

# Antifungal Potency of *Musa paradisiaca* L. Peel Extract Against *Candida albicans* as Acrylic Denture Cleanser

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Online submission : 11 September 2023

Accept Submission : 06 Juni 2024

## ABSTRACT

**Background:** Denture stomatitis is one of the diseases that can arise due to unattended denture hygiene. One of the microorganisms that cause denture stomatitis is *Candida albicans*. **Objective:** The purpose of this study is to determine the potential of *Musa paradisiaca* L. extract concentrations of 25;50;75% as antifungal against *Candida albicans* on removable denture acrylic base. **Materials and Methods:** This study is a laboratory experimental study with a post-test-only control group design using 28 samples for 4 treatment groups. *Candida albicans* (ATCC 10231) was bred on acrylic plates. The acrylic samples were immersed in aquadest, *Musa paradisiaca* L. peel extract concentrations of 25;50; and 75%, respectively. The sample was immersed for 10 minutes and the amount of *Candida albicans* was calculated using colony counter. The research data was analyzed with the One-Way Anova parametric test followed by a post-hoc LSD test. **Results:** Based on the results of statistical tests, significant differences ( $p < 0.05$ ) were obtained in *Musa paradisiaca* L. peel extract concentrations of 25; 50; and 75% compared to the control group. There was a decrease in the amount of *Candida albicans* in the three concentrations of *Musa paradisiaca* L. peel extract, with increased effectiveness at a concentration of 75%. **Conclusion:** *Musa paradisiaca* L. peel extract 25; 50; and 75% solution, especially at 75% concentration, has antifungal activity to reduce the number of *Candida albicans* and has the potential as an acrylic denture cleaner.

**Keywords:** Antifungal, *Musa Paradisiaca* L. peel extract, *Candida Albicans*, Acrylic Base

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## INTRODUCTION

Acrylic removable dentures are an alternative treatment to replace tooth loss because the cost is affordable, with aesthetic preference due to their similar color to the oral mucosa.<sup>1,2</sup> However, acrylic material also has drawbacks, one of which is porous. This porosity property results in the absorption of fluid in the mouth and can cause the accumulation of food residues and plaque that will interfere with the health of the mucous tissue under the denture.<sup>1,3</sup> Inadequacy of denture care such as poor hygiene, and long-term and night use can lead to the occurrence of *denture stomatitis* (DS).<sup>4,5</sup>

*Candida-associated denture stomatitis is prevalent worldwide in the range of 20-67% of prosthesis wearers. The prevalence of DS in India is 70%, and in Indonesia, it is 57,3%. The details are 91.3% of male patients, 45.8% of patients aged 55-56, and 10% of denture stomatitis cases. The majority of the data showed a 60% prevalence rate of DS.*<sup>2-8</sup>

One of the main strain microorganisms found in DS was *Candida albicans*. It cannot only attach to the mucosa of the oral cavity but also colonize the acrylic resin base of dentures. It has several pathogenicity factors that can cause a disease called *candidiasis*.<sup>1</sup>

Denture cleaning is needed to prevent dentures from being contaminated by bacteria and fungi so that can avoid *denture stomatitis*.<sup>5</sup> Denture cleaning can usually be done using mechanical and chemical techniques; mechanical techniques are carried out using toothbrushes or ultrasonic devices, while chemical techniques are usually done by immersing dentures in disinfectant solutions with preparations that are widely circulated on the market in tablets such as *effervescent*.<sup>8,9</sup> Chemical denture cleaners have drawbacks, which are abrasive and cause unwanted side effects even though the material affects oral microorganisms.<sup>1,5</sup> Therefore, alternative materials are needed that are effective as

bactericides and fungicides, easy to use, and biocompatible with denture materials.<sup>5</sup>

Bananas are one of the plants that are widely studied for their antimicrobial effectiveness. It is known that all parts of the banana plant have a good effect on health, including the peel which has been ignored because it is considered a waste that is not useful. Banana peels contain many beneficial substances in the form of alkaloids, tannins, flavonoids, saponins, and steroids compared to other parts of the banana.<sup>10,11</sup> One type of banana that can be used as an antifungal in *Candida albicans* is a type of kepok banana (*Musa paradisiaca* L.). A similar study of the effectiveness of banana peel was shown by Loyaga-Castilo et al in 2020 in Peru only examined each 10, 30 and 50% concentrate, then Sari et al in 2023 in Indonesia, compared antifungal and antimicrobial activity from *Musa paradisiaca* L. extract. The two studies revealed that banana peel extract can be effectively used as an antifungal activity at 50 and 75% concentrate, respectively.<sup>12</sup> This study aims to determine the potential antifungal activity of *Musa paradisiaca* L. peel extract concentrations of 25;50;75% on acrylic base.

## MATERIALS AND METHODS

Extracting *Musa paradisiaca* L. peel was done by sorting out banana peels with good conditions, which are greenish-yellow with a few brown stains, no fungi or insects, and no discoloration.<sup>10,13</sup> The banana peel was cleaned with *aquadest* sterile, cut into small pieces (Figure 1.A) dried in the sun, and used in an oven. The dried banana peel was mashed and macerated with 96% ethanol (Figure 1.B). The maceration result was entered in a *vacuum rotary evaporator* then a thick extract of *Musa paradisiaca* L. peel was obtained. Next, this extract was diluted to a concentration of 25;50;75% using *aquadest*.

The sample of this study was *Candida albicans* ATCC (American Type Culture

*Collection*) 10231, then cultured on the acrylic plate (Figure 1.C) at the Microbiology Laboratory of Andalas University. The number of acrylic plates used in each treatment was 7 plates measuring 10x10x2 mm. These plates were immersed in *aquadest* to reduce residual monomers and sterilized with an *autoclave*. The acrylic plates were then immersed in artificial saliva for 1 hour before being immersed in a container containing *Candida albicans* and incubated for 24 hours at a temperature of 37°C (Figure 1.D)



**Figure 1.** (A) *Musa paradisiaca* L. peel cut into small pieces for drying, (B) Extract-making procedure, (C) Acrylic plate immersed in *Candida albicans* suspension, (D) Acrylic plate and *Candida albicans* specimen incubated for 24 hours for attachment to the acrylic plate.

Antifungal testing of *Musa paradisiaca* L. peel extract as an antifungal against *Candida albicans* ATCC 10231 was performed by immersing the plate in extract (25;50;75% concentrations) and control with *aquadest*.<sup>11</sup> Acrylic plates that had been contaminated with *Candida albicans* were put into a closed test tube containing a solution of banana peel extract

of 25;50;75% concentrations and the control for 10 minutes. The plates are rinsed and the acrylic plates are put into the PDB solution for vibration using a vortex until the *Candida attachment* is loose. The *Potato Dextrose Broth* (PDB) solution from the vibration process is taken to be planted on *Potato Dextrose Agar* (PDA) media by the *Spread Plate* method and then incubated. After 48 hours of colony, *Candida albicans* will be formed and calculated on its growth using a *colony counter*. Data analysis was tested statistically using the *one-way ANOVA* followed by a *post-hoc LSD* test.

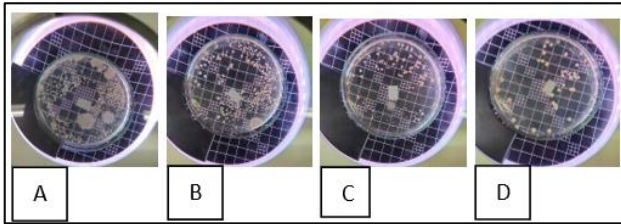
## RESULTS

Data analysis was performed using the one-way ANOVA test. The results showed that the value of  $p < 0.05$  means there is a significant difference in the average amount of *Candida albicans* between *aquadest*, and *Musa paradisiaca* L. peel extract concentrations of 25;50;75%.

**Table 1.** Colonies *Candida albicans* after 10 minutes of immersing in each group

| Treatment                 | N | Mean $\pm$ SD (CFU/ml) | p value |
|---------------------------|---|------------------------|---------|
| Aquadest solution         | 7 | 249.14 $\pm$ 69.293    | 0.0001  |
| Extract concentration 25% | 7 | 179.43 $\pm$ 64.205    |         |
| Extract concentration 50% | 7 | 119.57 $\pm$ 37.960    |         |
| Extract concentration 75% | 7 | 70.14 $\pm$ 31.403     |         |

Table 1 shows that the highest average amount of *Candida albicans* is found in the *aquadest* solution. The amount of *Candida albicans* decreased in samples immersed with *Musa paradisiaca* L. peel extract concentrations of 25;50;75%. The lowest amount of *Candida albicans* was in samples immersed with a solution of *Musa paradisiaca* L. peel extract at a concentration of 75%.



**Figure 2.** The growth of *Candida albicans* in the control group, a solution of extract of *Musa paradisiaca* L. peel extract concentration (A). Aquadest, (B). 25%, (C). 50% and (D). 75%

Figure 2 shows the difference between the control group and the extract solution. Most colonies were in the control group with aquadest, followed by a concentration solution of 25%; 50%; and 75%. The number of colony *Candida albicans* is counted by *Total Plate Count* (TPC).

**Table 2.** Results of Post Hoc Analysis of LSD *Musa paradisiaca* L. peel extract

| Amount of <i>Candida albicans</i> |                           | p-value |
|-----------------------------------|---------------------------|---------|
| Extract concentration 25%         | Extract concentration 50% | 0.046   |
|                                   | Extract concentration 75% | 0.001   |
|                                   | Aquadest solution         | 0.022   |
| Extract a concentration 50%       | Extract concentration 75% | 0.095   |
|                                   | Aquadest solution         | 0.0001  |
| Extract concentration 75%         | Aquadest solution         | 0.0001  |

Table 2 showed a significant difference between *Musa paradisiaca* L. peel extract concentration of 25% and aquadest solution group, *Musa paradisiaca* L. peel extract concentration of 50% and 75% group. Table 2 showed a significant difference between the aquadest solution group and *Musa paradisiaca* L. peel extract concentrations of 50% and 75% group. Meanwhile, there was no significant difference between *Musa paradisiaca* L. peel extract concentrations of 50% and 75% groups.

## DISCUSSION

The results of the study that was conducted on 28 acrylic plate samples for the control group and the treatment group showed that there was a significant difference in the average number of *Candida albicans* ( $p < 0.05$ ). Increasing the concentration of *Musa paradisiaca* L. peel extract in this study may reduce the number of cells of *Candida albicans* on acrylic plates. The results of this study are in line with research conducted by Loyaga-Castillo *et al* to test the antifungal activity of banana peel extract with concentrations of 10%, 30%, and 50% against growth *Candida albicans*. In this study, it was found that the effectiveness of its inhibition of growth *Candida albicans*. The optimum concentration is 50%.<sup>10</sup>

The *Post Hoc* LSD data analysis showed a significant difference between the amount of *Candida albicans* on acrylic plates immersed with aquadest solution group and *Musa paradisiaca* L. peel extract concentrations of 25;50;75% groups. This shows that any concentration of *Musa paradisiaca* L. peel extract has potential as an antifungal against *Candida albicans*. The potential antifungal activity of *Musa paradisiaca* L. peel extract increases along with the increase in concentration from 25% to 50%, and 75%.

Based on data analysis, it is also known that there is no significant difference in the amount of *Candida albicans* from acrylic plates immersed in *Musa paradisiaca* L. peel extract with concentrations of 50% and 75%. It could be interpreted that *Musa paradisiaca* L. peel extract concentrations of 50% and 75% both have the potential to be a good antifungal among all concentrations of *Candida albicans* on removable denture acrylic plates. From the explanation above, it can be seen that in this study, *Musa paradisiaca* L. peel extract concentration of 50% is a minimal effective concentration that can be used as an antifungal against *Candida albicans* on removable denture acrylic plates.



Some other studies have suggested that *Musa paradisiaca* L. peel contains alkaloids, flavonoids, saponins, and tannins which can be used as antioxidants, analgesics, antispasmodics, and also antimicrobials.<sup>10-14</sup> In Previous research conducted by Monica Loyaga-Castillo *et al*, it was found that hydroethanol extract from the peel of *Musa paradisiaca* L. peel extract on *Candida albicans*. So it can be considered an alternative therapy for *Candidiasis* and can reduce the side effects of other chemicals.<sup>10</sup>

In research conducted by Karadi *et al*, it is known that *Musa paradisiaca* L. peel extract at a concentration of 100 µg/ml has an inhibitory zone of 24±0.3 mm against fungal colony growth *Candida albicans*. The inhibitory zone is larger than the inhibitory zone in commonly used antifungal drugs such as fluconazole with an inhibitory zone value of 23 mm.<sup>14</sup> Research by Sari *et al* showed that *Musa paradisiaca* L. peel extract has antifungal activity against *Candida albicans* and antibacterial against *Streptococcus mutans* starting from a concentration of 25%.<sup>15</sup>

*Musa paradisiaca* L. peel extract is proven to function as an antifungal against *Candida albicans* on acrylic plates. This happens because *Musa paradisiaca* L. peel extract can inhibit the growth of fungi (*Candida albicans*, *Candida tropicalis*, *Aspergillus niger*) with the content of compounds in the form of tannins, alkaloids, saponins, polyphenols, and flavonoids.<sup>14-18</sup> These compounds are active substances in extracts that act as antifungals with different mechanisms.<sup>10,15,16,19,20</sup> Based on numerous studies, *Candida* can either directly or through the plaque layer stick to acrylic resin dentures. The emergence of an infectious process can be attributed to this first phase. When food or saliva is eaten without this adhesion, the germs are released from the mouth cavity [53]. Antifungal compounds contained in the peel of *Musa paradisiaca* L. peel extract can affect the structure and function of the cell section *Candida albicans* such as cell walls and cell membranes.<sup>8</sup> that prevent lipids

on the cell membrane from dissolving. Phenolic chemicals' antifungal properties can precipitate proteins, inactivate enzymes, and destroy cell walls and membranes. Then make it difficult to stick to acrylic resin.<sup>5</sup>

In addition to antifungal activity, other studies have also found antibacterial activity in banana peel extract against *Streptococcus mutans*, *Staphylococcus aureus*, *Klebsiella pneumonia*, *Pseudomonas aeruginosa*, and *Salmonella tippy*.<sup>14,16</sup> Not only limited to the peels, another study from Melisa *et al* (2023) proved antibacterial activity in a combination of Mauli Banana stem and Basil leaves against *Staphylococcus aureus*.<sup>18</sup> Therefore, further research is needed to explore the potential of banana plants as antibacterial and antifungal optimally. Based on this research, the *Musa paradisiaca* L. peel extract, especially with a concentration of 75% has the potential to be used as an alternative to denture cleanser solution so that it can prevent the growth of *Candida albicans* exaggeration and *denture stomatitis* in acrylic removable denture users.<sup>19,20</sup> However, denture-soaking by this extract has potential side effects on the acrylic denture, including tannin can lead to staining and color change. The limitation of this study is the percentage of the active compound of banana peel extract was not measured, so need advance and further study to check the rate of each active compound and side effects by using banana peel extract, especially for acrylic dentures.

## CONCLUSION

Based on the results, it concluded that *Musa paradisiaca* L. peel extract especially at 75% concentration has an antifungal activity against *Candida albicans* on acrylic plate and the potential for acrylic denture cleanser. This study can be used as basic data for the next research so that the antimicrobial activity of *Musa paradisiaca* L. peel extract can be used in dentistry.

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