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Effect of Non-Herbal and Siwak *(Salvadora Persica)* Herbal Whitening Toothpaste Against Tooth Enamel Discoloration

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ABSTRAK

Latar Belakang: Masyarakat memiliki minat yang tinggi dalam mencegah atau menghilangkan noda ekstrinsik pada gigi agar gigi tampak lebih putih. Metode umum pembersihan gigi yang dilakukan hingga saat ini adalah menyikat gigi menggunakan pasta gigi. Bahan pemutih pada pasta gigi non-herbal diketahui dapat menyebabkan efek samping yang tidak diinginkan seperti iritasi, alergi, dan ulserasi mukosa. Penelitian mengungkapkan siwak mengandung konsentrasi silika yang tinggi sehingga dapat membuat warna gigi lebih cerah. Penelitian ini bertujuan untuk mengetahui efektivitas pasta gigi pemutih non-herbal dan pasta gigi herbal siwak terhadap perubahan warna email gigi. **Metode:** Penelitian eksperimental laboratorium dengan sampel penelitian 30 gigi premolar. Sampel dibagi 3 kelompok, yaitu kelompok perlakuan yang disikat menggunakan pasta gigi herbal siwak dan pasta gigi non-herbal, serta kelompok kontrol yang direndam dalam akuades. Tiap kelompok perlakuan disikat selama 7, 14 hari, sampel diukur menggunakan VITAPAN Classical. **Hasil:** Pasta gigi herbal, pasta gigi non-herbal, dan kelompok kontrol mengalami peningkatan nilai skor perubahan warna gigi pada hari ke-14. Perbandingan antara pasta gigi herbal siwak dan pasta gigi non-herbal tidak menunjukkan perbedaan yang tidak signifikan dengan nilai p = 0,796 (p>0,05). **Kesimpulan:** Pasta gigi non-herbal lebih efektif dalam memutihkan email gigi dibandingkan pasta gigi herbal siwak, namun perbedaannya tidak signifikan.

Kata kunci: Pasta Pemutih Non Herbal, Pasta Pemutih Siwak Herbal, Perubahan Warna.

ABSTRACT

Background: *The public interest in removing extrinsic tooth stains has increased substantially. Tooth brushing with whitening toothpaste remains most common approach, however some non-herbal whitening agents may be associated with adverse effect such as irritation, allergies and mucosal ulceration. Research reveals that siwak (Salvadora persica) has reportedly contains high concentrations silica which contribute to tooth stain removal and colour improvment. This study aimed compare the effectiveness of non-herbal whitening toothpaste and siwak-based herbal whitening toothpaste (Salvadora persica) on enamel discoloration.* ***Methods:*** *Laboratory experimental research 30 extracted premolar teeth divided into three group siwak-based herbal toothpaste, non-herbal toothpaste and control group immersed in distilled water the treatment group were brushed for 14 days, then enamel color changes were assesed using VITAPAN Classical shade guide.* ***Results:*** *All groups showed changes an discoloration score on day 7 and 14. The siwak herbal toothpaste and non-herbal toothpaste was not statistically significant with a value of p = 0.796 (p>0.05).* ***Conclusion:*** *Non herbal whitening toothpaste demonstrated more potential whiten tooth enamel than siwak based herbal whitening toothpaste), however, the difference was not statistically significant*

Keywords*: Non Herbal Whitening Toothpaste, Herbal Whit`Ening Toothpaste, Color Change*

INTRODUCTION

Tooth color is determined by the color of dentin and enamel. Enamel's natural color is translucent white and the underlying tooth structure tends to be visible. Dentin located beneath the enamel is normally yellowish, but due to its porous structure and the presence of dental nerves, it can darken becoming brownish-yellow.[1]

The color of the enamel is determined by two factors, namely mineralization and thickness of the enamel, and it can be from grayish-white to yellowish-white. Dental enamel develops from the enamel organ

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through the formation of ameloblasts, a special type of epithelial cell, and the process of tooth enamel formation is known as amelogenesis.[2]

Tooth discoloration is a condition in which tooth color changes due to various factors, both physiological and pathological or exogenous and endogenous. Physiological discoloration occurs with age. As a person ages, the enamel layer thins while the dentin thickens as the teeth continue to form secondary dentin. Pathological discoloration can be extrinsic or intrinsic. Tooth discoloration is caused by several factors.[2,3]

Intrinsic tooth color is related to light and the absorption propertis of enamel and dentin. Extrinsic stains are caused by the absorption of substances found in cigarettes and the consumption of substances found in cigarettes and the consumption of foods high in tannins (e.g., tea, coffee, soft drinks, etc)[4]

The effectiveness of tooth whitening depends on the type of stain present, which can be categorized as extrinsic staining, intrinsic staining, and internal discoloration. The use of toothpaste with whitening agents is recommended to prevent or remove external tooth stains due to their chemical effects. The cleaning effect of toothpaste depends primarily on its abrasive properties. Toothpaste requirements include abrasiveness, fluoride release rate, compatibility of the released fluoride with other toothpaste ingredients, and cleaning ability.[4]

Optimal toothpaste has an ideal concentration of each ingredient. Toothpaste containing whitening agents such as silica hydrate, calcium carbonate, dicalcium phosphate, calcium pyrophosphate, or sodium bicarbonate can mechanically remove external stains. Toothpaste containing low concentrations of hydrogen peroxide agents can potentially cause discoloration due to the interaction of hydrogen peroxide with dentin pigments called chromophores. Chromophores function to determine the color of tooth tissue. Toothpaste containing blue covariate has an abrasive effect, leaving a transparent bluish layer on the tooth surface. This interaction allows light to penetrate the tooth surface, making teeth appear brighter and whiter. [4]

The process of cleaning and removing plaque and extrinsic stains can be done by brushing your teeth. Whitening toothpaste can brighten the tooth structure through mechanical and chemical reactions. Stains can be removed through a mechanical process achieved by the use of abrasive materials. Commonly used abrasives include silica oxide, hydrated silica oxide, calcium carbonate, calcium phosphate dihydrate, calcium pyrophosphate, alumina oxide, 70-75% perlite (silica oxide), and sodium bicarbonate. Chemical agents such as enzymes, antitartars, and peroxides can help remove stains.[5]

Intrinsic tooth color is related to light and the absorption propertis of enamel and dentin. Extrinsic stains are caused by the absorption of substances found in cigarettes and the consumption of substances found in cigarettes and the consumption of foods high in tannins (e.g., tea, coffee, soft drinks, etc).[6] Research conducted in 2021 by Bayahu C et al., showed that whitening toothpaste containing 7% perlite, hydrated silica, or sodium bicarbonate was effective in improving the brightness of extrinsic tooth color, but had no effect on red/greenish, bluish-yellow discoloration.[7]

The use of toothpaste with containing whitening agents is recommended for stain removal. Whitening dentifrices and whitening toothpaste are generally formulated to remove external stains using physical methods and to prevent the reformation of these discolorations.[7,8] To address this gap, herbal whitening toothpaste has emerged as promising alternative including formulation contains siwak *(Salvadaro persica)*. Siwak (*Salvadora persica*). Siwak has high concentrations of chloride, silica,and sodium bicarbonate which lighten up and effectively reduce the dental plaque formation.[9]

The high percentage of in organic materialis what makes tooth enamel brittle and non vital. The smaller organic portion of tooth enamel is composed primarly of proteins including amelogenin, tufflein and aminoglicans . The larger in organic portion of tooth enamel is composed primarily of hydroxyapatite crystals.[10]

Research conducted in 2021 by Bayahu C et al, showed that whitening toothpaste containing 7% perlite, silica hydrated, or sodium bicarbonate was effective in increasing the brightness of extrinsic tooth color, but had no effect on red/greenish color, bluish-yellow color change.[11] This increases consumer interest in teeth whitening because improving dental aesthetics at home is easy and comfortable. However, there are concerns

that whitening toothpaste can have a bad impact, namely there are side effects that occur if used excessively can result in hypersensitivity, soft tissue irritation such as ulceration, toothache, and uneven color.[12] Sigmar et al (2020) based on researchers tested the effect on human gingival fibroblast cells and found that some whitening toothpastes significantly reduced cell viability.[13] That it is necessary to develop whitening toothpaste by selecting other ingredients to reduce the negative effects of excessive use of whitening toothpaste.[13]

Herbal whitening toothpaste preparations are an alternative used today, one of which is a whitening toothpaste preparation that contains siwak *(Salvadora persica).* Siwak has high concentrations of chloride, silica, and sodium bicarbonate, which make the color of the teeth lighter and effectively reduce the formation of plaque on the teeth.[14,15,16]

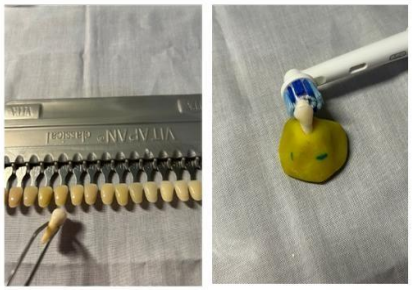
Siwak is part of the stem, root or branch of the *Salvadora persica* plant. Traditionally, *Salvadora persica* has been used in a variety of used for oral hygiene, food, fuel, cosmetics, and medicinal purpose even as a medicine.[17] This study aims to the comparison of the effectiveness of non-herbal whitening toothpaste and siwak base herbal whitening toothpaste on tooth enamel discoloration.

METHODS

The type of research was an experimental laboratory research with a post-test only control group design, namely by conducting observations and measurements of the control group and the treatment group after the sample was given treatment at a predetermined time to determine the results caused by a treatment.

Ethical approval has been obtained from the Research Ethics Commission of the Faculty of Dentistry, Prof. Dr. Moestopo University (Beragama) with number 19/KEPK/FKG UPDMB/IV//2023. This study was conducted at the IMTKG laboratory of the Faculty of Dentistry (FKG) Moestopo (Beragama). This was an experimental study using permanent first premolars from the upper and lower jaws.

The inclusion criteria: 1. Caries-free teeth; 2. Teeth that are not cracked or fractured; and 3. There was no restoration. While the exclusion criteria: 1. Carious teeth; 2. Cracked or fractured teeth; and 3. There is no restoration. The variables are herbal toothpaste based on miswak extract was toothpaste made from natural ingredients based on miswak (*Salvadora persica*) extract and containing lemon and salt. 2 Non-herbal toothpaste is toothpaste that does not contain natural ingredients. In general, toothpaste contains abrasives, surface astringents, humectants, binders, flavorings, and other chemicals



(A) (B)

Figure 1. (A) Determination of tooth color before the experiment, (B) Experiment conducted

The number of samples used in this study was 30 premolar teeth were randomly divided into three groups: two experimental groups (EG) and one control group (CG). Each group consisted of 10 premolar teeth. Determining the color of the premolar teeth before the experiment The color of the premolar teeth in the three treatment groups was observed before brushing with toothpaste. The initial color of the teeth before the experiment was determined using the VITAPAN Classical shade guide. Photographs were taken of the entire group as evidence of the research. The photographs were taken in the same location, position, and lighting.

Afterward, the premolar teeth were re-immersed in a plastic container filled with sterile distilled water. The samples in group 1 were brushed every day 2× a day using herbal toothpaste containing siwak extract is toothpaste , from PT Kino Indonesia (*Salvadora persica*, Sasha brand). Samples in group 2 were brushed every day 2× a day using non-herbal toothpaste (Pepsodent brand).tooth paste Pepsodent, PT Unilever, Indonesia The samples in the control group were not brushed with toothpaste and was left to soak in sterile distilled water. The three groups were brushed for 7 days and 14 weeks (2 weeks), then the results of the sample brushing were measured using VITAPAN Classical.

The amount of toothpaste used was a pea-sized amount on the toothbrush bristles.

Brushing was done for 1 minute, followed by 1 minute of rest after brushing to increase contact between the toothpaste and the teeth. Afterward, the teeth were rinsed. The distilled water was changed daily after brushing. This procedure continued daily until the end of the study.

Post experiment tooth color measurements were conducted on days 7 and 14. Dental photographs were also taken on days 7 and 14 to determine any differences. The final assessment was conducted on week 2 or day 14 for all treatment group samples using the VITAPAN Classical shade guide, and photographs were taken of all samples as research evidence. The photographs and observations of the samples must be taken in the same location, position, and lighting.

Data analysis used univariate analysis to explain each research variable and its characteristics. Bivariate data analysis was conducted to determine whether there were significant differences between two or more sample groups. Data analysis was performed using SPSS. The Shapiro-Wilk test was used to determine normal distribution. The paired t-test was used if the data were normally distributed. If the data were not normally distributed, the Kruskal-Wallis H test was used, followed by the Mann-Whitney U test.

RESULT

Toothpaste contains various ingredients that can be used to brightenthe color of teeth. Siwak is natural ingredient that can whiten tooth enamel. Silica is a natural abrasive agent found in siwak and is a material that can whiten tooth enamel.

Day	Deskritpif		
	Mean	St.Deviasi	Min-Max
Day 1			
Herbal Toothpaste	12	1.414	9.00-15.00
Non-herbal Toothpaste	12.5	1.354	11.00-15.00
Control	12.6	1.578	11.00-16.00
Day 7			
Herbal Toothpaste	12	1.414	9.00-15.00
Non-herbal Toothpaste	12.1	1.792	9.00-15.00
Control	12.2	1.033	11.00-15.00
Day 14			
Herbal Toothpaste	9.9	1.197	9.00-12.00
Non-herbal Toothpaste	9.6	2.633	3.00-12.00
Control	11.7	0.483	11.00-12.00

Table 1: Enamel discoloration results before and after brushing for 7 days and 14 days with siwak herbal toothpaste and non-herbal toothpaste.

All samples in groups 1, 2 and 3 did not have a tooth discoloration or were relatively the same color of tooth enamel on days 1 and 7 after brushing with herbal toothpaste, non-herbal and without toothpaste, except for samples no 5 and 6 in group 2 (toothbrushes with non-herbal toothpaste) and sample no 9 in the control group saw a change in color. At 2 weeks (14 days) after the treatment, tooth enamel discoloration was seen in all samples after brushing with herbal and non-herbal toothpaste. In the control group, there was a color change on day 14 in samples no. 5 and no. 9.

Group	N to	Color Before Brushed	Color After 7 days Brushed	Color After 14 days Brushed
Herbal Siwak (*Salvadora persica*)	1	A3.5	A3.5	A3
	2	A3.5	A3.5	B3
	3	A3.5	A3.5	A3
	4	A3.5	A3.5	A3
	5	A3	A3	A3
	6	A4	A4	A3.5
	7	A3.5	A3.5	A3
	8	A3.5	A3.5	B3
	9	A3.5	A3.5	B3
	10	A3.5	A3.5	A3
Non Herbal	1	A3.5	A3.5	B3
	2	A3.5	A3.5	A3
	3	A3.5	A3.5	A3
	4	B3	B3	B3
	5	A3.5	A3	A3
	6	A3.5	B3	B2
	7	A4	A4	A3.5
	8	A3.5	A3.5	B3
	9	A3.5	A3.5	A3
	10	A4	A4	A3.5
Control	1	A3.5	A3.5	A3.5
	2	A3.5	A3.5	A3.5
	3	B3	B3	B3
	4	A3.5	A3.5	A3.5
	5	A4	A4	B3
	6	A3.5	A3.5	A3.5
	7	A3.5	A3.5	A3.5
	8	A3.5	A3.5	A3.5
	9	C4	A3.5	B3
	10	A3.5	A3.5	A3.5

Table 2: Average tooth color and email discoloration data values before and after brushing for 1 day, 7 days and 14 days with siwak herbal toothpaste and non-herbal toothpaste.

Table 2 shows that the herbal toothpaste group has an average tooth discoloration score from the 1st, 7th, and 14th days, namely 12.00, 12.00 and 9.90. In the non-herbal toothpaste group, the average tooth discoloration score on the 1st, 7th, and 14th days was 12.50, 12.10 and 9.60. The control

group had an average score of tooth discoloration on the 1st, 7th, and 14th days, namely 12.60, 12.20 and 11.70.

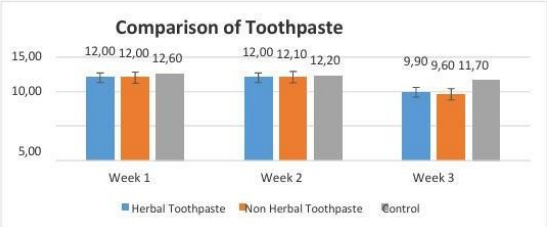


Figure 2. Graph of Average Values of Tooth Color Data Before and After Brushing for 7 days and 14 days with Siwak Herbal Toothpaste and Non-herbal toothpaste.

Based on figure 2, it shows that herbal toothpaste, non-herbal toothpaste and the control group have an increase in the value of the tooth discoloration score on the 14th day, namely to 9.90, 9.60 and 11.70. In this study, the normality test used the Shapiro Wilk Test and the homogeneity test with the levene test.

Group	Pasta Gigi Herbal	Pasta gigi Non Herbal	Group Control
Herbal Toothpaste		0.796	0.002
Non-herbal Toothpaste			0.011

* p<0.05 (there is a significant difference)

Table 3. Mann-Whitney U Test between Before and After Brushing for 7 days and 14 days with Herbal Siwak Toothpasteand Non-herbal toothpaste.

Table 3 shows the results of the statistical test obtained results that show that the comparison of the siwak herbal toothpaste group and non-herbal toothpaste does not have a significant difference because the p-value > 0.05, so it can be concluded that the zero hypothesis is unacceptable, so the alternative hypothesis is valid, namely there is no significant difference between the siwak herbal toothpaste group and non-herbal toothpaste group. Meanwhile, the herbal toothpaste group with the control group and non-herbal toothpaste with the control group had a significant difference because the p-value was<0.05.

DISCUSSION

Some studies show moderate to severe changes in the surface of enamel after carbamide peroxide use, including demineralization, decreased organic protein concentrations, and calcium loss. Many efforts have been made to reduce the side effects and demineralization due to bleaching, by applying pastes that aid in remineralization before, during, or after the bleaching process.[18] Clinical evidence suggests that fluoride is effective in preventing the onset of caries and stopping or possibly reversing the demineralization process. Although the efficacy of fluoride demineralization is substantially justified, the material is not able to overcome the challenge of high caries experienced by some individuals, and this highlights the need to find new methods to improve the remineralization process.[19]

Siwak is one of the natural ingredients that can whiten tooth enamel. Siwak or siwak is a stem taken from the roots and twigs of the wine plant. Silica is a natural abrasive agent for teeth found in siwak is a material that can whiten tooth enamel.[20,21] This study began with the determination of the color of all samples using the VITAPAN Classical shade guide to see if there was an increase in color after brushing. In the second phase of the study, samples number 1 – 10 were brushed using siwak herbal toothpaste and samples number 11 – 20 used non-herbal toothpaste for 14 days.

Herbal toothpaste, non-herbal toothpaste and the control group had an increase in the value of the tooth discoloration score on the 14th day, namely to 9.90, 9.60 and 11.70. The results of the study showed that the color change in the herbal toothpaste group did experience an increase in color, but it was not significant, perhaps because the herbal siwak toothpaste only had hydrated silica content which had the potential to whiten tooth enamel, which meant that the silica content was quite low, so the ability of the paste was not optimal to whiten teeth. This is in accordance with research conducted by Kalliath et al. in 2018 stating that the brightness of the color of the enamel was seen increasing on teeth brushed with non-herbal toothpaste rather than toothpaste containing herbal ingredients.

However, the average value obtained from herbal toothpaste and non-herbal toothpaste did not have a statistically significant difference. The average of herbal toothpaste is statistically but the difference is the paste used.[22] Kalliath's research, et al. brushed their teeth using colgate visible white tooth paste and Himalaya sparkling white toothpaste and the research I conducted was brushing my teeth using pepsodent whitening

paste and sasha whitening siwak toothpaste.[22]

This study is not the same as the Halib N Research, et al in 2017 conducted a study to assess the effect of siwak bleach (Salvadora persica) on stained teeth that were extracted by brushing their teeth extraction, then divided into two groups, namely siwak toothpaste and commercially available toothpaste as a control group, then obtained the result, namely siwak toothpaste shows superior results and has the potential to be an effective alternative teeth whitening product, especially for removing extrinsic stains.[23]

A study by Zarabadipour M. et al in 2020 conducted the same study and showed that the group that used siwak whitening toothpaste (Salvadora persica) was able to reduce dental plaque, mechanically using siwak whitening toothpaste and if used in active form was able to reduce plaque accumulation more prominently and effectively.[14]

The research of Dursun M.N et al in 2022 conducted a comparative study between whitening toothpaste with different ingredients, namely toothpaste containing abrasive ingredients, polyphosphates, activated charcoal, and hydrogen peroxide on the color of the enamel, the results obtained were that all whitening toothpastes had a clinical discoloration but there was no significant difference in all toothpastes.[24]

In a study by Nam, et al. in 2017 compared two non-herbal toothpastes containing hydrated silica and sodium bicarconate. The results of Nam's study stated that there was a significant change in the color of tooth enamel after brushing with toothpaste for 8 weeks and there was a significant difference after 6 weeks of observation.[25]

Base on the results of statistical testsusing the Kruskal-Wallis test, there were no significant differences inweek 1 (before brushing) and week 2 (day 7ofbrushing). Meanwhile, in week 3 (day 14 ofbrushing) there was a significant difference in the average enamel discoloration observed in both brushing groups.

Futhermore, a Mann-Whitney U test showed no significant difference between the herbal toothpaste and non herbal toothpaste groups. Meanwhile, there were significant differences between the herbal toothpaste and control group. Base on the descriptive data, the average change in the groups after 14 days was significant. The longer the brushing time, the greater the color chance in the brushing group. This study yielded similar esults to the study conducted by Kalliath et. al, with compared the effects of commercially available chemical tooth whitening pastes containing herbal ingredients on human enamel.[23]

Unlike the study conducted by Nam et al, their study demonstrated that toothpastes containing hydrated silica and sodium bicarbonate can whiten teeth.[25]

The differences between our study and Nam et al's study lie in the different ratios of herbal and non herbal toothpastes, while Nam et. al. used non-herbal and non herbal toothpastes, and the different brushing times (e.g., eight weeks in Nam et al's study, two weeks in ours). The results of the study showed that the color change in the herbal toothpaste group did experience a change in color increase but it was not significant, perhaps because the herbal siwak toothpaste only contains silica which has the potential to whiten tooth enamel, which means the silica content is quite low, so the ability of the paste is not optimal for whitening teeth. The herbal siwak toothpaste group compare to the non herbal toothpaste group, the non herbal toothpaste group has a superior ability to whiten tooth enamel. Based on the results of the study above , non herbal toothpaste is more effective in whitening tooth enamel comparedto the herbal siwak toothpaste but the difference is not significant.

CONCLUSION

Based on the results of the research that has been carried out, the following conclusions are obtained: (1) Pasta group non-herbal teeth are more effective in whitening tooth enamel compared to siwak herbal toothpaste (Salvadora persica) but the difference is not significant; (2) There is a discoloration in the email that has been brushed with siwak herbal toothpaste (Salvadora persica) and non-herbal toothpaste for a duration of 7 days and 14 days; (3) The highest discoloration in tooth enamel is found in the brushing duration of 14 days; (4) Discoloration of tooth enamel is caused by the hydrated silica content in herbal toothpaste and the silica content in non-herbal toothpaste.

Suggestions from the author include: (1) It is necessary to conduct further research on the content of active ingredients of herbal toothpaste in whitening tooth enamel; (2)

Further research needs to be carried out with different time variations in order to obtain optimal results.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest to this original research.

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