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Research Article

ANTIFUNGAL ACTIVITY OF MULTIPURPOSE CONTACT LENS SOLUTIONS AGAINST *CANDIDA ALBICANS*

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ABSTRACT

Multipurpose contact lens solution / MPS (multipurpose solution) is a contact lens disinfecting solution to disable microbes that can cause infections in the eyes. The cause of the infection is the lessened activity of the multipurpose solution on the contact lens. The research aims to determine the antifungal activity of the multipurpose solution against *Candida albicans* and determine the time contact of the multipurpose solutions. This study evaluated the antifungal activity of five MPSs that were tested based on based on the International Organization for Standardization (ISO) 14729, with time contacts of 1,3,6 and 12 hours. The results showed that MPS has antimicrobial activity against *Candida albicans* with a contact time of 3 hours. MPS containing polyhexanide as the active agent was found to have excellent antifungal activity and a desirable contact time.

Keywords : Multipurpose solution, antimicrobial, *Candida albicans*

INTRODUCTION

Contact lenses are visual aids that are placed on the cornea of the eye and can be used as cosmetic[1]. Most people use contact lenses to help improve their eyesight[2,3]. Although rare, incorrect use of MPS can cause permanent loss of vision. The most common condition related to the use of contact lenses is keratomycosis[2,4].

Keratomycosis is an infection or inflammation of the eye caused by a fungus that attacks the cornea, in the anterior part of the pupil[4]. Some fungi can cause infectious keratomycosis such as *Aspergilus niger* and *Candida albicans*[1,3]. The use of contact lenses that are not in accordance with the rules and knowledge of contact lens users can affect eye infections[5]. Unhygienic use when wearing contact lenses may affect keratomycosis[6]. The occurrence of eye infection using contact lenses can be prevented by using multipurpose solutions (MPS)[7].

MPS is a solution commonly used to clean and disinfect contact lenses. However, contact lens solution can also be one cause of pathogenic microorganisms in the eye causing eye infection[1,2]. The non-sterility of this contact lens solution results in a cornea in the eye indicating a keratomycosis [8]. Contamination of the contact lens solution is a major cause of microbial keratitis due to contact lens wearer's noncompliance to contact lens solution rules[1].

The antifungal qualities of contact lens solutions have been studied, but the duration of contact time between the contact lens and the solution has not been determined. This study determined the antifungal activity of contact lens solutions against *Candida albicans* and determined the ideal contact time[8].

MATERIALS AND METHODS

MPS Solutions, *Candida albicans, Staphylococcus Aureus, Triptone Soya Agar* (Oxoid), *Triptone Soya Broth* (Oxoid), and Sodium Chloride 0.9%.

Room Contamination Test

Petri dishes containing TSA media were placed inside LAF and outside LAF. The petri dishes were kept open for 15-30 minutes. Then they were closed again and put into the incubator for 24 hours at 37 ° C, and the growth of the colony was observed[9].

Selection of MPS Solution Samples

Three bottles of each contact lens solution were evaluated using a single-blind controlled experiment method. These test solutions were categorized based on their identified disinfecting ingredient [1]. The contact lens solutions tested in this experiment are listed in Table 1.

Table 1: Characteristics of contact lens solutions tested.

Contact Lens Solution	Active substances	Recommended minimum disinfection time (h)
A	Polyaminopropyl biguanide	6
B	Polyhexamethylene biguanide	6
C	Polyhexanide	6

Test of Antimicrobial Effectiveness

The sample was subcultured on an agar recovery medium (Triptone-Soya broth and Sabourband Dextrose broth). The recovery plate was incubated for 24 hours at a temperature of 20–

25 °C. The number of colonies was determined using total plate count and log reduction[1,9].

Statistical Analysis

The two-way analysis of variance (ANOVA) was used to determine the factors affecting the concentration of challenge organisms (log cfu/mL) with a level of significance (a) of 0.05. The Tukey Honestly Significant Difference (HSD) test was used to determine the post-hoc differences among the variables presented[1].

RESULTS

The results of the LAF contamination test can be seen in Table 2.

Table 2: The result of LAF contamination test

Area	Number of colonies (cfu/m^3)
I (Inside LAF)	0
II (Outside LAF)	7

The results of the LAF contamination test showed no growth of microorganisms in the LAF and met the sterility requirements of class I (sterile room), that is, <1 cfu/m^3 [12].

MPS sampling was done using the non-probability method that does not allow any element or member of the population to be selected to be sampled. In the use of non-probability sampling, the sample was chosen randomly without considering the representation of a particular product. As long as the sample was taken, it fulfilled the requirements required in the study[1].

The result of antifungal activity

The MPS solution is effective when it is able to kill bacteria by reducing ≥1 log of the number of fungal colonies within the recommended minimum disinfection time listed on the packaging. The results of effectiveness testing and contact time can be seen from Table 3.

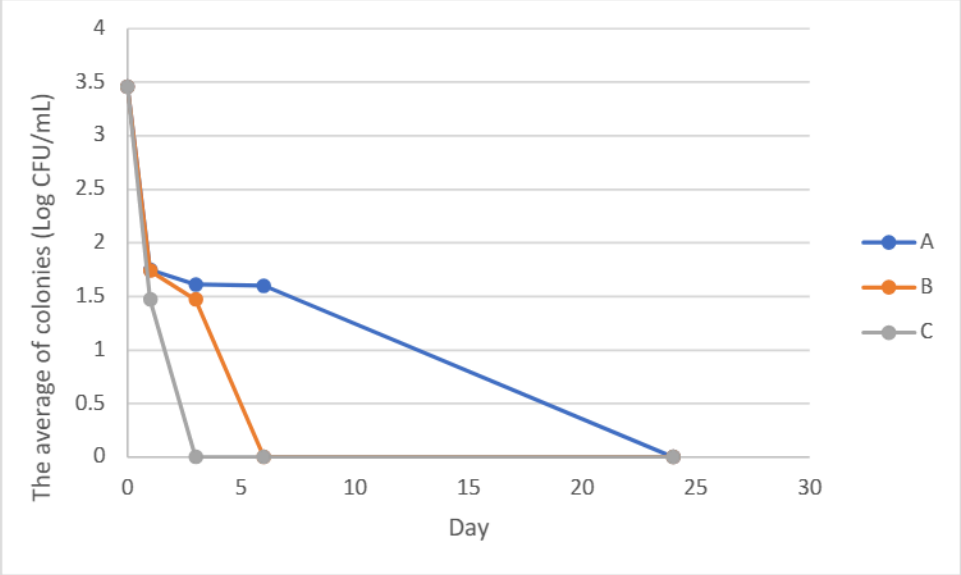

Figure 1: Results of antibacterial activity against *Candida albicans* (Good Microbial Activity: ≤2 log cfu/mL, Fair Microbial Activity: > log 2 but ≤ log 4 cfu/mL, Poor Microbial Activity: > log 4 cfu/mL)

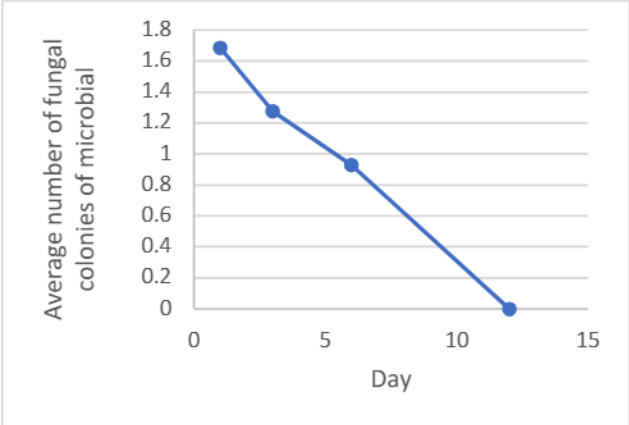

Figure 2: Average number of fungal colonies of microbial.

Figure 1 shows that each MPS has an effective time within 3 hours. MPS C has the most effective ability against *Candida albicans* fungi compared to the other MPSs. Based on the comparison with the recommendations in the packaging, all MPS solutions acted in accordance with the recommendations in the packaging.

The effect of each time grouping on the *Candida albicans* concentration can be seen in the figure 2.

The results showed that the most effective MPS contact time for *Candida albicans* was 24 hours with 0 log CFU / mL. However, based on antibacterial activity, the MPS solution has good activity under 2 CFU / mL log values, so the recommended contact time on the packaging label is listed in accordance with the time tested on the *Candida albicans* fungus.

Statistical Analysis

Measurements of the antimicrobial activity of each MPS solution to *Candida albicans* were statistically analyzed from three treatments (MPS A, MPS B, and MPS C) as well as on four groups of contact time observations (1 hour, 3 hours, 6 hours, and 24 hours). The effect of each treatment of MPS solution on *Candida albicans* concentration can be seen in the table 3.

Table 3: Average number of fungal colonies of *Candida albicans*

Treatments	Contact time	Average number of fungal colonies of microbial
MPS A	4	1.24
MPS B	4	0.80
MPS C	4	0.36

Table 4 shows that the highest concentration of *Candida albicans* colonic colonies is 1.24 CFU / mL logs, that is, MPS brand A, while the lowest concentration of *Candida albicans* colony is MPS brand C of 0.3675 CFU / mL.

The effect of each time grouping on the *Candida albicans* concentration can be seen in the table 4.

Table 4: The average of *Candida albicans* colonies

Times (h)	The average of *Candida albicans* colonies
1	1.68
3	1.27
6	0.92
24	0

Table 4 shows that the highest concentration of Candida albicans colonies was 1.68 CFU / mL Logs at 1 hour contact time at 3 hours at 1.27 CFU / mL Logs, 6 hours contact time of 0.92 CFU Log / mL, and the lowest average is at the time of contact 24 hours that is equal to 0 CFU Log / mL.

To determine whether the antimicrobial activity of multipurpose solutions had a different effect on *Candida albicans* concentration, we tested experimental data using the variance analysis method (ANOVA).

For the effect of group (contact time) on *Candida albicans* fungi value Fcount = 2.76 <Fα = 3.25, then H0 is accepted, meaning there is no difference in the influence of contact time of MPS solution to decrease the amount of *Candida albicans*.

DISCUSSION

Candida albicans fungus was used as a test microbial because it complies with the SO 14729 standard[1]. In addition, *Candida albicans* is known as the most common cause of keratomicosis[13].

The antimicrobial active substances contained in the MPSs are polyhexamide (MPS C), polyaminopropyl biguanide (MPS A), and Polyhexamethylene biguanide (MPS B). Polyhexanide contains a highly-charged active side that has the ability to damage microbial cell membranes with effective electrostatic interactions against wide-range microbes[1]. Polyaminopropyl biguanide works by damaging membranes and reducing permeability, which has a deadly effect on microbes. This substance can bind bacterial DNA, alter transcription, and cause DNA damage[10]. Polyhexamethylen biguanid works by interacting on the surface of the bacteria then is transferred to the cytoplasm and the cytoplasmic membrane. Polyhexamethylene biguanide has little effect on neutral phospholipids in the membrane. Bacterial membranes that are negatively charged and acidic will be induced to combine which leads to increased fluidity and permeability. This results in the release of lipopolysaccharide from the outer membrane and microbial death[11].

CONCLUSION

The results of this study indicate that all of the MPSs tested demonstrated antifungal activity against *Candida albicans*, with effective contact time recommendation of 6 hours. The MPS containing polyhexanide as the active agent was found to have excellent antifungal activity and a desirable contact time.

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