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THE EFFECT OF SPRAYING MAULI BANANA (*Musa acuminata*) STEM EXTRACT 25% CONCENTRATION ON THE DIMENSIONAL STABILITY OF ALGINATE IMPRESSION

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ABSTRACT

Background: Alginate is an ingredient derived from brown seaweed extract which is anhydro-P-d-mannuronic acid. Alginate is often used as an impression material. A factor that must be considered when using impression materials is to prevent the infection. Prevention of infection transmission is done by administering disinfectants by spraying. However, this material has imbibition properties and expansion can occur in the model. 25% Mauli banana extract solution can be used as a disinfectant in alginate impressions and does not affect the dimensional stability of the alginate impressions. **Objective:** To analyze the effect of spraying mauli banana (*Musa acuminata*) stem extract 25% concentration on the dimensional stability of alginat impression. **Methods:** This research was pure experimental research using pretest-posttest and control group design. The research sample consisted of 15 samples that divided into 3 groups; aquades, 1% sodium hypochlorite, and 25% Mauli banana stem extract. The research data were analyzed using One Way Anova. **Results:** The average value calculation of the difference before and after spraying the aquades was 0.504 mm, the 1% sodium hypochlorite group was 0.502 mm and the 25% Mauli banana stem extract was 0.328 mm. Statistical tests showed no significant differences among all treatment groups on alginate dimensional stability or there was no effect on spraying 25% Mauli banana stem extract in the dimensional stability of alginate impression with sig. 0,401 ($p > 0.05$). **Conclusion:** There was no significant effect on spraying Mauli banana (*Musa acuminata*) stem extract 25% on the dimensional stability of the alginate impression.

Keywords: Alginate impression, dimensional stability, disinfection, 25% Mauli banana stem extract solution, spraying technique.

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INTRODUCTION

The results of the Basic Health Research (RISKESDAS) in 2018, the proportion of Indonesian population experiencing tooth loss was 19.0% while in the South Kalimantan was 17.8% .¹ Tooth loss can be overcome by making dentures with the first stage of jaw impression. Jaw impression largely determines the results of work in dentistry. It usually uses impression material which is used to obtain negative impressions from oral tissue. The results will be used to create study models and work models. Impression materials in dentistry vary in types, one of which is hydrocolloid irreversible or alginate. ^{2,3}

Alginate is an ingredient derived from brown seaweed extract; anhydro-P-d-mannuronic acid or

alginic acid. This is often used because it has good gel strength, easy manipulation, does not require much equipment, inexpensive and convenient for patients. This material has imbibition properties, so that the alginates are easier to expand and there is an expansion in the model that can cause dimensional changes, so that the results of alginate impression are not accurate.^{4,5} Factors that must be considered when using this kind of materials is to prevent cross-contamination of diseases such as blood, saliva, pus, and debris which can stick to the impression and can cause disease transmission. The study found that 67% of the material sent by dentists to the laboratory was contaminated with pathogenic bacteria.^{6,7}

Based on the recommendations of the American Dental Association (ADA), it is important to clean the blood and saliva of impressions using disinfection before filling the gypsum in the laboratory. The most common chemical disinfectant is sodium hypochlorite because it has several advantages including working fast, easily obtained and having broad spectrum antimicrobial ability.^{7,8}

There are two suggested methods for disinfection of immersion and spray methods to kill microbes and prevent cross-infection caused by alginate.^{3,9} Based on Oderinu OH (2007) research that use sodium hypochlorite 1% by spraying technique for 10 minutes in alginate, there were no significant dimensional changes in the model.^{7,9,10}

In addition to chemicals, available traditional plants that can be used as alternative ingredients is mauli banana stems.¹¹ Mauli banana (*Musa acuminata*) are typical bananas of South Kalimantan and widely grown in Banjarmasin.¹² Previous research stated that methanol extracts of Mauli banana stems contain bioactive components, in the form of saponins (14.49%), flavonoids (0.006%), and tannins (67.59%)^{13,14} Based on previous research, methanol extracts of Mauli banana stem have antifungal activity against *Candida albicans* and *Streptococcus mutans* at concentrations of 25 %^{15,16,17} Concentration of 25% has better antibacterial activity when compared to concentrations of 6.25%, 12.5%, and control.¹⁶

Until now, there had not been researched on the effect of mauli banana extract on the dimensional stability of alginate impression, so the researcher is interested in conducting research on the influence of distilled water, 1% sodium hypochlorite and the 25% mauli banana stem extracts toward the dimensional stability of alginate impression.

MATERIALS AND METHODS

This research was conducted after obtaining the research permit and ethical eligibility issued by the Medical Research Ethics Commission of the Faculty of Dentistry, Lambung Mangkurat University No. 067 / KEPKG-FKGULM / EC / I / 2020. This study used a pure experimental method with a pretest-posttest with control group design consisting of 3 treatments using aquades, 1% sodium hypochlorite, and 25% Mauli banana extract. The number of repetitions for each treatment was 5 times each the treatment. Samples used were normal setting type alginate which was sprayed for 15 seconds and waited for 10 minutes

using Mauli banana extract (*Musa acuminata*) concentration of 25%, sodium hypochlorite 1%, and aquades that grouped into 3 treatment groups.

Alginate Sample Making

The alginate powder and water measurements were carried out according to the manufacturer's instructions using a measuring spoon and cup. Alginate powder and water were poured into a rubber bowl, then stirred using a mixer until evenly distributed. Each group was given the same treatment time, which was 10 seconds. Subsequently, the alginate with Master Die ISO No. 19 was made as many as 15 samples for 3 treatment groups in accordance with predetermined research sample. After the impression material set, the Master Die ISO No. 19 were removed from the impression and then cleaned under running water.

Mauli Banana Stem Extract Concentration of 25%

Mauli banana stems were made by taking 10 cm from a 1-year-old root hump that has been fruiting. Mauli banana stems were obtained from the school garden at SMK PP Banjarbaru, South Kalimantan. Mauli banana stems were then cleaned and weighed, then cut into small pieces and dried using an oven at 40 - 50°C for 5 x 24 hours. Mauli banana stems that have been dried and then mashed using a blender to form a simplicia powder and obtained weighing of 600 g. Mauli banana stem simplicial powder was soaked with 70% ethanol in a closed container for 3 x 24 hours with occasional stirring. The filtering process was carried out using filter paper and stored in glass bottles and left for 4 x 24 hours to precipitate it. The extract was evaporated using a rotary evaporator at 40°C. The extract was evaporated again in water using waterbath until it became a thick and blackish brown mauli banana stem extract of 48.54 g. Mauli banana extract with 25% concentration was made by mixing 25 g of mauli banana stem extract with 100 ml of distilled water.

Disinfection Technique Procedure

The disinfection technique used in this research was spraying technique using sodium hypochlorite 1% disinfecting solution and 25% Mauli banana extract. This technique was done by spraying using a disinfectant solution to hit all parts of the alginate surface. The distance between the spray tool and alginate material was ± 5 cm and the disinfectant solution used was ± 3 ml. Each treatment technique was sprayed for 15 seconds and waited for 10 minutes.^{2,10,18}

The impression was filled using gypsum type 3 with the HINRIZIT B BLUE brand with powder and water ratio of 2: 1 equivalent to 100 grams of powder: 50 ml of water. To make the material filling, powder and water were placed into the mixer for 60 seconds with a pressure of 1 bar, then it was filled into the alginate then placed on the vibrator so that all parts of the alginate were filled

with gypsum. The impression then was left for 10 minutes until the gypsum set.^{2,3,7,18}

RESULTS

The measurement results of alginate diameter before and after spraying in the aquades group, sodium hypochlorite 1%, 25% Maui Banana stem extract can be seen in Table 1.

Table 1. The Calculation Results of Alginate Diameter Before and After Spraying in All Treatment Groups

	Treatment	Alginate Diameter		Average	Standard Deviation
		Highest	Lowest		
Aquades (mm)	Pre test	38.74	38.10	38.30	0.256164
	Post test	37.94	37.71	37.80	0.32145
SH 1% (mm)	Pre test	38.40	38.05	38.16	0.149432
	Post test	37.80	37.38	37.65	0.14096
EBPM 25% (mm)	Pre test	38.10	37.89	38.00	0.084439
	Post test	37.78	37.50	37.68	0.17936

In the table above, it can be seen that the results of alginate diameter calculation in the Aquades group before sprayed, it had an average diameter of 38.30 mm, while after sprayed, the average diameter was 37.80 mm. The next group was alginate that has not been sprayed with sodium hypochlorite has an average diameter of 38.16 mm

and after spraying has an average diameter of 37.65 mm. The last group was alginate that has not been sprayed with 25% Maui banana stem extract. It was the last group with an average diameter of 38.00 mm and after being sprayed with the extract, it turns to 37.68 mm.

Table 2. The Calculation Results of Difference in Alginate Diameter in All Treatment Groups

Treatment	Average (mm) ± Standard Deviation
Aquades	0.5040 ± 0.32145
Sodium Hypochlorite 1%	0.5020 ± 0.14096
25% Maui Banana Stem Extract	0.3280 ± 0.17936

In the table, it can be seen the difference in the mean of diameter of each group before and after spraying. Aquades group has an average (mm) ± standard deviation of 0.5040 ± 0.32145. The next group is 1% sodium hypochlorite that had an average difference (mm) ± standard deviation of 0.5020 ± 0.14096. The last group is 25% Maui banana stem extracts which had an average difference (mm) ± standard deviation of 0.3280 ± 0.17936.

Shapiro-Wilk normality test results showed a significance value of aquades was 0.249, sodium hypochlorite 1% was 0.711, and 25% Maui banana stem extract was 0.836. All significance values were $p > 0.05$ which means that all data were normally distributed. Homogeneity analysis test

results revealed the significance value of Levene's Test was 0.541.

It can be concluded that the data has the same or homogeneous variance which then proceed to the One Way Anova Parametric Test. One Way Anova test results can be seen in table 3.

Table 3. One Way Anova Parametric Test Results

Treatments	Significance value
Aquades	
Sodium Hypochlorite 1%	0,401
25% Maui Banana Stem Extract	

Based on the One Way Anova test results, the significance value of the test results is equal to

0.401 ($p > 0.05$) which means there is no significant difference between all treatment groups on the stability of the alginate dimensions or there is no effect on spraying the 25% Mauli Banana Stem extract against changes in the dimensional stability of the alginate impression.

DISCUSSION

Aquadest

Alginate has another characteristic, namely imbibition properties, which are the nature of alginate which absorbs water. When it comes into contact with water so that the shape is easier to expand and changes in shape or expansion. The properties cause the alginate to have dimensional stability that is sensitive to several things such as the treatment. When alginate impressions removed from the mouth, it causing syneresis because water is forced out and gel molecules are pulled close together. Evaporated water can also affect the stability of the alginate dimensions because the impression can shrink and evaporation can occur, this is referred as imbibition. In addition, room temperature also affects the alginate because it can cause any expansion and distortion.^{19,20} In this study, there was a change in the dimension of the alginate impression. The difference in the average diameter before and after spraying aquades was 0.5040 ± 0.32145 .

Zeni et al (2015) also stated that there was a change in the dimensions of alginate after spraying using water (Aquadest). The difference in alginate dimensions caused by spraying with distilled water is due to various factors including the addition of water ratio (the ratio of alginate powder to water and the ratio of gypsum to water), time, room temperature, alginate stirring, the presence of compressed stress which is not balanced by the strain when removing the impression tray. The stress received will be greater than the strain, this will result in permanent deformation.^{5,9,21}

Sodium Hypochlorite 1%

Sodium hypochlorite is a disinfectant which classified as cheap, safe, easy to obtain and this disinfectant material contains free aldehydes, potassium peroxomonosulfate, sodium benzoate, and tartaric acid.²⁷ The antibacterial properties of sodium hypochlorite come from free chlorine ions which function to damage the bacterial component.²⁸ Sodium hypochlorite is reacted with water to form hypochlorous acid (HOCL) and hypochlorite ions.⁵ Hypochloric acid will be degraded and then form hydrochloric acid and

oxygen. Oxygen is a very strong oxidizer so that oxidation occurs which causes an increasing pressure on the solution. Sodium hypochlorite, in contact with alginate during disinfection, there will be stress on the alginate impression.

Alginate has water-absorbing properties. While the absorbed solution has pressure properties, the results of the alginate impression will experience imbibition.⁶ In this study, there are changes in the dimensions of the alginate impression which the difference in the average diameter before and after spraying 1% sodium hypochlorite was 0.5020 ± 0.14096 . Previous research also stated that alginate impressions that are in contact with disinfectant solutions can cause dimensional changes due to absorption of disinfectant solutions by alginates. It is causing expansion of the impression material, where alginate contain ions such as Na, SO₄²⁻, and PO₄³⁻ as osmotic potential.²²

25% Mauli Banana Stem Extract

Mauli banana extract contains several phenolic compounds which work together to produce an antibacterial effect, including flavonoids, saponins, and tannins. Tannins and alginates have the same OH ions. Therefore, if tannins OH ions bind to alginate OH ions, an esterification reaction will occur because the tannin content belongs to the polyphenol group. The diameter before and after the Mauli banana extract concentration of 25% spraying had an average (mm) \pm standard deviation of 0.3280 ± 0.17936 .

The results of previous studies showed that extracts of Mauli banana stems with concentrations of 6.25%, 12.5%, and 25% can inhibit the growth of *Streptococcus mutans*. The concentration of 25% has a better antibacterial activity when compared with concentrations of 6.25% and 12.5%.¹⁷ The phenol derivative compounds will bind to the polymer chains in the form of carboxylic acids in alginates to produce esters and H₂O through the esterification process. The H₂O content causes the alginate to become easily absorbed and has an impact on the dimensional changes in the alginate, but the disinfection technique used is a spray technique so that the impact of imbibition due to the phenol derivative content becomes more minimal.⁵

Effect of Aquades, 1% Sodium Hyperchlorite, Mauli Banana Stem Extract (*Musa acuminata*) 25% Concentration Spraying on Alginate Impression Dimensional Change.

In the spraying technique, the liquid is less absorbed then the imbibition that occurs is also less

so that changes in the dimensions of alginate impressions are smaller. Research on spraying techniques with disinfectants showed the same antimicrobial activity with the immersion technique, which has less exposure than this spraying technique, so that the alginate did not undergo dimensional changes. Based on the One Way Anova test results, it is known that the significance value is 0.401 ($p > 0.05$) which means that there is no significant difference between all treatment groups on the stability of the dimensions of the alginate impression^{10,18,22,25}

The balance process occurs after spraying alginate and the process of imbibition or water absorption in the alginate impression results. Then the process of syneresis will occur when the impression is left for 5 or 10 minutes at room temperature. The syneresis process is the evaporation of water in alginates, the process produces an impact in the form of no changes in the dimensions of the alginate impressions, because there is a balance between the imbibition and syneresis process that causes no change in dimensions.^{9,25,26}

The spraying process was carried out for 10 minutes because the effectiveness of disinfectants only occurred during 10-15 minutes of spraying time and the method of spraying with 1% sodium hypochlorite during the above time did not cause significant dimensional changes in the model.^{7,9} The results of this study note that Mauli banana stem extracts as an anti-bacterial has the smallest impact on the value of alginate dimension changes. The results of this study also prove that Mauli banana stem extract has a smaller effect in causing dimensional changes compared to aquades and 1% sodium hypochlorite in alginate impressions. This is supported by previous research which stated that the content of tannins, alkaloids, flavonoids, sterols, and tripen (disinfectants) does not affect the dimensional changes in alginate because there is a balance of imbibition and syneresis processes.²⁵ significant effect on spraying mauli banana (*Musa acuminata*) stem extract 25% on the dimensional stability of the alginate impression.

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