and 1.6 CFU/cm2 for total microorganisms and 0.4 CFU/cm2 for fungi after application. The mean values of the total ACC were detected in ambient air samples: 258 CFU/m3 for total microorganisms and 208 CFU/m3 for fungi before application, and 20 CFU/m3 for total microorganisms and 15 CFU/m3 for fungi after application.

Conclusion: The total ACC values obtained before and after applications have shown that orthophenylphenol (Fumispore) is suitable for adequate disinfection in healthcare environments.

Key words: Orthophenylphenol, disinfection, disinfectant, total aerobic colony count, ambient air, surface swab, environmental sample

1. Introduction

Nosocomial infections are one of the most important causes of morbidity and mortality in hospitalized patients. In the United States, it is estimated that there are 1.7 million nosocomial infections each year, resulting in approximately 99,000 deaths (1).

The contamination of healthcare environments (e.g., clinical or nonclinical environmental surfaces, inanimate objects, medical equipment, or materials) may play an important role as a significant reservoir for the transmission of potential nosocomial pathogens (2). However, the extent to which hospital environmental reservoirs contribute to nosocomial infections is not conclusively known (3). On the other hand, it has earlier been reported that the reduction of hospital environmental contamination contributes to the control of nosocomial infections (4).

The transmission risk of nosocomial infections from hospital environmental surfaces, such as operation tables, ventilation devices, instrument panels, dressing tables, telephone handsets, computer keyboards, or medical equipment, is probably small (4). However, there is also much clinical evidence obtained from case reports and nosocomial outbreak investigations that identifies links between poor hospital environmental hygiene and the transmission of microorganisms causing nosocomial infection (3,4).

Today, significant increases in rates of nosocomial infection have revealed the importance of both applied disinfection methods and disinfectants used in hospitals. In recent years, many new disinfectants have been put to use in hospitals. Fumispore (LCB, La Salle, France), which can disinfect both ambient air and surfaces in a single operation at the same time, is a disinfectant of ambient air, the environment, and surfaces. Fumispore, which was previously only used in the food industry, contains 20% orthophenylphenol and makes disinfection through

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** Correspondence: alicemtekin@gmail.com

smoke from aerial contact. The orthophenylphenol wraps completely around the microorganism cells, thereby breaking off their connection with the external environment. Thus, microorganism cells that cannot exchange air or food with the external environment die after a while.

Orthophenylphenol is a disinfectant that has been known for a long time. Many studies have been conducted on orthophenylphenol. The present study is the first study to be performed on the disinfection method through smoke from aerial contact. The purpose of this study is to assess both antibacterial and antifungal effectiveness of Fumispore in healthcare environments, on various surfaces, and in ambient air through quantitatively determination of the microbial load.

2. Materials and methods

The present study was performed in 3 different units (operating room, burn center, and clinical microbiology laboratory) of the Dicle University Hospital. The ambient air samples were collected with an Air Test Omega air sampling device. We collected a total of 6 ambient air samples as examples from each unit before and after application. Hospital environmental surface swab samples were also collected by using sterile brain heart infusion broth-impregnated cotton swabs. Sterile cotton swabs were contacted directly onto the surfaces for environmental sampling. We collected a total of 30 surface swab samples as 5 examples from each unit before and after application.

Ambient air samples and surface swab samples were collected twice immediately before the application and 6 h later following the application of Fumispore. While ambient air samples were directly inoculated on culture media [plate count agar (PCA) and Sabouraud dextrose agar (SDA)], surface swab samples were inoculated by spreading onto culture media. Each sample was inoculated on 2 different SDA medium for yeast and mold. PCA media were incubated in an incubator at 35 ± 2 °C for 24–48 h, while the 1 SDA medium was incubated in an incubator at 35 ± 2 °C for 24–48 h for yeast, and the other was incubated at 22–26 °C for 7–10 days for mold. The colonies grown on culture media were quantitatively counted by the naked eye.

In the present study, we used standard petri dishes of 9 cm in diameter. A standard petri dish contained PCA medium for total live microorganisms and SDA medium for fungi as a nutrient medium for the total aerobic colony count (ACC). For surface swab samples, the number of breeding colonies was divided into the media surface area (surface area of 9-cm-diameter petri dish is approximately 64 cm^2), and the total ACC was obtained as CFU/cm^2. For ambient air samples, the number of breeding colonies was divided into the collected air volume and the total ACC was obtained as CFU/m^3.

3. Results

In the present study, the total ACC mean values detected in the ambient air samples were as follows: 265 CFU/m^3 for total live microorganisms and 208 CFU/m^3 for fungi before application, and 23.3 CFU/m^3 and 15 CFU/m^3 after application. In addition, the total ACC mean values determined on surface swab samples were: 12.1 CFU/cm^2 for total live microorganisms and 2.9 CFU/cm^2 for fungi before application, and 1.6 CFU/cm^2 for total live microorganisms and 0.36 CFU/cm^2 for fungi after application.

In ambient air samples, the microbial load ranged from 20 to 25 CFU/m^3 for total live microorganisms after application. This value was 15 CFU/m^3 for fungi after application in the ambient air samples (Table 1). In surface swab samples, the microbial load ranged from 0.4 to 2.7 CFU/cm^2 for total live microorganisms and from 0 to 0.9 CFU/cm^2 for fungi after application (Table 2).

Table 1. Distribution of findings obtained from ambient air samples.

Names of media	Before application (CFU/m^3)	After application (CFU/m^3)
Operating room		
PCA	225	20
SDA	210	15
Burn center (dressing and shower room)		
PCA	280	25
SDA	160	15
Clinical microbiology laboratory		
PCA	290	25
SDA	255	15

PCA: plate count agar, SDA: Sabouraud dextrose agar.

Table 2. Distribution of findings obtained from environmental surface swab samples.

Media	Before application (CFU/cm^2)	After application (CFU/cm^2)
Operating room		
PCA (operating table)	15.6	1.7
SDA (operating table)	9.4	0.8
PCA (ventilation device)	13.0	2.6
SDA (ventilation device)	5.6	0.9
PCA (instrument panel)	15.6	2.3
SDA (instrument panel)	4.7	0.5
PCA (telephone handset)	4.2	0.4
SDA (telephone handset)	2.7	0.3
PCA (sphygmomanometer)	3.9	0.8
SDA (sphygmomanometer)	3.3	0.5
Burn center (dressing and shower room)		
PCA (dressing table 1)	15.6	2.7
SDA (dressing table 1)	4.7	0.6
PCA (dressing table 2)	14.4	2.3
SDA (dressing table 2)	4.7	0.6
PCA (instrument table)	7.8	1.1
SDA (instrument table)	0.7	0.1
PCA (shower head)	12.5	0.8
SDA (shower head)	0.9	0
PCA (tap)	7.8	0.4
SDA (tap)	0.3	0
Clinical microbiology laboratory		
PCA (desk)	18.8	1.9
SDA (desk)	1.9	0.4
PCA (incubator)	14.1	2.3
SDA (incubator)	1.6	0.25
PCA (centrifugal device)	15.6	1.8
SDA (centrifugal device)	1.2	0.25
PCA (tap)	13.4	1.3
SDA (tap)	0.6	0
PCA (keyboard)	9.4	1.3
SDA (keyboard)	1.4	0.13

PCA: plate count agar, SDA: Sabouraud dextrose agar.

In ambient air samples, either the median or mode was 25 CFU/m^3 for total live microorganisms and 15 CFU/m^3 for fungi after application. In surface swab samples, the median and mode respectively were 1.7 and 2.3 CFU/cm^2 for total live microorganisms and 0.3 and 0 CFU/cm^2 for fungi after application.

4. Discussion

Nosocomial infections, which are recurring and leading to rather serious problems, will continue to be a health issue that may be frequently be encountered in the future. To reduce the severity of this problem, complete compliance with infection control programs, preventive measures, and precaution recommendations should be ensured.

Of these applications, hospital environmental cleaning, disinfection, and sterilization procedures occupy a major place (5).

If a surface or environment seems clean, it can be considered safe for patients. However, the microorganisms that cause infections cannot be noticed by the naked eye. Therefore, visual assessment is not based on a basic science, but is rather reduced to only aesthetic concern. Unfortunately, visually clean surfaces may not be microbiologically or chemically clean, and may even be contaminated (3,6).

In recent years, 2 microbiological standards have been proposed for surface hygiene in hospitals. The first standard is the identification of an indicator microorganism of potential high risk to patients in any amount. The second standard is quantitative assessment of all live microorganisms found within a known specific surface area (2,4). In this study, the total ACC was determined by using the standard method based on quantitative bacterial measurement. This is a quantitative method to determine the total aerobic viable count on a known surface area. The quantitative bacterial measurement method is a quantitative evaluation of all live microorganisms that are grown in a known specific area (cm^2) for environmental surface swab samples and within a known specific volume (m^3) for ambient air samples (2).

Ambient air samples can be collected in 2 ways: by active (mechanical) air samplers or by passive air sampling (to settle plates). Both methods are widely used in various countries of the world. In the present study, the active (mechanical) air sampling method was used. Air Test Omega air samplers have a 50 L/min air sampling capacity (7).

There is an index of microbial air (IMA) contamination established for the microbial load in hospital ambient air at risk (1). The microbial load of air can be measured by counting the number of colony forming units per cubic meter of air. Official standards for air control are based primarily on this measurement. For this purpose, active air samplers, which collect a known volume of air, are used and blown to collect air onto medium by different techniques (7).

The total ACC is the total number of all aerobic microorganisms that are obtained from a sampled specific area, providing a general measure related to the microbial load. The US Department of Agriculture has accepted that the microbial load on surfaces of food processing equipment should be 5 CFU/cm^2 before food processing. The Swedish Food Standards Agency has advocated that the microbial load on environmental surfaces should be 5 CFU/cm^2 after cleaning. Investigators have used 2.5 CFU/cm^2 for microbial load to evaluate cleaning efficiency in the United Kingdom. Authorities have said that the internationally recognized value of 5 CFU/cm^2 could be used as a starting point. However, it should be kept in mind that not all surfaces in a hospital are analogous with surfaces in the food industry (2,8).

Analyses after disinfection indicated that 2.5 CFU/cm^2 was practicable for all surfaces (6). The total standard ACC for a hand-contact surface should be ≤5 CFU/cm^2. The finding of >5 CFU/cm^2 from a hand-contact surface, whatever the identified microorganism, indicates that there might be an increased risk of infection for the patient in that environment (2,7).

In the present study, the 30 different surface swab samples were investigated for the total ACC. Generally, in applied areas, a low microbial load (<2.5 CFU/cm^2) was obtained after disinfection. Only 2 (6.7%) surfaces yielded >2.5 CFU/cm^2 microbial load.

Five classes of IMA were defined for ambient air samples: 0–5 CFU/m^3 as very good; 6–25 CFU/m^3 as good; 26–50 CFU/m^3 as fair; 51–75 CFU/m^3 as poor; and ≥76 CFU/m^3 as very poor (9). In the present study, microbial loads were detected from 20 to 25 CFU/m^3 for total live microorganisms after application in ambient air samples. This value was determined as 15 CFU/m^3 for fungi after application in ambient air samples. These values obtained in the present study appear to belong to the good class (6–25 CFU/m^3) of IMA, consistent with the literature.

In conclusion, the total ACC values detected before and after application have shown that orthophenylphenol is suitable for adequate disinfection of the environment, surfaces, and ambient air. Orthophenylphenol appears to be a safe, effective, and easily applicable method for disinfection of pathogenic microorganisms. The results of this study might be acceptable as a basis for further investigations about the effect of this disinfectant on pathogenic microorganisms, especially those that are air- and environment-borne.

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