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THE EFFECT OF MAULI BANANA STEM (*Musa acuminata*) AND BASIL LEAF (*Ocimum basilicum* L.) EXTRACT ON THE VALUE OF DIAMETRAL TENSILE STRENGTH OF BIOACTIVE COMPOSITE RESIN

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ABSTRACT

Background: Chemical contents in mouthwash could cause several side effects in the oral cavity, hence natural ingredients were used such as Mauli banana stem and basil leaf extract. Mouthwash exposure in the oral cavity affects composite resin, one of it is a bioactive composite resin which has advantages over conventional ones. The contact of mouthwash with bioactive composite resin affects strength properties.

Purpose: To analyse the effect of Mauli banana stem and basil extract on the diametral tensile strength value of the bioactive composite resin. **Method:** Thirty specimens (diameter 6mm x thickness 3mm; n=5/ group) were made using Activa™ Bioactive Restorative (Pulpdent) and immersed in the following group of 25%, 50%, 75% and 100% Mauli banana stem and basil leaf extract as a treatment groups, chlorhexidine gluconate 0,2 % (CHX) and aquadest as a control groups for 24 hours in the incubator at 37°C. Diametral tensile strength value was measured by Universal Testing Machine (Tokyo Testing Machine MFG CO.LTD) with 0,5 mm/minute crosshead speed and 250 kgF load cell. **Result:** One Way Anova and Post Hoc Bonferroni show there is a significant difference between treatment groups of 25% extract (41,33±6,20 MPa) and treatment groups of 100 % extract (55,06±6,42 MPa). Meanwhile, there is no significant difference for other groups.

Conclusion: There is a significant effect of Mauli banana stem and basil leaf extract on the diametral tensile strength value of bioactive composite resin.

Keywords: Basil leaf extract, bioactive composite resin, diametral tensile strength value, mauli banana stem extract.

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INTRODUCTION

Mouthwash is a solution or liquid containing active ingredients that can be used as intended to maintain oral hygiene, reducing or eliminating plaque accumulation besides of brushing teeth. An ideal mouthwash should have the ability to eliminate bacteria that cause dental and oral health problems, does not irritate, does not interfere the balance of oral flora, does not cause microbial resistance and does not cause stains on teeth. One of the recommended ingredients for mouthwash is chlorhexidine gluconate 0.2% (CHX) which is effective as a plaque control agent used by dental practitioners and the public.^{1,2,3}

Mouthwash that available in the market in the long term use may cause side effects such as taste disturbance, tooth discoloration and allergic contact stomatitis, due to it's chemical content. A few examples of these chemical constituents are chlorhexidine gluconate, alcohol and etc. Considering the side effects, herbal mouthwash is produced with minimal side effects.⁴ One of the potential material to be used as a mouthwash are Mauli banana stems. Mauli banana (*Musa acuminata*) is a banana plant that grows a lot in Banjarmasin, South Borneo, Indonesia. Mauli banana stem extract contains compounds that have antioxidant, antibacterial and anti-fungal effects.^{5,6}

Another natural ingredient used as an alternative to herbal mouthwash is basil leaf, which is believed to help maintain healthy oral and teeth.⁴ Basil leaf (*Ocimum basilicum* L.) contain essential oils with the most component of *linalool* which is a terpenoid alcohol compound.^{7,8}

The prolonged use of mouthwash may have adverse effects due to it's chemical component interaction in the mouthwash, not only to the oral cavity but also to the restorations in the oral cavity. The use of mouthwash triggered changes on the structure of restorative materials: composite resin.⁹ Along with its development, composite resin continues developing to improve their shortcomings, as now a bioactive composite resin product developed with the bioactive resin matrix is produced. Bioactive composite resin have the ability to assist the tooth remineralization process and have superior physical, biological and mechanical properties compared to conventional composite resins.¹⁰

The mechanical properties of bioactive composite resin may change as its contact with mouthwash, this cause the bioactive composite resin to degrade and increase the wear of bioactive composite resin and lead to the material's fail. One of the mechanical properties that change is the value of diametrical tensile strength, which is an important indicator of a material to measure the strength of the material against masticatory loads.^{9,11} Material such as resin restoration are clinically exposed to compression forces and brittle behaviour. The restoration subjected to force may lead to fracture under tensile stress during mastication. Hence, these properties can be measured by the diametral tensile strength. Various studies about mouthwash toward resin restoration properties have been conducted, but the information about the effect of herbal mouthwash toward the diametral tensile strength of bioactive composite resin is still limited in any literature. This study aims to analyse the effect of the mixed solution of Mauli banana stem (*Musa acuminata*) and basil leaf (*Ocimum basilicum* L.) extract on the diametral tensile strength of bioactive composite resin.

MATERIALS AND METHODS

The study has passed the ethical clearance test published by the Faculty of Dentistry, Lambung Mangkurat University No.145/KEPKG-FKGULM/EC/I/2019. This study is a true experimental research and a post-test only with control group design. The extract was prepared using the maceration method. The 100% concentration of Mauli banana stem and basil leaf extract was made by cleaning, drying and grinding the Mauli banana stem and basil leaf to make simplicia powder. The simplicia of Mauli banana stem were immersed for 5x24 hours and basil leaf for 3x24 hours with 70% ethanol solvent. The simplicia that had been dissolved in 70% ethanol was filtered and evaporated with a rotary evaporator at 40°C and then evaporated again with a water bath until a pure extract was obtained.

The main solution of the mixed solution of Mauli banana stem extract and basil leaf extract with a concentration of 100% is a mixture of 25% Mauli banana stem extract and 10% basil leaf extract with a volume ratio of 1:1.¹² The main solution extract of Mauli banana stem and basil leaf with a concentration of 100% was then diluted with distilled water to obtain extracts with concentrations of 25%, 50% and 75%.

The specimens are made using bioactive composite resin (Activa™ Bioactive Restorative (Pulpdent)) for 30 specimens with sizes based on ADA Specification no. 27 (6mm diameter x 3mm thickness). The surface of the mold is coated with celluloid strips which is then placed on a glass plate, therefore the surface of the bioactive composite resin will remain flat. The bioactive composite resin was cured for 20 seconds using a light curing unit at a distance of 1 mm from the sample surface. Celluloid strips was removed after the bioactive composite resin setting. Samples were stored in saline solution and placed in an incubator at 37°C for 24 hours. The samples were subsequently immersed for 24 hours at 37°C in the mixed solution of Mauli banana stem and basil leaf extract at concentrations of 25%, 50%, 75%, 100%, CHX and distilled water. CHX and distilled water were used as control groups. Prior to

immersion, the pH of each medium was measured and recorded.

The measurement of the diametrical tensile strength value was carried out using the Universal Testing Machine after the samples were immersed in the mixed solution of Maui banana stem and basil leaf extract at concentrations of 25%, 50%, 75% and 100%. Samples were measured with a crosshead speed of 0.5 mm/min and a load cell of 250 kgF until the specimen cracked or fractured. The data obtained from this study are quantitative data on the value of the load/force (F). The load will be converted into the diametral tensile strength formula.

$$S = \frac{2F}{\pi DT}$$

S = diametral tensile strength value (MPa)
 F = load/force(F)
 D = specimen diameter
 T = specimen thickness

Data analysis were carried out with One-way ANOVA test with a 95% confidence level ($\alpha=0.05$) and followed by Post Hoc Bonferroni analysis to determine the significance value.

RESULT

The mean of the diametral tensile strength value of bioactive composite resins are presented in Table 1.

Table 1. The Mean Diametral Tensile Strength Value of Bioactive Composite Resin

Groups	Mean \pm SD (MPa)	Degree of Acidity of Solution (pH)
25% extract	41,33 \pm 6,20	5,73
50% extract	44,13 \pm 4,80	5,21
75% extract	44,23 \pm 7,63	5,05
100% extract	55,06 \pm 6,42	4,95
CHX	49,07 \pm 4,72	7
Distilled water	49,85 \pm 1,31	7

Based on Table 1, the group of bioactive composite resin in 100% concentration of the mixed solution of Maui banana stem and basil leaf extract had the highest diametral tensile strength mean value (55.06 \pm 6.42 MPa) with a pH of 4.95, while the group of bioactive composite resin in the mixed solution Maui banana stem and basil leaf extract with a concentration of 25% had the lowest diametral tensile strength mean value (41.33 \pm 6.20 MPa)

with a solution pH of 5.73. Among of all treatment groups, the value of diametrical tensile strength increased with increasing concentration of the extract solution.

The results of the significance value of bioactive composite resin are presented in Table 2.

Table 2. Significance Value of Diametral Tensile Strength Value of Bioactive Composite Resin

Groups	p value					
	25%	50%	75%	100%	CHX	Distilled water
25%	—	1,00	1,00	1,01*	0,56	0,34
50%	—	—	1,00	0,07	1,00	1,00
75%	—	—	—	0,07	1,00	1,00
100%	—	—	—	—	1,00	1,00
CHX	—	—	—	—	—	1,00
Distilled water	—	—	—	—	—	—

*post hoc Bonferroni

Table 2 shows that there is a significant difference between the group of bioactive composite resin immersed in an extract solution with a concentration of 25% and the group of bioactive composite resin immersed in an extract solution with a concentration of 100%, while the other groups had no significant difference.

DISCUSSION

The mechanical properties of bioactive composite resin may be altered by the oral environment characteristic, it can be indicated by the presence of material degradation, especially chemical degradation. In the present study, we are interested to find out the effect of mouthwash on the diametral tensile strength. The results of the study showed the value of diametrical tensile strength increased along with the increase in extract concentration. Factors that affect the value is the amount of active material concentration in extract solution which affects the degree of acidity (pH) and the viscosity of the solution. The components in the bioactive composite resin containing bioactive glass (BG) also play a role in increasing the diametral tensile strength value of the bioactive composite resin.

Maui banana stem contain dominant compound, namely tannin and basil containing essential oils with the dominant component of linalool.^{7,13} Tannin and linalool are compounds

that have -OH groups.^{8,14} -OH groups dissolved in the water cause the solution to be more acidic due to dissolution of H⁺ ions.¹⁵

The results showed that the bioactive composite resin immersed in distilled water and CHX had a higher diametral tensile strength value than the bioactive composite resin immersed in the mixed solution of Mauli banana stem and basil leaf extract with concentrations of 25%, 50% and 75%. Mauli banana stem and basil leaf extract with low pH showed high H⁺ concentration, hence while it exposed with bioactive composite resin, the Si-O-Si bonds in the bioactive composite resin reacted to form silicic acid (Si(OH)₄). While Si(OH)₄ is formed, other BG components simultaneously release Calcium and Phosphorus to form an amorphous calcium phosphate (ACP) phase which will then crystallize into hydroxyapatite (HA). The more acidic a solution is exposed to the bioactive composite resin, the more HA may formed. The amount of HA formed causes the strength of the material to increase.^{16,17} The number of HA formed makes hydrolytic degradation minimal because HA is an inorganic compound that is less susceptible to hydrolytic degradation than the polymer matrix as in other conventional composite resins, therefore the bioactive composite resin is mechanically resistant.¹⁸

The increasing concentration of Mauli banana stem and basil leaf extract showed an increase in the viscosity of the solution. This is due to the amount of water diluted were decreased as the concentration increased, hence the viscosity of the solution is higher. A solution with high viscosity is difficult to penetrate into the Bioactive Glass (BG) particles in the bioactive composite resin.^{9,19}

In the group of 25% Mauli banana stem and basil leaf extract showed the lowest diametral tensile strength value. This is due to the higher pH of the solution and lower viscosity compared to other concentrations of Mauli banana stem and basil leaf extract. The high degree of acidity causes less HA to form than bioactive composite resin at other concentrations and low viscosity indicates a small amount of active material and a large amount of water diluted in the solution result in

a hydrolytic degradation process of bioactive composite resin in the 25% Mauli banana stem and basil leaf extract compared to other concentrations.^{9,16,19}

The occurrence of hydrolytic degradation begins with the absorption of water into bioactive composite resin. Water absorption in bioactive composite resin occurs due to methacrylate diurethane component which has an urethane group. An urethane group in methacrylate diurethane is hydrophilic, which can attract electrons from water, that is OH- molecules. Withdrawal of OH- molecules from water causes the Si-O-Si (siloxane) chain to break, therefore silanol (Si-OH) and Si-O bonds are formed. The siloxane chain termination continuously occurs, hence it can degrade the bioactive composite resin.²⁰

The limitations of this in vitro test are related to the fact that the condition at the time of the study were not completely in accordance with the actual state of the oral cavity due to experiment laboratory study. However, this study was managed to approach the actual state of immersion in saline solution and stored in an incubator at 37°C which is the normal temperature of the oral cavity. In addition, this study did not test the pH stability of the mixed solution of Mauli banana stem and basil leaf extract, so the time interval for the stable pH of the Mauli banana stem and basil leaf extract is still unknown.

It can be concluded there is an effect of the mixed solution of mauli banana stem (*Musa acuminata*) and basil leaf (*Ocimum basilicum* L.) extract on the value of diametral tensile strength of bioactive composite resins, which is 100% of the mixed solution higher than CHX and water.

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