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The Effectiveness of Strawberries (Fragaria x ananassa) on Extrinsic Stanins and Salivary pH

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ABSTRACT

Background: Strawberries (Fragaria x ananassa) are a fruit plant in the form of herbs that were first discovered in Chile, America. The benefits of strawberries are used as a natural ingredient to overcome all dental and oral problems. Tooth stains are pigmented layers on the surface of the teeth, one of the aesthetic problems, usually occurring due to the adhesion of food, drink, or cigarette color that leaves a brown to black layer on the teeth, which occurs over a long period of time is difficult to remove by brushing. Objective: The purpose of this study was to determine the effectiveness of strawberries in cleaning extrinsic stains and saliva pH in the academic community of the Polytechnic Health of Jakarta I. Method: Quasi-experimental research design with a pre-post experiment approach. The sample used was 60 people. Changes in extrinsic stains were measured using the Lobene Stain Index, which measures the intensity and extent of the stain, as well as a combined score of both, then measuring the pH of saliva using litmus paper. Results: The average combined score was 5.03. The extrinsic stain score after strawberry application showed an average combined score of 2.23. After analysis using the Dependent T test (paired test) and a p-value of 0.01. Meanwhile, the results of the saliva pH analysis obtained a p-value of 0.01 (P<0.05). Conclusion: There was a decrease in the extrinsic stain score after treatment and it showed that strawberry extract could affect saliva pH.

INTRODUCTION

Strawberries, scientifically known as Fragaria x ananassa, are a type of herbal fruit first discovered in Chile, America (Ahmed et al., 2007).. Strawberries contain fat and protein, with the main content being 91% water and 7.7% carbohydrates, vitamin C, vitamin B9 (folate), vitamin B6, vitamin K, vitamin E, and the minerals iron, magnesium, phosphorus, copper, and potassium. Strawberries also contain antioxidants that are beneficial for the body, particularly pelargonidin, ellagic acid, ellagitannins, and procyanidins. The high antioxidant content in this fruit can protect body cells from damage caused by free radicals, protect the liver, and have anti-inflammatory properties (Halim, 2020).

According to Setyorini and Probosari (2019), the benefits of strawberries are used as a natural ingredient to overcome all dental and oral problems, including being able to inhibit salivary bacteria that stick to teeth, can remove plaque, toothpaste ingredients, prevent tooth enamel fluorosis, prevent cavities/dental caries, naturally clean teeth (self-cleaning), and clean tooth stains. Tooth stain is a pigmented layer on the surface of the teeth, one of the aesthetic problems, usually occurs due to the adhesion of food coloring, drinks such as tea/coffee, or cigarettes which leave a brown to black layer on the teeth, which occurs over a long period of time and is difficult to remove by brushing teeth (Khalisa, 2016).

According to Elly (2015), the most common extrinsic stains are: (1.) Yellow stain, which is visible as a yellowish plaque on the tooth surface, is caused by food; (2.) Brown stain, which is translucent, with a thin pellicle but is free of germs and pigmentation. It is often seen on the surface of maxillary molars and the lingual surfaces of mandibular incisors. It is caused by tea, coffee, and soy sauce; (3.) Tobacco stain, which is a cuticle deposit from cigarette smoke, adheres to bacteria on the tooth surface and is dark brown or black in color; (4.) Black stain, which is a thin black line on the oral and vestibular surfaces of teeth near the gingival contour and on the proximal surfaces, is caused by chromogenic bacteria; (5). Green stain, which is more common in primary teeth or children, contains chromogenic bacteria and is green or greenish-yellow in color.

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One of the roles of saliva pH in the condition of the oral cavity, if the saliva pH is too acidic it can increase the risk of tooth decay/cavities, whereas if the saliva pH is too alkaline it can form calculus on the teeth/tartar (Amerongen, 1992). The aim of this study was to determine the effectiveness of strawberries (Fragaria x ananassa) in reducing extrinsic stain scores and saliva pH in the academic community of the Polytechnic of Health Jakarta I.

METHOD

The method used is a Quasi Experimental research design with a pre-post experiment approach. The sample used was 60 people. Inclusion criteria with the requirement of having 12 upper and lower anterior teeth that experienced extrinsic stains were obtained by 22 people, then 38 were divided into 3 groups for gargling treatment with strawberry extract, namely with a concentration of 15%, 45% and 75% then salivary pH examination with subjects with inclusion criteria, namely a DMFT value of less than 3, not using orthodontic or prosthodontic devices, and the position of the teeth is not crowded. While the exclusion criteria are pregnant women and sensitivity to sour tastes.

The tools and materials used are strawberries, small bowls, toothbrushes, alcohol, scales, saliva collection pots, stopwatches, pH meters/litmus paper, cotton pellets, tissues, status stain paper and mouthwash cups. This study was divided into four groups:

1. Group 1 measured extrinsic stains on 12 upper and lower anterior teeth with extrinsic stains, a total of 22 individuals.
2. Group 2 measured pH at a 15% concentration on 12 individuals.
3. Group 3 measured pH at a 45% concentration on 12 individuals.
4. Group 4 measured pH at a 75% concentration on 12 individuals.
5. Two individuals withdrew from the study due to pregnancy and acid sensitivity.

To apply strawberry extract, clean, and calculate the extrinsic stain score, follow these steps:

1. Mash strawberries in a bowl or juice them, then remove the pulp.
2. Gently rub the strawberry pulp onto your teeth with a small cotton ball. Leave it on for 5 minutes, then gently brush your teeth and rinse with water.
3. Apply this twice daily for 5 consecutive days.
4. Changes in extrinsic stains are measured using the Lobene Stain Index, which measures the intensity and extent of the stain.
5. Measure the average combined score of both before and after.
6. Analyze using a paired dependent t-test.

The intensity score was calculated using the following formula:

$$\text{Intensity Score} = \frac{\text{Total intensity score}}{\text{Number of teeth examined}}$$

The extent score was calculated using the following formula:

$$\text{Extent Score} = \frac{\text{Total extent score}}{\text{Number of teeth examined}}$$

Subsequently, for each subject, the combined score was calculated and the mean value was determined. The procedure for determining salivary pH conditions using strawberry extract was conducted as follows:

1. Fresh strawberries were blended to obtain the extract. The extract was then weighed and prepared into concentrations of 15%, 45%, and 75%.
2. Salivary pH was measured before and after gargling with strawberry extract for 2 minutes in the treatment groups according to the assigned concentration.
3. The measurement was performed using a pH meter or litmus paper to determine whether the saliva was acidic, neutral, or alkaline, and was conducted for five consecutive days.

4. The average combined salivary pH value (before and after gargling) was then calculated.
5. The data were analyzed using One-Way ANOVA, followed by the Tukey post hoc test to determine the most effective concentration of strawberry extract (15%, 45%, or 75%).

RESULT

Table 1. Mean Scores of Extrinsic Stain

Stain Score	Before	After	Difference
Intensity	2.24	1.04	1.20
Extent	2.79	1.19	1.60
Combined	5.03	2.23	2.80

The examination results from 22 subjects showed the extrinsic stain scores before and after treatment with strawberry fruit, measured using the Lobene Stain Index. Based on Table 1, the mean combined score before treatment was 5.03. After treatment with mashed strawberry fruit applied to the tooth surface for 5 minutes, followed by tooth brushing twice daily for five consecutive days, a reduction in extrinsic stain scores was observed.

Table 2. Results of Paired Samples Test for Extrinsic Stain

Variable	Mean	SD	t	Sig. (2-tailed)
Intensity (0–1)	1.20	0.71	7.92	0.000
Extent (0–1)	1.60	0.73	10.29	0.000
Combined (0–1)	2.80	1.22	10.74	0.000

Based on Table 2, the p-value was 0.000 ($p < 0.05$), indicating that there were statistically significant differences between the pre-treatment and post-treatment scores in terms of intensity, extent, and combined extrinsic stain scores.

The observation results of the gargling treatment with strawberry extract were conducted on 36 subjects, who were divided into three groups: the 15% concentration group (12 subjects), the 45% concentration group (12 subjects), and the 75% concentration group (12 subjects). The difference in salivary pH before and after gargling for approximately 2 minutes was calculated over five consecutive days.

Table 3. Mean Differences in Salivary pH

Mean pH Difference	Strawberry Extract Concentration
15%	-0.08
45%	-0.12
75%	-0.03

Based on Table 3, the highest mean difference in salivary pH before and after gargling with strawberry extract was -0.03 in the 75% concentration group.

To determine the effectiveness of strawberry extract, the data were analyzed using the One-Way ANOVA test.

Table 4. One-Way ANOVA Analysis Results

Source	Sum of Squares	Mean Squares	Sig.
Between Groups	2.049	0.512	0.001
Within Groups	5.228	0.095	
Total	7.277		

Based on Table 4, the result shows $p = 0.001$ ($p < 0.05$) at a 95% confidence level, indicating that strawberry extract has a statistically significant effect on changes in salivary pH.

To determine which concentration of strawberry extract was the most effective, a Tukey post hoc test was performed.

Table 5. Tukey Test Results for Strawberry Extract

Group Comparison	Mean Difference	Sig.
Extract 15% – Extract 45%	-0.005	1.000
Extract 15% – Extract 75%	0.018	1.000
Extract 45% – Extract 15%	-0.005	1.000
Extract 45% – Extract 75%	0.013	1.000
Extract 75% – Extract 15%	-0.018	1.000
Extract 75% – Extract 45%	-0.013	1.000

Based on Table 5, the largest mean difference was observed in the 75% strawberry extract concentration when compared with the 15% concentration (0.018) and the 45% concentration (0.013). These results indicate that the 75% strawberry extract concentration was the most effective in altering salivary pH.

DISCUSSION

The mean change in extrinsic stain score before and after treatment with mashed strawberry fruit was 2.80, while the mean combined score after treatment decreased to 2.23. These findings indicate that the application of strawberry fruit was associated with a reduction in extrinsic stain scores among the study subjects.

This study demonstrated a change in color, intensity, and extent of extrinsic stains on teeth before and after treatment with mashed strawberry fruit applied by gentle rubbing on the tooth surface. The results indicate that the application of strawberry fruit contributed to the reduction of extrinsic stains. These findings are consistent with the study conducted by Karmawati (2014), which reported that the application of mashed strawberry fruit in an in vitro experiment on 32 extracted human teeth with stains resulted in cleaner tooth surfaces and a reduction in stain accumulation.

Strawberries contain ellagic acid and malic acid which act as natural whitening agents. The malic acid in strawberries acts as an oxidizing agent that can help remove extrinsic stains on the surface of tooth enamel. The use of strawberries (either in the form of fresh fruit or extract/patch) has been proven effective in increasing the brightness of tooth enamel and restoring the color of teeth that have yellowed due to coffee or tea consumption.

Therefore, this study demonstrates that strawberry extract is effective in reducing extrinsic stains, as indicated by the decrease in the mean stain index scores after treatment. This finding is consistent with the study conducted by Wutsqo (2015), which reported that there were changes in salivary pH before and after gargling with strawberry extract.

The interaction of strawberries with saliva is dynamic, initially lowering the pH but then triggering the body's natural protective mechanisms. The sour taste of strawberries stimulates the salivary glands to increase the rate of saliva flow. Although the natural pH of strawberries is quite acidic (ranging from 3.0–3.9), the process of chewing strawberries can actually increase the pH of saliva to become more alkaline after a while. The sour taste of strawberries stimulates the salivary glands to increase saliva production. Thinner saliva with a high flow rate is essential for the natural self-cleansing process.

Increased salivary flow brings more bicarbonate (buffer) system which effectively neutralizes the acidic environment in the mouth, thus helping to prevent the risk of caries. Strawberries contain the natural sweetener xylitol and polyphenol compounds that can inhibit the growth of Streptococcus mutans bacteria, thereby helping to maintain a stable oral pH and preventing the formation of caries. This fruit is rich in potassium and magnesium which supports internal pH balance and gum health.

CONCLUSION

Strawberry extract was found to be effective in reducing extrinsic dental stains, as indicated by the decrease in the mean stain index scores before and after treatment. In addition, strawberry extract at a concentration of 75% was shown to be the most effective concentration in altering salivary pH.

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