

Effect of Areca Nut Extract Tooth Paste on Tooth Discoloration

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ABSTRACT

Background: Areca nut extract is an active compound that can be used as an alternative toothpaste ingredient because it has antibacterial properties that can prevent cavities, but the tannin and flavonoid content in areca nut extract has the potential to cause discoloration of tooth. **Objective:** To determine the effect of areca nut extract (*Areca catechu* L.) toothpaste on tooth enamel color. **Materials and Methods:** This study was a true experimental laboratory type using pre test - post test with control group design. The study sample was 28 post-extraction human premolars who met the inclusion and exclusion criteria. The samples were divided into 4 treatment groups, 7 samples each in the group brushed using areca nut extract toothpaste concentrations of 1,5%, 3%, 4,5% and toothpaste without areca nut extract. Samples were brushed 2 times a day for 14 days. Measurement of color change using ColorFlex EZ spectrophotometer. **Results:** The results of data analysis obtained the average value of color change for toothpaste concentration of 1,5% of 4,38, 3% concentration of 5,40, 4,5% concentration of 7,37 and without areca nut extract of 0,98. The results of the One Way ANOVA test obtained a p value <0,05, meaning that there were a significant effect in each treatment group. The results of Post Hoc LSD analysis showed significant differences between all treatment groups, except between the treatment groups using 1,5% concentration of areca nut extract toothpaste and 3% concentration of areca nut extract toothpaste. **Conclusion:** areca nut extract toothpaste has an effect on the color of tooth enamel. The 4,5% concentration of Areca nut extract toothpaste has a significant effect on tooth discoloration.

Keywords: Areca Nut Extract, Tooth Discoloration, Tooth Paste

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INTRODUCTION

Aesthetics is a very important aspect in human daily life. Aesthetics can affect the quality of human life, especially the appearance of teeth, which is influenced by several factors such as the color, position, alignment, and shape of the teeth.¹ Tooth color is one of the physical aspects that can affect appearance and for some individuals tooth color can directly affect quality of life (2). Changes in tooth color have a psychological impact on a person, namely the emergence of a lack of confidence and discomfort with the appearance of their teeth.³

Research conducted in Medan stated that of 70 Prima Indonesia University students, 31,4% were not confident with their smiles and 84,3% wanted to have brighter color of teeth.⁴ Another study conducted in India regarding satisfaction with smiles, there were 201 women and 225 men involved and the results of the majority of subjects with a percentage of 57,7% were very satisfied with their smiles, more than a third of subjects with a percentage of 37,7% were satisfied and as many as 4,9% subjects were dissatisfied with their smiles. The component of the smile that causes dissatisfaction in the subject is the color of the teeth with a percentage level of 27,9%.⁵ A person is dissatisfied with the appearance of his smile caused by tooth discoloration so that various ways are done to achieve a better smile.^{3,6}

Tooth discoloration can be caused by intrinsic, extrinsic or both factors.⁷ Intrinsic discoloration can be caused by stains present in enamel and dentin during odontogenesis or after tooth eruption.⁸ Extrinsic discoloration is staining that occurs on the surface of tooth enamel, for example, staining caused by smoking, food, and drinks containing tannins.¹⁰

Some studies state that the tannin and flavonoid content contained in herbal plants (red betel leaves, coffee, green betel leaves, areca nut seeds, bay leaves) can cause discoloration of natural tooth enamel and artificial teeth.

Research conducted by Amanda and Wahyuni stated that there was a color change in acrylic resin artificial teeth after being soaked in basil leaf extract.¹⁰ Research conducted by Puspasari showed that there was a change in the color of premolar tooth enamel after extraction after being soaked in coffee solution for 14 days.¹¹ Research conducted by Kalasworjati et al stated that there was a color change in acrylic resin dentures after being soaked in red betel leaf essential oil boiling water.¹² Research conducted by Sovira et al on the effect of strawberry extract toothpaste on tooth discoloration states that there is a color change after applying toothpaste for 14 days.¹³

Areca nut (*Areca catechu* L.) seeds contain compounds such as alkaloids, tannins, quinones, terpenoids, saponins, and flavonoids that have antibacterial properties.¹⁴ Research conducted by Afni et al stated that toothpaste of areca nut ethanol extract with concentrations of 1,5%, 3%, and 4.5% has inhibition against *Sterptococcus mutans* bacteria and *Staphylococcus aureus* bacteria with the greatest inhibition at a concentration of 4,5%.¹⁵

Based on the above background, areca seeds have the potential to be used as a toothpaste ingredient because they have antibacterial properties, but can also cause discoloration of tooth enamel. Based on the description above, the author is interested in examining the effect of areca nut extract toothpaste (*Areca catechu* L.) on the color of tooth enamel. This study aims to determine the effect of areca nut extract toothpaste (*Areca catechu* L.) on the color of tooth enamel.

MATERIALS AND METHODS

This research was a true experimental laboratory study with a pre test and post test research design with control group design conducted on 28 post-extraction human tooth samples. The manufacture of areca nut extract was carried out at the Organic Chemistry Laboratory, Faculty of Mathematics and Natural

Sciences, Andalas University, the manufacture of areca nut extract toothpaste was carried out at the Pharmacy Laboratory, Andalas University, planting and brushing samples were carried out at the Microbiology Laboratory, Faculty of Medicine, Andalas University, and measurement of sample color before and after treatment was carried out at the Instrumentation Laboratory, Faculty of Agricultural Technology, Andalas University.

The research procedure commenced with the collection of areca nuts. Areca nut is cultivated throughout Indonesia; nevertheless, the largest distribution and primary export production centers are situated on Sumatra Island, specifically in Jambi Province and Aceh Province.¹⁶ The Central Bureau of Statistics of West Sumatra Province states that West Sumatra is able to produce 8,048 tons of areca nut annually with Pasaman Regency in second place in producing 1,402 tons of areca nut annually.¹⁷ Areca nuts that have been collected will be wet sorted then washed thoroughly with running water and dried using tissue, Areca nuts that have been cleaned are then split and the seeds are thinly sliced and then dried using sunlight for 5 days, Areca nuts that have been dried are then mashed using a blender so that they are powdered and sieved, Store the sieved powder in a tightly closed and clean container, and then sterilization of the tools to be used, then proceeds with the manufacture of areca nut extract. The extract was made by maceration method using 96% ethanol solvent, and continued by concentrating the extract with a rotary evaporator. Planting the sample is done using epoxy resin with the buccal part facing up and checking the initial color using ColorFlex Ez Spectrophotometer. Areca nut extract toothpaste was made with concentrations of 1,5%, 3%, 4,5% and toothpaste without areca nut extract as treatment control. The samples were brushed for 10 seconds twice a day for 14 days and after brushing the samples were soaked in artificial saliva and stored in an

incubator at 37°C. Samples checked for final color using ColorFlex Ez Spectrophotometer.



Figure 1. (Color measurement with ColorFlex EZ spectrophotometer)

The results of the study were the difference in color changes before and after brushing. The data obtained were then analyzed with One Way ANOVA and Post Hoc LSD tests.

RESULT

The results showed a change in color that occurred on tooth enamel after brushing using toothpaste with areca nut extract concentrations of 1,5%, 3%, 4,5%, and toothpaste without areca nut extract. The average results of tooth sample color changes can be seen in Table 1.

Table 1. Average color change of tooth samples in treatment groups

Treatment	n	Tooth Discoloration		
		Mean ±SD	Min	Max
Areca Nut Extract Toothpaste 1.5%	7	4,3892± 0,6880	2,2465	7,5225
Areca Nut Extract Toothpaste 3%	7	5,4016± 0,5817	3,5600	8,0713
Areca Nut Extract Toothpaste 4.5%	7	7,3736± 0,8738	2,6966	10,3483
Toothpaste without Extract Areca Nut	7	0,9874± 0,1682	0,3002	1,6727

The results of the univariate analysis in Table 1 show that the greatest color change occurred in the group that brushed their teeth using toothpaste of areca nut extract concentration 4,5% with an average of 7,37, while the smallest color change occurred in the group that brushed their teeth using toothpaste of areca nut extract concentration 1,5% with an average of 4,39.

The data from the univariate analysis were then processed statistically to analyze the effect of areca nut extract toothpaste on tooth enamel color. Bivariate analysis begins with a normality test, namely the Saphiro Wilk test with meaning ($p > 0,05$) to determine whether the data is normally distributed. The results of the Shapiro Wilk test obtained a value of $p > 0,05$ which indicates that the data is normally distributed. The Levene's test homogeneity test was carried out next to find out whether the data was homogeneous or not. The results of the Levene's test showed a value of $p = 0.30$ which means $p > 0,05$ so that the data was declared homogeneous. Furthermore, the One Way ANOVA parametric test was carried out with the results of $p < 0,01$, which means that there was a significant effect of the value of changes in tooth enamel color before and after brushing using areca nut extract toothpaste and toothpaste without areca nut extract. Differences in color changes between treatment groups analyzed by the Post Hoc LSD test can be seen in Table 2.

Table 2. Post Hoc LSD Test Results

	Areca Nut Extract Tooth paste 1,5%	Areca Nut Extract Tooth paste 3%	Areca Nut Extract Tooth paste 4,5%	Tooth paste without Extract Areca Nut
Areca Nut Extract Tooth paste 1,5%		0,269	0,003*	0,001*
Areca Nut Extract Tooth paste 3%			0,038*	0,001*

Areca Nut Extract Tooth paste 4,5%				0,001*
Tooth paste without Extract Areca Nut				

Notes: *P value $< 0,05$ (significant)

The results of the Post Hoc LSD test in Table 2 showed that there are significant differences between each treatment group except between the treatment groups using areca nut extract toothpaste concentrations of 1,5% and 3%.

DISCUSSION

The results of the average difference in color changes in each treatment group are influenced by the content of polyphenols (tannins and flavonoids) contained in each concentration.¹⁸ Polyphenolic compounds are compounds that can be characterized by the presence of aromatic rings that carry more than one hydrogen ion. Polyphenolic compounds are divided into two groups, namely flavonoids (flavones, flavanols, flavanones, isoflavones anthocyanidins and chalcones) and tannins (phenolic acid polymers, catechins or isocatechins).¹⁹ Polyphenols are known as powerful antioxidants that can neutralize free radicals by donating hydrogen ions.²⁰ These compounds (polyphenols) are the color-producing compounds in areca nuts.²¹

These results are in line with research conducted by Annisa and Pintadi, (2013), stating that coffee with concentrated concentrations contains high polyphenols. Polyphenols have hydrogen ions (H) that can bind directly to the surface of tooth enamel, H ions in polyphenols will bind to the negative charge contained in the enamel. So, the higher the concentration of areca nut extract, the more H ions that bind to the surface of the enamel so that it will cause a

darker color change in tooth enamel.²² Another study stated that the difference in color produced by coffee, tea, and cola is due to differences in chromogen content (compounds that produce colored substances such as polyphenols) contained in each solution. The highest color difference is produced by coffee because of the high chromogen content contained in it.²³

Significant color changes in each treatment group brushed using areca nut extract toothpaste are due to the content of polyphenolic compounds contained in areca nut. Areca seeds, which were originally brownish in color after being extracted, turned into a reddish brown.²⁴ Areca nut extract is acidic because it contains polyphenols, namely flavonoids and tannins. Tannins contained in areca nuts can produce a strong color and are water soluble so that they can cause discoloration of tooth enamel. The acid content contained in areca nuts helps discoloration by making the surface of the enamel rough so that the stain easily sticks and causes discoloration.²⁵

Extrinsic stains occur outside the tooth surface or inside the pellicle protein. The mechanism of extrinsic stains is through denaturation of pellicle proteins by acidic tannins and the incorporation of chromogen compounds (colored compounds) into pellicle proteins. The acid contained in tannins has strong denaturation properties against pellicle proteins. Denatured pellicle proteins will then increase the ability to stain. The pellicle protein can selectively bind to the enamel surface through calcium bonds, the chromogen contained in areca nut then interacts with the pellicle through hydrogen bonds. Chromogen that binds to pellicle proteins will produce a color on the surface of the tooth enamel with the natural color of the chromogen itself.²⁶ The acidic properties contained in tannins can cause discoloration of tooth enamel both in vitro and in vivo. Previous study explained that the acidic nature of tannins can denature pellicle proteins and increase the ability to stain. The acid in tannins has a strong strength in denaturing pellicle proteins.²⁷

The sample group brushed using toothpaste without areca nut extract also obtained a significant color change value. This result is because toothpaste without areca nut extract contains abrasive compounds (calcium carbonate) that cause erosion of the teeth. Dental erosion is the loss of hard tooth tissue by a nonbacterial chemical mechanical process, which results in the loss of superficial (outer) enamel and causes the color of the teeth to become yellower or darker.²⁸

The insignificant difference between the tooth brushing treatment group using 1,5% concentration of areca nut extract toothpaste and tooth brushing using 3% concentration of areca nut extract toothpaste is caused by the color change value (ΔE) which is 1,00 ($\Delta E < 2$). ΔE is the value of changes in the color of tooth enamel before and after brushing using areca nut extract toothpaste. These results are in line with research conducted by Pani et al, (2015), which states that if the color change value (ΔE) is less than 2 then it cannot be seen with the naked eye (not significant). The average value of color change (ΔE) between other treatment groups shows a value (ΔE) > 2 which means it can be seen with the naked eye (significant).²⁹

The significant results that occur between each treatment group are due to the higher concentration of areca nut extract in toothpaste, the greater the color change that occurs on tooth enamel. Discoloration of enamel can occur directly through chromogen compounds (colored compounds) attached to pellicle proteins. Chromogen compounds (colored compounds) can bind directly to the tooth surface through double bonds between H ions produced by tannins with enamel surfaces that have a negative charge. The charge produced by this enamel will absorb H ions through pellicle proteins. Pellicle protein is a glycoprotein compound that can be formed by conditioning the sample like the atmosphere in the oral cavity, namely by immersing the sample in artificial saliva. So, the more H ions that bind

to the surface of the enamel, the greater the color change that occurs in tooth enamel.^{29,30}

The results of this study indicate that areca nut extract toothpaste with concentrations of 1,5%, 3%, and 4,5% cannot be used as commercial toothpaste because it exceeds the threshold of color change values that can be seen by the human eye, namely $\Delta E > 2$.

CONCLUSION

Areca nut extract toothpaste has an effect on the color of tooth enamel. The 4,5% concentration of Areca nut extract toothpaste has a significant effect on tooth discoloration.

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