ECO-FRIENDLY EFFECTS OF ROOIBOS TEA (ASPALATHUS LINEARIS) RINSE ON SALIVA PH AND ORAL HEALTH

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ABSTRACT

Bacteria in the formation of dental caries are affected by saliva and its pH level occupy an important place. Another promiscuous consequence of low salivary pH is dental caries, an increase in the pH can ideally be produced by gargling. Because mouthwash now contains natural substances, rooibos tea or Aspalathus linearis, is one of the most preferred mouthwash. Aspalathus linearis is caffeine free, is low in tannins, is fortified with antioxidants besides having fluoride content in it; and has E6CG which may promote enhanced flow of saliva leading to raised saliva pH level. This research aimed to examine the effect of gargling Aspalathus linearis on salivary pH changes. An experimental pretest-posttest control group design was employed with two treatments: The two are Aspalathus linearis and aquades (distilled water). Paired Sample T-Test and Independent T-Test were used for data analysis. The study found that rinsing with Aspalathus linearis resulted in a significant increase in salivary pH levels, indicating its potential in promoting a less acidic oral environment. However, when compared to rinsing with aquades. This suggests that while rooibos tea can positively influence salivary pH, its effectiveness may not differ significantly from that of plain water in this context.

Keywords: aspalathus linearis, rooibos tea, gargling, salivary pH, dental caries

INTRODUCTION

Periodontal health is an essential part of the general health, well-being and quality of life of an individual. Oral health problems are largely unpreventable and are normally curable. These diseases include dental caries, periodontal diseases, tooth loss and oral cancer. The World Health Organization's Global Oral Health Status Report 2022 (Fahrion A, 2023) estimates that nearly 3.5 billion people worldwide are affected by oral diseases. Around the world 2 billion people having dental caries throughout their lifetime and 514 million children having early childhood caries. In Indonesia, the 2023 Indonesian Health Survey (SKI) reported that 82.8% of the population has dental caries, with a high prevalence of 71.7% among the 15-24 age group. Dental caries is a microbial disease affecting calcified dental tissues, characterized by demineralization of inorganic components and destruction of organic dental matter. Featherstone put forward the "Caries Balance Concept" which means that caries does not develop from one single factor but from mutual interaction of pathological factors and protective factors. Saliva is one of the protective factors.

It is also widely known that teeth are in a constant contact with saliva and depending on the quality of saliva, people may have increased susceptibility to dental caries. Saliva is a periodically secreted fluid that originate from salivary glands which are present in and around the orofacial area in the form of ducts that drain in the oral cavity. Most of the saliva is produced by the major glands which include the parotid gland, the submandibular gland and the sublingual gland. Another factor of saliva, which is in some way connected with dental caries, is pH level. Salivary pH is a measure of the acidity of saliva, with normal values ranging from 6.7 to 7.3, and a critical pH value being below 5.5. As stated by Putri (2019), low salivary pH range proved to correlate with dental caries as enamel demineralization is possible at ph levels below 5. 5 (Fachruddin et al., 2022).

The prevention of dental caries is a critical aspect of oral health, and one of the key strategies involves raising the pH level in the mouth. A higher pH environment reduces the acidity that promotes the development of caries. This can be achieved by stimulating the secretion of saliva, which naturally helps neutralize acids in the oral cavity. Saliva plays a protective role by washing away food particles and buffering acids produced by bacteria. Therefore, the enhancement of saliva production is crucial in maintaining oral hygiene and preventing caries.

There are several methods to stimulate saliva secretion, with factors such as chemical, mechanical, psychological, and thermal stimuli all playing a role. Gargling, a common mechanical method, is particularly effective in increasing saliva flow. This practice helps moisten the oral tissues and encourages the mouth's natural defense mechanisms. Moreover, gargling with specific solutions or natural products has gained traction as part of oral hygiene routines, offering both mechanical and chemical benefits.

In recent years, natural products have become increasingly popular in oral care formulations, particularly in mouthwashes. Many people seek alternatives to synthetic compounds, and natural substances with antimicrobial and antiseptic properties are in high demand. Tea, for instance, has long been recognized for its antiseptic value. Its ability to reduce bacterial load in the mouth makes it a favorable option in the prevention of dental caries. Tea is also one of the most widely consumed beverages globally, including in Indonesia, where it is a staple drink. This widespread consumption suggests that tea-based mouthwashes could be an accessible and effective method for caries prevention.

One particular type of tea, Aspalathus linearis, commonly known as rooibos, offers additional benefits for oral health. Rooibos is caffeine-free, low in tannins, and rich in antioxidants, making it a gentle yet powerful option for those concerned with both general and oral health. Notably, it contains fluoride, a mineral known to strengthen teeth and protect against dental damage. The combination of antioxidants and fluoride in rooibos tea provides a multifaceted approach to caries prevention, offering both protection from oxidative stress and reinforcement of the enamel. This positions rooibos tea as a promising natural product for inclusion in oral care regimens aimed at preventing dental caries.

Black and green tea gargling has been a focus of prior studies as a manner to assess salivary pH levels. In the work of Mardiati and Prasko in 2017, it was now shown that black and green tea solutions for gargling enhance the percentage of salivary pH. Kamalaksharappa et al's research in 2018 provided similar results. Nevertheless, there is scientific information gap related to the impact of Aspalathus linearis gargling on the salivary pH. Consequently, this research intends to fill this gap by evaluating the effects of Aspalathus linearis gargling on change in salivary pH.

METHOD

This research used pure experimental research design with pretest-posttest control group. The research population included active preclinical students of the Faculty of Dentistry in Prof. Dr. Moestopo (Beragama) University. In this research, 16 participants fulfilling the inclusion criteria agreed and enrolled themselves in the research after giving written informed consent for the research. Most of the research was carried out in the Integrated Laboratory 3, Faculty of Dentistry, Jakarta in Friday, May 31, 2024.

The inclusion criteria for the research subjects were: preclinical students active in their studies, aged 17 to 25 years on average (according to the classification of the Ministry of Health for late adolescents), participants who are willing to sign informed consent; participants with no history of smoking and/or excessive alcohol consumption and those who were not under taking any medications during the course of the research. Exclusion criteria included: respondents who were not present at the time of data collection, people who did not want to participate, smokers, alcoholics, and people taking certain medications during data collection (Bryman, 2016).

The instruments used in the research were Smart Sensor PH818 digital pH meter, personal protective equipment (PPE), 250 mL beakers, 30 mL plastic measuring cups (64 units), 10oz plastic cups (32 units), a stopwatch, a thermometer, calibration pH powder, notebooks, pens, adhesive labels, an electric stove, pots, spoons, "Numi Organic Rooibos Tea" tea bags, distilled water (aquades), and saliva samples from the participants.

Procedures

The research was conducted in a single day with two treatments: rinsing with aquades (control) and rinsing with Aspalathus linearis (treatment). The procedures were as follows:

Aquades Treatment:
320 mL of aquades was prepared. Participants were instructed to sit upright with their heads slightly tilted forward. Saliva samples were collected before the treatment using the spitting method until 5 mL was obtained (Ahmad et al., 2017). Each participant received a 20 mL cup of aquades and was instructed to gargle for 30 seconds. Post-treatment saliva samples were collected again using the spitting method into a 5 mL measuring cup.

Aspalathus linearis Treatment:
Aspalathus linearis was prepared by brewing 9.6 grams of tea in 384 mL of warm water at 80°C and stirring until room temperature was reached (Bechir et al., 2022). Saliva samples were collected before treatment using the spitting

method into a 5 mL measuring cup. Each participant received a 20 mL cup of Aspalathus linearis and was instructed to gargle for 30 seconds. Post-treatment saliva samples were collected using the same method.
The pH level of the collected saliva samples was measured using a digital pH meter, and the results were recorded for further analysis.

Data Analysis

The data were analyzed using statistical methods. If the data were normally distributed (as determined by the Shapiro-Wilk test), a Paired Sample T-Test was performed to determine the effect of both treatments on salivary pH (Laerd Statistics, 2018). The Independent T-Test was employed to compare the differences between the aquades and Aspalathus linearis treatments. Ethical approval for the research was granted by the Research Ethics Committee of the Faculty of Dentistry, Prof. Dr. Moestopo (Beragama) University (No: 8/KEPK/FKGUPDMB/IV/2024).

RESULTS AND DISCUSSION

Result

The outcomes of the current research are displaying the impact of washing with Aspalathus linearis and aquades on oral pH value. Descriptive statistical analysis was conducted to identify the characteristics of the data collected. The average pH values and standard deviations for both treatments, aquades and Aspalathus linearis, are provided in Table 1.

Table 1. Average pH of Saliva before and after gargling with aquades and aspalathus linearis

	Mean ± SD Saliva pH Before Treatment	**Mean ± SD Saliva pH After Treatment**
Aquades	7,9888 ± 0,25445	8,1094 ± 0,12835
Aspalathus linearis	8,0863 ± 0,14151	8,1388 ± 0,15019

Table 1 shows the average pH of saliva before and after rinsing with aquades. The average salivary pH before rinsing was 7.9888 ± 0.25445, while the pH after rinsing increased to 8.1094 ± 0.12835. Similarly, the pH of saliva before and after rinsing with Aspalathus linearis. The average pH before rinsing was 8.0863 ± 0.14151, and after rinsing, it increased to 8.1388 ± 0.15019.

To determine if the data followed a normal distribution, the Shapiro-Wilk Test was applied, as shown in Table 2. The test results indicate that all data sets (both before and after rinsing) for both treatments (aquades and Aspalathus linearis) were normally distributed ($p > 0.05$).

Table 2. Data normality test (Shapiro-Wilk Test)

	Group	**n**	**P-value**
Aquades	pH before	16	0,989
	pH after	16	0,327
Aspalathus linearis	pH before	16	0,512
	pH after	16	0,786

Next, a paired sample t-test was conducted to analyze the changes in salivary pH before and after treatment with each solution (Table 3). The p-values for both treatments were statistically significant, with $p = 0.029$ for aquades and $p = 0.017$ for Aspalathus linearis, indicating that rinsing with both solutions led to a significant increase in salivary pH.

Table 3. Parametric statistical test (Paired T-Test)

	pH Before-pH After Treatment	**P-value**
Aquades	35.251	0,029
Aspalathus linearis	782,12	0,017

Finally, an independent t-test was conducted to compare the salivary pH after treatment with aquades and Aspalathus linearis (Table 4). The p-value of 0.556 ($p > 0.05$) indicates that there was no statistically significant difference in salivary pH between the two treatments. Based on these studies, it can be concluded that, aquades and Aspalathus linearis was efficient in raising the salivary pH though the effectiveness were almost similar.

Table 4. Parametric statistical test (Unpaired T-Test)

	P-value
Saliva pH after Treatment between Aquades and Aspalathus linearis	0,556

Discussion

The aim of this research was to provide information on the effect of gargling with Aspalathus linearis on salivary pH changes so that the public can understand its benefits for oral health. The research used a pretest-posttest control group experimental design to observe the influence of Aspalathus linearis on salivary pH before and after treatment. A total of 16 subjects participated, with 64 samples divided into two groups: one gargling with aquades while the other one gargling with Aspalathus linearis. The human saliva used was collected from preclinical students at the Faculty of Dentistry, UPDM(B), who met the inclusion criteria and provided informed consent.

In the course of the research, it was realised that Aspalathus linearis could elevate the salivary pH. The average pH before gargling with Aspalathus linearis was 8.0863, and after gargling, it increased to 8.1388. Statistical analysis using the paired sample t-test showed a significant difference in pH values before and after gargling with Aspalathus linearis, with a p-value of 0.017 ($p < 0.05$), confirming that Aspalathus linearis significantly alters salivary pH. The average pH values observed were higher than the normal range of 6.7-7.3, likely due to the research being conducted after 12 p.m., which aligns with the circadian rhythm of saliva pH. Saliva pH tends to peak in the late afternoon and reach its minimum in the early morning (Nishimachi et al., 2019).

Only Aspalathus linearis is found to have very low tannins and zero caffeine and it has very high antioxidant activity. These antioxidant effects must be traced to its polyphenol content especially Aspalathin which is the most abundant polyphenol in the Aspalathus linearis (Xiao et al., 2020). Compared to Camellia sinensis, Aspalathus linearis has a lower tannin content, which can prevent mineral absorption like iron when consumed in excess (Yuyama et al., 2020). Besides, it has been established that Aspalathus linearis harbours anticariogenic potential, thus its potential to support dental health (Szmagara et al., 2022).

Rooibos tea (Aspalathus linearis), as a herbal tea, is generally known to stimulate the secretion of saliva and can alleviate subjective and objective symptoms of dry mouth, eyes, and skin with continuous consumption (Nishimachi et al., 2019). In addition, other research has indicated that parts of Aspalathus linearis, especially eriodictyol-6-C-β-D-glucoside (E6CG), can activate the M3 muscarinic acetylcholine receptor (M3R), stimulating saliva secretion (Yuyama et al., 2020). This causes an increase in saliva production that may in turn increase the rate of saliva flow, enhancing the buffering capacity of saliva and subsequently increasing its pH (Arakaki et al., 2019).

The mechanical stimulation that was caused by gargling also enhance salivary secretion as highlighted in the previous studies involving green tea where there was an increase in salivary pH as a result of mechanical stimulation of the salivary glands (Halboub et al., 2020). Rinsing reaches areas of the oral cavity which brushing does not reach and reduces debris that may be left behind within the mouth (Meylia & Rimbyastuti, 2014). Herbal mouthwashes, like those containing Aspalathus linearis, are gaining popularity due to their safety and natural composition, as they lack the cytotoxicity of chemical-based mouthwashes (Ramamoorthy et al., 2021).

Saliva's pH is a critical factor in preventing dental caries, periodontal disease, and other oral health issues. A pH between 6.5 and 7.5 promotes bacterial growth, while a pH below 5.5 fosters the proliferation of acidogenic bacteria like Streptococcus mutans and Lactobacillus, which can lead to tooth demineralization (Keumala, 2017). An increase in pH promotes remineralization, protecting against dental caries (Xiao et al., 2020).

Interestingly, the control group, gargling with aquades, also showed a slight increase in pH. The average salivary pH before gargling with aquades was 7.9888, rising to 8.1094 afterward. This change aligns with previous studies indicating that even neutral substances like aquades can increase salivary pH due to the mechanical stimulation of saliva production (Meylia & Rimbyastuti, 2014).

Finally, while the independent t-test revealed no significant difference in salivary pH between the Aspalathus linearis and aquades groups ($p = 0.556 > 0.05$), this may be attributed to the low fluoride content in Aspalathus linearis, as fluoride is crucial for preventing dental decay (Szmagara et al., 2022). Factors such as oral hygiene, stress, temperature, environmental contamination, and measurement errors could have introduced biases in the results.

CONCLUSION

Aspalathus linearis, commonly known as rooibos, has been identified for its potential impact on oral health, particularly in regulating salivary pH. This study reveals that rinsing with Aspalathus linearis can stimulate an increase in salivary secretion. As saliva plays a crucial role in neutralizing acids and maintaining oral health, an increase in its secretion can potentially reduce the risk of dental caries. Saliva acts as a natural buffer, helping to mitigate the harmful effects of bacterial acids that contribute to tooth decay, and thus, any agent that enhances its flow could offer protective benefits.

However, the findings of this research present a more nuanced perspective when comparing the effects of Aspalathus linearis with water (aquades). Although the herb seems to enhance saliva production, its direct influence on salivary pH levels does not significantly differ from the effects of a simple water rinse. Both Aspalathus linearis and aquades produced similar outcomes in terms of maintaining salivary pH, indicating that while the herb may have other health benefits, its role in altering pH is limited under the conditions studied.

The implications of these results suggest that while Aspalathus linearis can be beneficial in stimulating saliva, its specific contribution to modulating salivary pH—and thus directly reducing dental caries risk—requires further investigation. The comparable effects of water and rooibos on pH raise important questions about the mechanisms involved in salivary regulation. More extensive research is needed to determine whether different concentrations or forms of Aspalathus linearis could yield more pronounced effects on oral health, particularly in altering salivary pH levels.

Factors such as oral hygiene, environmental conditions, and the timing of sample collection may have influenced the results. Poor oral hygiene can alter bacterial activity, which affects salivary pH, while environmental conditions like temperature and air contamination during saliva collection may introduce variability. Additionally, factors like circadian rhythms, stress, hydration, and recent food intake can also impact salivary pH measurements.

Such factors must be controlled by future studies for enhancement of the results being generated. Further research is recommended to explore other potential benefits of Aspalathus linearis for oral health and to investigate its efficacy as a natural ingredient in mouthwash formulations. Participants should also be asked to brush their teeth before the research and salivary pH should be measured immediately to reduce effecting environmental factors.

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