

## IN VITRO: EVALUATION OF BARANGAN (*MUSA ACUMINATA LINN.*) PEEL EXTRACT PASTE ON TOOTH COLOR

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Received: 25 Jan 2024, Revised and Accepted: 10 Apr 2024

### ABSTRACT

**Objective:** Tooth color is an important factor influencing the appearance of someone's smile. Tooth discoloration can cause a significant change in appearance and loss of confidence, therefore, patients are carrying dental bleaching as a treatment for appearance improvement. Dental bleaching is a non-invasive treatment that uses chemical ingredients and was reported to have several negative effects on teeth. Banana peel extract was reported effective as a dental bleaching agent due to its saponin and mineral content. This study aimed to determine the effects of barangan (*Musa acuminata Linn.*) peel extract paste on tooth color changes.

**Methods:** Samples were human premolar teeth that were randomized and divided into four groups (n=15), which are group 1 (5% paste), groups 2 (discoloration teeth, 5% paste), groups 3 (10% paste), and group 4 (discoloration teeth; 10% paste). Barangan peel extract was made using ethanol (70%) maceration method and made into a paste with concentrations of 5% and 10%. Discoloration was conducted by soaking the samples in tobacco solutions for 9 d. Paste treatment was done for 12 d by applying the paste on the teeth surfaces (15 min/day). Tooth color measurement is by CIE-Lab method using a colorimeter (CS-10) for baseline and after treatment. Data was analyzed using one-way ANOVA for  $\Delta E$  value and t-dependent for L value using GraphPad Prism software version 9.3.1.471 for Windows.

**Results:** There were significant differences in  $\Delta E$  and L values before and after treatment in all groups.

**Conclusion:** Barangan peel extract paste with a concentration of 10% showed a greater color change than 5%, which lightened up the color of teeth.

**Keywords:** Bleaching, Tooth color, Banana peel

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### INTRODUCTION

Smiles are an important factor in creating interactive communication between humans. The lips and teeth influence the beauty of a smile, so healthy and white teeth make a beautiful smile and improve confidence. Tooth discoloration on anterior teeth can cause a significant change in appearance, therefore, discoloration of the teeth will be the first consideration for most people to do dental treatment. In determining treatment for tooth discoloration, dentists must understand the etiology and clinical manifestations. Tooth discoloration is caused by intrinsic and extrinsic factors. One of the extrinsic factors that can cause tooth discoloration is chewing tobacco or using smokeless tobacco products. Tooth discoloration from chewing tobacco is caused by stain penetration to enamel, dentin, and root surfaces, causing a brown to black discoloration [1, 2].

Dental treatment of tooth discoloration is an invasive and non-invasive treatment. Invasive treatment is by making crowns and veneers, while non-invasive treatment is by dental bleaching. Generally, dental bleaching is more popular because it is more conservative and less invasive. Dental Bleaching agents use chemicals, such as hydrogen peroxide and carbamide peroxide, the different concentrations according to individual clinical needs [3-5]. It is reported that high concentrations of these ingredients will cause tooth sensitivity [3], gingival irritation [5], and potentially have side effects on the enamel and restorative materials [4]. The use of hydrogen peroxide as a bleaching agent causes changes in the texture, composition, and micro-roughness of tooth enamel. Hydrogen peroxide also penetrates deeply into the dentine, causing sensitivity after treatment [4].

The development of natural materials as dental bleaching materials is currently popular, triggering a lot of research on the concept of "back to nature" [6]. Natural bleaching materials are developed from organic components to develop effective bleaching agents without damaging the tooth structure [5-7]. Natural whitening ingredients proven to change tooth color are lemons [8], apples [8],

rosella [9], green pears [8], and bananas [8]. Bananas are a local food source plant whose production level is relatively high in Indonesia and tends to increase yearly [10].

Almost 60% of banana biomass is wasted after harvest and banana peel waste loss amounts to 114.08 million metric tonnes worldwide, which contributes to environmental issues such as the excessive production of greenhouse gases [11]. These wastes contain many bioactive substances with various functionalities, especially phenolic compounds, including flavonoids, saponin, hydroxycinnamic acids, and catecholamines. Banana peel has excellent antioxidant, antibiotic, and antibacterial due to these phenolic compounds [12, 13].

Barangan (*Musa acuminata Linn.*) are known as typical bananas from North Sumatra province and are the leading commodity in North Sumatra [10, 14]. Banana peel contains secondary metabolites such as alkaloids, flavonoids, and saponins, as well as minerals and calcium in bananas are also quite high. These ingredients are reported to effectively whiten teeth without causing wear and tear on the enamel [4, 8, 15]. Extraction of phytochemical components of bananas using the maceration method with 70% ethanol as solvent is effective due to the solubility of compounds in polar solvent [16]. Saponin has the capability as a cationic biosorbent and structurally can bind with chromogens so it can lighten the color of the teeth. Ingredients banana peel are potentially useful as dental bleaching materials due to secondary metabolites, especially saponin [8, 15]. Therefore this study aims to determine the effect of barangan (*Musa acuminata Linn.*) peel extract paste on tooth color changes.

### MATERIALS AND METHODS

The ethical clearance of this study was approved by the Ethics Committee of Faculty of Medicine, University of North Sumatra with number 1089/KEPK/USU/2022. This was an experimental laboratory study.

**Materials**

Samples of this study were freshly extracted premolars without caries, restoration, enamel cracks, or fractures that were cleaned, soaked in saline and refrigerator-stored until treatment.

**Methods**

**Preparations of extract and paste**

Banana peel extract was made by maceration method using ethanol 70% as solvent. Three kilograms of banana peels (*Musa acuminata Linn.*) were collected, sorted, cleaned, and cut into small pieces. Then, dried in a drying cabinet for 3-4 d at 40-50 °C. Dried banana peels ground into a coarse powder. A total of 300 g of banana peel powder was poured into the container and 3000 ml of ethanol was added as a solvent, then soaked for 6 h and stirred occasionally until 3 d. The filtrate is filtered using filter paper and the filtrate extraction is concentrated with a rotary evaporator at 50 °C until viscous banana peels ethanol extract in 100% concentration.

To obtain 100 gr of 5% banana peel extract paste, require concentrated extract 5 gr, and for 10% is 10 gr. For 5% concentration, as much as 75 ml of distilled water, and 10% is 70 ml of distilled water heated on a hot plate and 5 gr of CMC-Na (*Carboxymethyl Cellulose Sodium*) dissolved, then 5 g and 10 g of banana peels extract stirred until smooth, then 10 ml glycerine is added, and 5 ml propylene glycol is stirred until a paste is formed. The pH of the paste is measured using a universal pH paper Indicator by diluting the paste into distilled water. The pH result of banana paste is 6.

**Preparation of tobacco solution**

The tobacco solution was made by dissolving 60 g of smokeless tobacco in 200 ml of warm water and then filtering.

**Sample preparation and discoloration**

Samples were randomized and divided into four groups (n=15), which are Group 1 (5% paste), Group 2 (discoloration teeth, 5% paste), Group 3 (10% paste), and Group 4 (discoloration teeth; 10% paste). All samples were cleaned using a prophylaxis paste and prophylaxis brush. For the discoloration tooth, a total of 30 samples were soaked in 5 ml tobacco solution for each sample and done for 9 d at room temperature. The solution was replaced every day.

**Sample treatment**

Extract paste was applied on the buccal or lingual part of samples, then wrapped using a plastic sheet to allow the paste to spread evenly on the surfaces and leave for 15 min. Then samples were brushed and rinsed with distilled water and then stored in distilled water at room temperature for further treatment. The application was conducted every day for 12 d.

**Measurement of tooth color changes**

Color measurements were done using a colorimeter (CS-10) to measure L\* (brightness), a\* (reddish or greenish), and b\* (yellowish or bluish) values. The color measurements were recorded before (L<sub>0</sub>, a<sub>0</sub>, b<sub>0</sub>) and after (L<sub>1</sub>, a<sub>1</sub>, b<sub>1</sub>) extract paste treatment. Then, color change values (ΔE) were calculated using the formula:

$$\Delta E = \sqrt{(L_1 - L_0)^2 + (a_1 - a_0)^2 + (b_1 - b_0)^2} \quad [15]$$

**Statistical analysis**

The data were analyzed using the ANOVA test to compare ΔE values between all groups and the t-dependent test for L values. Statistical analysis was performed using GraphPad Prism software version 9.3.1.471 for Windows (GraphPad Software, San Diego, CA, USA)

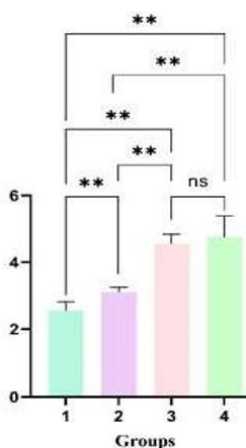
**RESULTS AND DISCUSSION**

This study was conducted to find out the differences in tooth color changes (ΔE) after the application of barangan banana peel extract paste 5% and 10% for 12 d (15 min/d). There were two different pre-treatments (n=32), which were discoloration with tobacco solution and without discoloration.

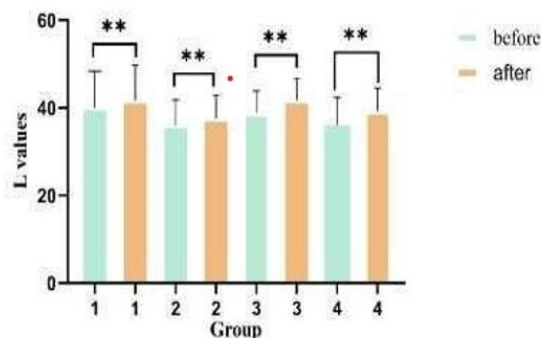
One method to measure the color change of a substance is a colorimetric test using a colorimeter. The basic color that can be assessed is based on the Commission Internationale de l'Eclairage (CIE), namely the L\* a\* b\* color scale. There is L\* value means relative lightness (light reflected by an object), a\* means redness (+) or greenness (-), and b\* means yellowness (+) or blueness (-). This method is used to characterize changes in tooth color [22, 23] It is reported that dental bleaching with hydrogen peroxide becomes brighter followed by an increase in L\* value (brighter), a\* (+) value (less red), and a decrease in b\*(+) (less yellow) [22]. In this study, the L\* value in all groups (fig. 2) showed a significant increase (p-value =0.001) after applying barangan peel extract paste at 5% and 10%, in result the brighter tooth color. The result of this study is presented in table 1.

**Table 1: Mean and standard deviation of L, a, b, and ΔE values after application of barangan peel extract paste for 15 min in 12 d**

Groups (n=15)	The average of L*, a*, b* value						ΔE
	L <sub>0</sub>	L <sub>1</sub>	a <sub>0</sub>	a <sub>1</sub>	b <sub>0</sub>	b <sub>1</sub>	
1 (5%)	40.01±8.34	41.67±8.03	(-) 3.16±1.40	(-)3.05±1.44	5.23±1.61	4.59±1.77	2.55±0.27
2 (discoloration teeth, 5%)	35.95±5.91	37.50±5.44	(-) 2.85±1.32	(-)2.30±1.14	4.56±1.38	6.13±1.46	3.11±0.13
3 (10%)	38.90±4.90	41.68±5.08	(-)3.20±0.74	(-)3.12±1.25	5.11±1.29	4.26±1.50	4.56±0.28
4 (discoloration teeth, 10%)	36.10±6.21	39.33±5.14	(-)2.13±1.13	(-)2.68±0.93	5.99±1.40	6.06±2.10	4.74±0.64



**Fig. 1: Mean, statistical significance, and ΔE value after application of barangan peel extract paste. \*\*p<0.05, ns p>0.05**



**Fig. 2: L values before and after application of barangan peel extract paste. \*\*p<0.05**

Smokeless tobacco products can cause dental staining due to various chemicals presence such as nicotine, formaldehyde,

polynuclear aromatic hydrocarbons, N nitrosamines, and polonium 210, and metals like arsenic, cyanide, cadmium, and benzene. This staining can affect tooth surface roughness and its organic matrix [17, 18]. It was reported that after 1 d of exposure to smokeless tobacco products on teeth, the tooth color becomes darker [17]. In this study, the initial measurement of lightness value  $L_0$  (table 1) on discolored groups (2 and 4) was lower than those without discolorations groups (1 and 3) which means the tooth color became darker after 9 d soaked in tobacco solution. This discoloration occurs due to penetration of the stain deposit into the enamel surface, the outer layer of dentin, and the root and then becomes yellow to brown-black discoloration over time [17, 19].

This study shows significant differences in tooth color changes ( $\Delta E$ ) after the application of Barangan peel extract paste with concentrations of 5% and 10% ( $p$ -value<0.05). Based on table 1, the  $\Delta E$  mean value for 10% barangan peel extract paste application (groups 3 and 4) are higher than 5% (groups 1 and 2). Fig. 1 presents that the higher the concentration of banana peel extracts paste, the higher the tooth color changes ( $\Delta E$  value).

$\Delta E$  values in the discolorations group were higher than without the discoloration group. This phenomenon occurred due to the initial lightness ( $L_0$ ) difference caused by the stain effect of tobacco solution, whereas the  $L_0$  value on discoloration groups was low, in means darker than others, fig. 2.

Moreover, the L values before and after the application of barangan peel extract paste 5 and 10% for each group are shown in table 1. The Mean L value before treatment is lower than after treatment for all groups. Fig. 2 shows a significant increase in L value after applying banana peel extract paste ( $p$ -value<0,05), which means that the tooth color has become lighter than before. Therefore, barangan peel extract paste of 5% and 10% is effective in removing the tobacco solution stain in the outer enamel and making the tooth color brighter.

Barangan peel extract paste can lighten up tooth color due to phytochemical components in banana peel, especially saponin. Saponin is derived from "sapo" the Latin that means soap-like. Saponin is a natural secondary metabolite that belongs to the glycoside complex group. Generally, saponin is used as a detergent because it has an amphiphilic structure. This structure has one hydrophilic and lipophilic structure (sapogenin). In aqueous solutions, these saponins tend to self-acclimate with air on a lipophilic structure which leads to stress reduction surface to form foam [20, 21]. Therefore, saponins are like soap so it is called a natural surfactant that can act as a cleaner. Saponins also have cationic biosorbent capabilities and adequate binding with chromogens so that the stain will be removed and cleaned, and as a result, lighten up the tooth color [8, 15]. It is assumed that tobacco stain due to its metal component in this study, was removed by saponin capabilities. Moreover, the chromagen binding capability is assumed to be proven by the result of an increased L value of all groups after banana peel extract paste exposure.

The  $a^*$  value in groups 1,2 and 3 after the application of banana peel extract paste shows an increase in negative values, which means that the tooth color changes to less green. In addition, group 4 shows a decrease in  $a^*$  value, which means the tooth color changes to greener. The variations of  $a^*$  value depend on the initial color of the teeth, i.e. the redness or greenness, before application of the bleaching agents.

The value of  $b^*$  in group 1,3 in this study shows a decrease in positive value, which means that the color of the teeth becomes less yellow. In group 2 and 4 shows an increase in the value of  $b^*$  which means that the color of the teeth becomes more yellowish. After bleaching, normally the  $b^*$  will decrease in positive value and then become less yellow, but the  $b^*$  value also can increase due to a significant increase of the  $L^*$  value. Occasionally, after bleaching, there is a decrease in the  $L^*$  value due to a significant decrease in the  $b^*$  value. Then, the tooth becomes less yellow to cover the lack of significant change in the  $L^*$  value.

The pH of 5% and 10% Barangan banana paste is 6, this pH value does not cause erosion of teeth, while alkaline or neutral (pH)

causes less alteration in the chemical composition of dentin [15, 22]. Other phytochemical components in banana peel are flavonoids, alkaloids, tannins, quinones, and which have antioxidant properties, while the mineral components consist of potassium, calcium, sodium, manganese, and iron. The content of extracts from banana peel also has antimicrobial activity [2, 11]. Banana peel contains minerals such as potassium, magnesium, and high manganese which can help clean stains and whiten teeth. The potassium content in banana peel can reduce sensitivity and manganese can help form hard enamel tissue and prevent cavities. In addition, high levels of calcium and vitamin D in banana peel can strengthen the mineral matrix in teeth. The high mineral content with the ability to whiten teeth from the astringent salicylic acid contained in banana peel effectively whitens teeth without causing wear and tear on the enamel [4, 5].

## CONCLUSION

Barangan peel extract paste potentially can be used as alternative dental bleaching (with or without tooth discoloration), which can lighten up tooth color due to phytochemicals, especially saponin and minerals components. Barangan peel extract paste with a concentration of 10% shows greater color changes than 5%. Mineral content in banana peel also effectively lightens up teeth' color without affecting the tooth structures.

## FUNDING

Nil

## AUTHORS CONTRIBUTIONS

All of the authors have contributed equally

## CONFLICT OF INTERESTS

All authors have no conflict of interest to declare.

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