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THE EFFECTS OF SOAKING EXTRACTS OF STEMS *Musa Acuminate* AND LEAVES *Ocimum Basilicum L.* ON FLUORIDE RELEASE OF WATER SETTABLE GIC

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ABSTRACT
Background: *Mouthwash is a dental and oral health product that is easy to obtain and practical to use. Mouthwash is able to kill bacteria causing dental and oral health problems. Mauli banana stems and Basil leaves can be used as an alternative to natural mouthwash because they contain bioactive compounds such as saponins, alkaloids, lycopene, ascorbic acid, flavonoids, and tannins.* ***Objective:*** *To analyze the effect of a mixture of extracts of Mauli banana (Musa acuminate var. sapientum) stems and Basil leaves (Ocimum basilicum L.) at concentrations of 75% and 100% on fluoride ion release in the Water Settable GIC.* ***Methods:*** *Pure experimental design with post-test only with control group design. The number of samples consisted of 21 samples, which were divided into 3 treatment groups, and then the value of fluoride ion release was measured after 22 hours.* ***Results:*** *One Way Anova test showed a significant difference with p <0.05 among the treatment groups. The results of the Post Hoc Bonferroni test obtained a p-value of <0.05, which means that there was a significant difference between the control group compared to the extracts of Mauli banana stems and Basil leaves at concentrations of 75% and 100%.* ***Conclusion:*** *There was an effect of the mixture of the extracts of Mauli banana (Musa acuminate var. sapientum) stems and Basil leaves (Ocimum basilicum L.) at concentrations of 75%, 100%, and artificial saliva on fluoride ion release in the Water Settable GIC.*

Keywords*: Basil Leaves, Fluoride Ion, Mauli Banana Stems, Water Settable.*
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INTRODUCTION

One of the dental and oral care products that are easy to obtain and practical to use by people is mouthwash.[1] Ideally, mouthwash is able to kill germs causing dental and oral problems, does not irritate the oral mucosa, maintains normal flora balance, does not change the perception of taste on the tongue, and does not leave stains and unwanted bad breath.[2] Chemicals contained in the mouthwash marketed in the society have antiseptic or antibacterial properties to inhibit the formation of plaque .[3] Mouthwash with chemical contents has side effects, which are burning sensation, irritating, causing a dry effect on the oral cavity, and has ideal characteristics, such as taste, color, and aroma/scent. This becomes the reason for herbal plants to be used as an alternative to mouthwash. One of the plants commonly found in South Kalimantan is the Mauli banana and Basil leaves.[4]

Mauli banana and Basil leaves are plants that commonly grow in Banjarmasin. The extract of Mauli banana (*Musa acuminata*) sem contains saponins, tannins, and flavonoids with the highest content of tannins, which has effects as antioxidant, antibacterial, and antifungal.[4] Basil *(Ocimum basilicum L.).* has good antibacterial potential. Basil has bioactive compounds that act as antioxidant, antimicrobial, antiviral, antihypertensive, and antiinflammation.[5] The contents in the Basil leaves are essential oils, alkaloids, glycosides, saponins, flavonoids, terpenoids, steroids, and tannins. One of the active ingredients in the Basil leaves that act as antibacterial and antifungal is the content of essential oil.[6]

The use of mouthwash as an antiseptic for the oral cavity will cause exposure of all parts of the oral cavity to mouthwash liquid, including filling material. One of the newest Glass Ionomer Cement (GIC) is water-settable GIC. 7 Water-settable GIC

can be directly mixed with sterile water, so it makes dentistry easier because its application is easy.[7] The acid solution in the liquid is freeze-dried and then directly combined into the powder so that it can be mixed with sterile water or distilled water. Several advantages of this ingredient are that it binds very well to enamel and dentin, is durable, and releases high fluoride.[8] Flouride ions in the oral cavity can be released efficiently through the ion exchange or hydrolysis process when the pH value of the oral cavity drops below the critical pH (4.5-5..5).[9] This critical pH condition occurs when the flow rate and acidity in saliva change. Several factors causing the decrease of pH in the oral cavity are oral microorganisms, drugs consumption, food and beverages consumption, and salivary buffer capacity.[10]

Fluoride ion release is initiated by the influence of pH change and the oral cavity.[9] Mouthwash is one of the causes of pH change in the oral cavity. The general properties of Mauli banana (*Musa acuminata*) are tannins. Tannins have a phenol group and are colloid, which is a solution whose content is not completely dispersed so that when dissolved in the water, tannins become weak acids.[11] The content of terpenoids in Basil leaves (*Ocimum basilicum L.*) is an alcohol-derived compound that can easily degrade the bond matrix of the filling material.[12,13,9] This stated that the lower the pH of the oral cavity, the fluoride ion release will occur and the demineralization process will occur accompanied by the remineralization process. Remineralization can occur with the help of fluoride ions. Fluoride ion is stated effective to maintain the enamel layer through the remineralization process.[14,15,16,17]

RESEARCH METHOD

The study was conducted after obtaining a research permit and ethical approval No. 070/KEPKG-FKULM/EC/V/2021 from the Ethics Committee Faculty of Dentistry Universitas Lambung Mangkurat.

This study was conducted in Biochemistry Laboratory Faculty of Medicine Universitas Lambung Mangkurat with a pure experimental method with post-test only with control group design, where a study to find out the effect of the fluoride ion release in Water Settable GIC after soaked in the mixed solution of the extracts of Mauli banana stems and Basil leaves. The number of samples was 21 samples. Samples were then divided into 3 treatment groups, soaking at concentrations of 75%, 100%, and artificial saliva.

Tools and Materials

Tools used were mold with a diameter of 5 mm and a thickness of 2 mm, sliding caliper, paper pad, celluloid strip, spatula agete, Erlenmeyer, beaker glass, measuring cup, incubator, waterbath, pH meter (*Lutron pH-208*), mortar, masks, and rubber gloves.

Research materials used were Water Settable GIC type II Restirativematerial chromoglass from Loscod, Italy BioActive Restorative, distilled water, and artificial saliva.

Samples Making

Samples were made by putting water-settable GIV into the mold. Mould was padded with a Celluloid strip, which was placed on a Glass lab smeared with vaseline. The celluloid strip was removed after the GIC setting. Samples were removed from the mold and the excess of GIC can be reduced using a scalpel. Samples that have been removed from the mold were first soaked in the saline solution for 24 hours and incubated at 37˚C to make the condition as in the oral cavity. After that, samples were soaked again into 3 treatments for 22 hours at 37˚C.

Making of Artificial Saliva

Artificial saliva was made by mixing all ingredients, 0.47 grams of NaCl, 9.8 grams of $NaHCO_3$, 0.57 grams of KCl, 10 grams of Na2HPO4 $12H_2O$, 0.12 grams of $MgSO_4$ 7 H_2O, then added with 500 ml of sterile distilled water into the beaker glass, and then stirred until homogeneous.

Soaking and Measuring the Flouride Ion Release

Samples were soaked in the beaker glass containing saline solution for 24 hours and incubated at 37˚C. After that, samples were divided into 3 groups and soaked into the extracts of Mauli banana stems and Basil leaves at concentrations of 75%, 100%, and artificial saliva for 22 hours and incubated at 37˚C. Then, preparation/pounding of Water Settable GIC was carried out before measuring the amount of fluoride ion release was carried out. Pounded Water Settable GIC was diluted with 10 ml of distilled water and 10 ml of sodium fluorine buffer. Then it was continued by soaking the electrode in samples' solution for 3 minutes using a pH meter (*Lutron pH-208*)

RESULTS

The results of the study related to the effects of the mixed extracts of Mauli banana *(Musa Acuminata var. Sapientum)* stems and Basil leaves *(Ocimum basilicum)* on fluoride ion release in the Water Settable GIC were obtained mean value and standard deviation presented in Tabel 1.

Table 1. Table of the Mean and Standard Deviation of Flouride Ion Release in Water Settable GIC

Groups	Mean of the Number of Flouride Ion Release (ppm) Mean ± Standard Deviation
Group 1	394.5 ± 4.48
Group 2	284.0 ± 4.98
Group 3	48.8 ± 4.48

According to Table 1, it can be analyzed that the highest mean and standard deviation of fluoride ion release in Water Settable GIC was in the group soaked in the extract solution of a mixture of Mauli banana stems and Basil leaves at a concentration of 100% with a value of 394.5 ± 4.48. Meanwhile, the lowest mean and standard deviation of fluoride ion release in Water Settable was in the group soaked in artificial saliva as control with a value of 48.8 ± 4.48 If the three groups were compared, the mean and standard deviation of fluoride ion release of the samples in Water Settable GIC soaked in the extracts of Mauli banana stems and Basil leaves at a concentration of 100% was higher than group soaked at a concentration of 75%. Moreover, the group soaked with artificial saliva had a lower mean of fluoride ion release.

The results of the measurement of fluoride ion release in Water Settable GIC were conducted by statistical analysis using SPSS 24.0. The normality test of the data was conducted using Shapiro-Wilk Test. The results of the test showed that all Sig value of each group was p>0.05 so it can be concluded that the data were normally distributed. A homogeneity test was conducted using Levene's Test and obtained Sig. value of 0.902 so that p>0.05 and can be concluded that the data variances were the same. Analysis was continued with the One Way Anova test and obtained p<0.05, showing H0 was rejected so that it can be concluded that there was a significant difference among treatment groups. After the One Way Anova test, it was continued with the Post Hoc Bonferroni test and obtained a p-value of <0.05, which means that there was a significant difference between artificial saliva treatment compared with extracts of Mauli banana stems and Basil leaves at concentrations of 75% and 100%. Furthermore, there was a significant difference between extracts of Mauli banana stems and Basil leaves at a concentration of 75% compared with extracts of Mauli banana stems and Basil leaves at a concentration of 100%.

The significance value of the fluoride ion release test in Water Settable GIC can be seen in Table 2.

Table 2 Table of Significance Value of Flouride Ion Release in Water Settable GIC

Groups	P-Value		
	I	II	III
I	-	0.000	0.000
II	-	-	0.000
III	-	-	-

DISCUSSION

The results of the study from all Water Settable GIC soaked groups experiencing fluoride ion release showed that the Water Settable GIC group soaked in a mixed solution of Mauli banana stem extracts and Basil leaf extracts at concentrations of 75% and 100% had a higher fluoride ion release than the control group, artificial saliva. Many factors can affect fluoride ion release in the extracts of Mauli stems and Basil leaves, one of which is the difference in pH. According to the study conducted, a mixed solution of Mauli banana stem extracts and Basil leaf extracts at concentrations of 75% and 100% had more acidic pH than the control group, artificial saliva.

The process of fluoride ion release is in accordance with a study by Tiwari et al. (2015), which was initiated by the effect of pH change in the oral cavity. This is because, at the beginning of the setting time, GIC materials had a high level of fluid contamination and susceptibility due to the stirring of GIC during the manipulation process of silica hydrogel formation. Silica hydrogel is one of the molecules that is soluble if it is in contact with liquid. GIC restoration materials absorb water involving the penetration of liquid molecules into the structure from restorative materials by diffusion. The volume of restoration materials can increase due to water absorption causing damage to the matrix structure and component solubility of restoration materials.

The reaction of fluoride release occurred in two stages, short-term release and long-term release. The short-term reaction is related to the initial reaction due to the maturation process after setting.[16] The highest fluoride release occurred in the initial of materials in contact with saliva. During the setting reaction, some of the inorganic ions from the glass particle were released after being in contact with saliva. Inorganic ions consisted of electropositive ions, which are strontium, calcium, sodium, and aluminum, and electronegative ions, fluoride and phosphate. A short-term reaction is also known as a fluoride burst.[18] Flouride burst is correlated with reactions between the glass particle and polyalkenoate acid during the setting reaction. This makes fluoride ion release of glass ionomer fissure sealant in initial soaking had the highest

value than next soaking time. In the long-term reaction, fluoride ion release in glass ionomer materials began to decrease and was relatively stable according to the balance of the long-term diffusion process. Fluoride ion release in glass ionomer materials was relatively stable and in accordance with the balance of the diffusion process.[19]

At a concentration of 100%, the pH in the extract solution of Mauli banana stems and Basil leaves was 5.6 and a concentration of 75% was 6.8. This was caused by active compounds of the extracts of Mauli banana stems and Basil leaves, which were in the form of flavonoids, saponins, and terpenoids, where when dissolved in the water, they were acidic. Most of the content was tannins, which were compounds of phenol groups and colloidal when dissolved in weakly acidic water.[11] Basil leaves (*Ocimum basilicum L.*) had essential oil contents, which were phenol compounds and able to release weak acid (H^+).[5,2] This is in accordance with the study by Septishelya (2016), which stated that when acid content in the extracts of Mauli banana stems and Basil leaves meets water, hydrogen ions will be ionized so that many hydrogen ions are released. Released hydrogen ions will break ionic bonds causing solubility in the restoration materials. The diffusion of water and hydrogen ions into the GIC restoration materials caused the fluoride ion release by matrix, then fluoride ions diffused out of the GIC restoration materials and dissolved with saliva.

According to the study by Fitriyana (2014), it was found that GIC experienced more morphological damage when under acidic conditions compared to saliva soaking with a pH of 7. This is probably caused by a high concentration of H^+ ions in the acidic solution, which can break the ionic bond between Ca^+ ions and the carboxyl chain in GIC type II, while artificial saliva with a pH of 7 was more neutral. Saliva has a role when the interaction between GIC and acidic solution in the oral cavity. The acidic pH of the acidic solution caused H^+ ions from the acidic solution to react with polycarboxylate groups at the end of the GIC matrix. The polycarboxylate salt group that bonds with H^+ ions will be disconnected from the polymer so that a residual monomer was formed. This process is called the degradation of the GIC matrix. [20]

Soaking in the acidic solution containing a higher concentration of H^+ ions can cause a higher potential to bind with the carboxyl group, which was caused by nucleophilic properties (ability to catch H^+ ions) of the carboxyl group. Saliva with neutral pH did not experience complete ionization to produce H^+ and OH- ions so it did not have the potential to bind with the carboxyl group. Saliva has several functions, including lubricating tissue in the oral cavity so that abrasion does not occur during mastication, helping carbohydrate metabolism, activity antibacterial against pathogenic bacteria of the oral cavity, help to maintain the stability of the buffer system in the oral cavity.[21]

When the pH of the oral is acidic, the bicarbonate anhydrase enzyme in the saliva will catalyze the reaction between free H^+ ions and bicarbonate ions. This reaction results in water and carbon dioxide that will be released into the oral cavity so that the pH of saliva will gradually return to normal pH in approximately 30-60 minutes.[21] Individuals with a low salivary flow, the capacity of the buffer will decrease and be susceptible to acid. This causes the pH of saliva to take more than 4 hours to slowly return to normal pH.[22] According to the explanation above, it can be concluded that there was an effect of the mixture of Mauli banana (*Musa acuminate var. sapientum*) stem extracts and Basil leaf (*Ocimum basilicum L.*) extracts at concentrations of 75% and 100% on the fluoride ion release in Water Settable GIC.

REFERENCES

1. Rawung F, Wuisan J, Leman MA. Pengaruh obat kumur beralkohol terhadap laju aliran saliva dan pH saliva. Jurnal e-GiGi. 2017; 5(2): 125-9.
2. Justicia AK, Ferdinan A, Maya M. Formulasi Mouthwash Minyak Atsiri Daun Kemangi (Ocimum sanctum L.) dan Kayu Manis (Cinnamomum zeylanicum) Dengan Menggunakan Tween 80 Sebagai Surfaktan. J Ilmiah Ibnu Sina. 2017; 2(1): 134 – 146.
3. Ladytama SR, Nurhapsari A, Baehaqi M. Efektifitas Larutan Ekstrak Jeruk Nipis (Citrus Aurantifolia) Sebagai Obat Kumur Terhadap Penurunan Indeks Plak pada Remaja Usia 12–15 Tahun-Studi di SMP Nurul Islami, Mijen, Semarang. ODONTO. 2014; 1(1): 39-43.
4. Puspitasari D, Apriasari ML, Rahayu D, Rachmadi P. The Effect Of Musa Acuminata And Ocimum basilicum L. Mixed Extracts To The Surface Hardness Of Bioactive Composite Resin. DENTINO. 2020; 5(2): 172-173.
5. Filip S. Basil (Ocimum basilicum L.) a Source of Valuable Phytonutrients. Int J Clin Nutr Diet. 2017; 3(118): 1-5.
6. Fatwati K, Puspitasari D, Apriasari ML. Effect Of Musa Acuminate And Ocimum basilicum L. Mixed Extracts On Bioactive Resin's Fluoride Release. DENTINO. 2020; 5(1): 94-95.
7. Ladha K, Verma M. Conventional and Contemporary Luting Cements: An Overview. J Indian Prosthodont Soc. 2010; 10(2): 79-88.
8. Keshani F, Khoroushi M. From Conventional Glass-Ionomer to Bioactive Glass Ionomer. Dent Res J (Isfahan). 2013; 10(4): 411-420.
9. Tiwari M, Tyagi S, Nigam M, Rawal M, Meena S, Choudhary A. Dental Smart Materials. Jornal of Orofacial Research. 2016; 5(4): 125-129.

10. Maharani N, Wibowo A, Aripin D, Fadil MR. Perbedaan Nilai Kekerasan Permukaan Glass Ionomer Cement (GIC) dan Resin Modified Glass Ionomer Cement (RMGIC) Akibat Efek Cairan Lambung Buatan Secara In Vitro. Padjadjaran J Dent Res Student. 2017; 1(2): 77-82.
11. Ismarani. Potensi Senyawa Tanin Dalam Menunjang Produksi Rammaah Lingkungan. J Agribisnis dan Pengembangan Wilayah. 2012; 3(49): 46-55.
12. Kanan SM, Mohammed A. The Effect of Mouth Rinses On Surface Micro Hardness of Two Esthetic Restorative Materials. Iraqi National Journal of Nursing Specialties. 2012; 25(1): 101-108.
13. Yadaf N, Yadaf R, Goyal A. Chemistry of Terpenoids. Int. J. Pharm. Sci. 2014; 27(2): 272-278.
14. Haghoo R, Mehran M, Ahmadvand M, Ahmadvand MJ. Remineralization Effect of Eggshell versus Nano-hydroxyapatite on Caries-like Lesions in Permanent Teeth (In Vitro). Journal of International Oral Health. 2016; 8(4):435-439.
15. Wiryani M, Sujatmiko B, Bikarindrasar R. Pengaruh lama aplikasi bahan remineralisasi casein phosphopeptide-amorphous calcium phosphate fluoride (CPP-ACPF) terhadap kekerasan email. Majalah Kedokteran Gigi Indonesia. 2016; 2(3): 141-142.
16. Sianturi E dan Riyanti E. Aplikasi Teknologi Surface Pre-Reacted Pada Restorasi Gigi Anak. Journal of Indonesian Dental Association. 2018; 1(2). 121-127
17. Ghifari Ma, Putri Dkt, Dwinuria Ye. Pengaruh Perendaman Larutan Kitosan Sisik Ikan Haruan (Channa Striata) Terhadap Pelepasan Kalsium Pada Gigi. DENTIN. 2020; 4(3). 111-115
18. Septishelya PF, Nahzi MYI, Dewi N. Kadar Kelarutan Fluor Glass Ionomer Cement Setelah Perendaman Air Sungai dan Akuades. Majalah Kedokteran Gigi Indonesia. 2016; 2(2): 96-98.
19. Fredian AE, Setyorini D, Probosan N. Efek Perendaman Bahan Fissure Sealant Semen Ionomer Kaca Pada Minuman Berkarbonasi Terhadap Pelepasan Fluor. E-Journal Pustaka Kesehatan. 2014; 2(3). 537-540
20. Kafalia RF, Firdausy MD, Nurhapsari A. Pengaruh Jus Jeruk Dan Minuman Berkarbonasi Terhadap Kekerasan Permukaan Resin Komposit. ODONTO. 2017; 4(1): 38-43.
21. Fitriyana Dc, Pangemanan D.H.C, Juliatri. Uji Pengaruh Saliva Buatan Terhadap Kekuatan Tekan Semen Ionomer Kaca Tipe Ii Yang Direndam Dalam Minuman Isotonik. Jurnal E-Gigi (Eg). 2014; 2(2): 1-6.
22. Apriasari ML, Fadhilahm A, Carabelly AN. Aktivitas antibakteri ekstrak metanol batang pisang mauli (Musa sp) terhadap Streptococcus mutans. Dentofacial. 2013; 12(3): 148-50.