

SALIVARY PH MODULATION WITH BETEL LEAF MOUTHWASH IN SMOKING-RELATED PERIODONTITIS

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ABSTRACT

Background: Saliva is one of the determinants of oral conditions and is easily available as a method of diagnosing and controlling periodontal disease. Smoking is also one of the causes of periodontitis. Periodontitis is a multifactorial chronic inflammatory disease associated with the accumulation of dental plaque (biofilm), and is characterized by progressive damage to the tissues supporting the teeth, including the periodontal ligament and alveolar bone. Periodontitis can be minimized by using betel leaf (*Piper betle* L.) herbal mouthwash, which has been proven to have many properties with minimal side effects. **Objective:** This study aims to determine whether there are differences in salivary pH before and after gargling with betel leaf mouthwash (*Piper betle* L.) in periodontitis patients with smoking habits. **Methods:** The study used an experimental design with a pretest-posttest control group design. The sampling technique used was purposive sampling. **Results:** The results showed that the average salivary pH of respondents increased from 5.8 before gargling with betel leaf mouthwash to 7.1 after gargling. **Conclusion:** Gargling using betel leaf mouthwash (*Piper betle* L.) can increase salivary pH and is effective in stabilizing salivary pH for periodontitis patients with smoking habits

Keywords: Periodontitis, Smokers, Saliva pH, Betel Leaf (*Piper betle* L.).

1. INTRODUCTION

Periodontal Oral health can be affected by many different indicators, including saliva, a complex, clear fluid produced by the salivary glands, which is an important component in maintaining oral homeostasis. The components of saliva include 99.5% water and 0.5% a mixture of salts, organic substances and inorganic substances. Organic substances in saliva include proteins such as amylase, mucin, histatin, cystatin, peroxidase, lysozyme, and lactoferrin, as well as lipids, glucose, amino acids, ammonia, vitamins, and fatty acids. In addition, inorganic substances in saliva include sodium, calcium, chloride, magnesium, bicarbonate, and potassium phosphate. (Kumar et al., 2017; Saitou et al., 2020)

Saliva functions to assist mastication and protect tissues by maintaining balance in the mouth through mechanical cleaning to minimize the buildup of dental plaque. (Haripa et al., 2019) The protective effect of saliva in its ability to neutralize the pH of the oral cavity as well as its ability to neutralize the pH of the oral cavity, clears food debris in the oral cavity. The normal range of salivary pH is 6.2-7.6, with 6.7 being the average pH. (Singh et al., 2017)

Periodontitis is a multifactorial chronic inflammatory disease associated with the build-up of dental plaque (biofilm), characterized by progressive destruction of the tissues supporting the teeth. (Sanz et al., 2017; Slots, 2017) In 1999, the AAP identified three types of periodontitis, including necrotizing periodontitis, periodontitis presenting as a symptom of systemic disease, and a form of the disease previously known as chronic or aggressive periodontitis. Now, all of these forms are combined under a similar category, periodontitis. The new classification focuses on determining the severity (stage), severity of inflammation (classification), and spread (extent). (Caton et al., 2018)

Chlorhexidine mouthwash is an antimicrobial agent that is predominantly used to maintain oral hygiene, reduce plaque formation, and treat oral diseases. However, long-term use of chlorhexidine has various side effects, such as staining on the teeth, a burning sensation, and taste changes. Alternatively, Betel Leaf can be used for its antiseptic and antimicrobial properties, which help reduce inflammation in the gums and surrounding areas. (Kaveti et al., 2016)

In recent years, there has been increasing interest in the use of natural products as alternative or adjunctive therapies in periodontal care. Plant-based agents are attractive because of their biocompatibility, availability, and multiple bioactive compounds with antimicrobial, antioxidant, and anti-inflammatory properties. Betel leaf (*Piper betle* L.), in particular, has been reported to contain phytochemicals such as hydroxychavicol, chavibetol, and eugenol, which exhibit broad-spectrum antibacterial activity against oral pathogens including *Streptococcus mutans* and *Porphyromonas gingivalis*. (Chakraborty & Shah, 2011) These compounds not only suppress bacterial growth but also modulate oxidative stress and inflammatory responses, thereby contributing to improved periodontal health. Incorporating betel leaf into oral hygiene practices, such as mouthwash formulations, may therefore offer a promising and safer alternative to conventional chemical agents.

2. METHODS

This research is a type of experimental research with a *pre-test post-test design*. This research was conducted at the Faculty of Dentistry, Universitas Prof. Dr. Moestopo (Beragama), Jakarta, from June 19 to 28, 2024. The sample consisted of 32 patients of RSGM UPDM (B) who had met the inclusion criteria. The subjects were explained the objectives and flow of the research and were asked to agree to their participation through *informed consent*. Subjects were instructed to collect 5 ml of saliva into a saliva container, and then an initial saliva pH measurement was carried out using a pH meter. Subjects in the treatment group were instructed to gargle with betel leaf mouthwash at the rate of 10 ml for 30 seconds.

Subjects in the control group were instructed to gargle with chlorhexidine 0.2% mouthwash at a dose of 10 ml for 30 seconds. Furthermore, the two groups of subjects waited for 5 minutes, then the saliva was collected back into the saliva container to be measured after the treatment using a pH meter.

3. RESULTS AND DISCUSSION

A total of 32 subjects were divided into two groups, namely the treatment group and the control group. The treatment group of 16 people gargled with betel leaf mouthwash and the control group of 16 people gargled with chlorhexidine mouthwash 0.2%. The distribution of subjects in these groups is as follows:

Table 1. Frequency Distribution of Subjects by Gender

Gender	Frequency	Percentage (%)
Man	27	84,4%
Woman	5	15,6%
Total	32	100%

Based on table 1, it shows that subjects with male gender are more dominant, namely 27 people with a percentage of 84.4% compared to subjects with female gender, namely 5 people with a percentage of 15.6%.

Table 2. Distribution of subjects by age

Age	Frequency	Percentage (%)
40 Years	2	6,3%
41 Years	1	3,1%
42 Years	1	3,1%
43 years	4	12,5%
44 Years	2	6,3%
45 Years	2	3,1%
46 Years	2	6,3%
47 Years	1	3,1%
48 years	1	3,1%
49 Years	1	6,3%
50 Years	1	3,1%

52 Years	2	6,3%
53 Years	2	6,3%
54 Years	2	6,3%
56 Years	2	6,3%
57 Years	2	6,3%
64 years	1	3,1%
67 years	1	3,1%
68 Years	2	6,3%
Total	32	100%

In table 2. showed that the distribution of the research sample based on the most age was 43 years as many as 4 people with a percentage of 12.5% and the least age sample was 41 years, 42 years, 45 years, 47 years, 48 years, 50 years, 64 years and 67 years, which was 1 person each with a percentage of 3.1%.

Table 3. Average pH of Saliva Before and After Treatment in Both Groups

Group	N	Initial pH	Final pH	Difference
First Group (Betel Leaf)	16	5.8944	7.1600	1.2656
Second Group (Chlorhexidine 0.2%)	16	5.7556	8.0481	2.2925

Table 3 showed that the average pH value of saliva before gargling using betel leaf mouthwash was 5.8944, and after gargling with betel leaf mouthwash, it was 7.1600, so the average difference in saliva pH before and after gargling using betel leaf mouthwash is 1.2656. The average pH value of saliva before gargling with chlorhexidine 0.2% was 5.7556, and after gargling with chlorhexidine 0.2% was 8.0481, so the average pH difference between saliva before and after gargling with chlorhexidine 0.2% was 2.2925.

Table 4. Normality Test Results

Variable	n	P Value	
		Before Treatment	After Treatment
Betel Leaf	16	0.018	0.532
Chlorhexidine 0.2%	16	0.017	0.064

Table 4 shows the results of the normality test of saliva pH data before and after gargling with betel leaf mouthwash and chlorhexidine 0.2%. Before treatment, a significance value below 0.05 (<0.05) indicates that the data distribution is abnormal. However, after treatment, a significance value above 0.05 (>0.05) indicates that the data distribution is considered normal.

Table 5. pH Value Before and After Gargling Betel Leaf

pH Value	Median (Minimum-Maximum)	p-value
Before Gargling Betel Leaf	5.99 (5.12-6.21)	<0.001*
After Gargling Betrl Leaf	7.15 (6.77-7.50)	

*Significant, wilcoxon sign rank test

Table 5. showed that gargling with betel leaf mouthwash, the pH of saliva before gargling had a median value of 5.99 with a range of 5.12 to 6.21. After gargling with betel leaf mouthwash, the median pH of saliva increased to 7.15 with a range of 6.77 to 7.50. A p-value of less than 0.001 indicates that this increase in pH is statistically significant.

Table 6. pH Value Before and After Gargling Chlorhexidine

pH Value	Median (Minimum-Maximum)	P value
Pre-Gargle pH Chlorhexidine 0.2%	5.76 (5.36 - 6.14)	<0.001
Chlorhexidine After Gargling pH 0.2%	8.15 (7.05 - 8.73)	

Table 6. shows that gargling with chlorhexidine 0.2%, the pH of saliva before gargling has a median value of 5.76 with a range of 5.36 to 6.14. After gargling with 0.2% chlorhexidine, the median saliva pH increased more significantly to 8.15 with a range of 7.05 to 8.73. Just like in betel leaf mouthwash, a p-value of less than 0.001 indicates a statistically significant increase in pH.

The p-value in both groups was <.001, where this value was smaller than the significance value of 0.05 (<0.05), so it can be concluded that there was a difference in the results before and after gargling with betel leaf and chlorhexidine solutions. It can be concluded that gargling with betel leaf mouthwash and chlorhexidine can increase salivary pH.

DISCUSSION

This study aims to determine the difference in saliva pH before and after the use betel leaf mouthwash (*Piper betle* L.) and chlorhexidine 0.2% in 32 patients at the Dental and Oral Hospital of Prof. Dr. Moestopo University. The results of the study showed that male respondents dominated with 27 out of 32 respondents (84.4%), which is in line with RISKESDAS data which revealed that 62.9% of men in Indonesia are smokers. (Kementerian Kesehatan Republik Indonesia, 2018) 43-year-old individuals dominated with 4 people (12.5%), who generally had a longer smoking history.(Harapan et al., 2020)

The results showed that the average pH value of saliva before gargling with betel leaf mouthwash was 5.8944, and after gargling it became 7.1600, with a pH difference of 1.2656, indicating a normal pH (6.7-7.4). Meanwhile, the average pH value of saliva before gargling with chlorhexidine 0.2% was 5.7556, and after gargling it was 8.0481, with a pH difference of 2.2925, indicating an alkaline pH. Betel leaf is effective in increasing salivary pH to normal due to the phenol and flavonoid compounds contained, in accordance with previous studies such as Ariyani *et al.* (2014) and Wilis *et al.* (2017), which support its effectiveness in maintaining salivary pH.(Ariyani et al., 2016; Rohmawati & Santik, 2019; Wilis & Andriani, 2017) Meanwhile, chlorhexidine 0.2% increases pH but can disrupt the balance of the oral microbiome if used in the long term due to its high pH buffering capacity, as shown by the study by Yaghobee *et al.* (2019).(Yaghobee et al., 2019)

Maintaining salivary pH within the neutral range is essential for oral health. A salivary pH below the critical threshold of 5.5 is known to facilitate enamel demineralization and accelerate the risk of dental caries (Featherstone, 2008).(Featherstone, 2008) Therefore, as shown by study of Pradhan *et al.* (2013) the increase observed after the use of betel leaf mouthwash may provide protective benefits by reducing enamel dissolution and enhancing remineralization. Betel leaf (*Piper betle* L.) contains bioactive compounds such as phenols, flavonoids, and alkaloids, which exhibit antimicrobial and antioxidant properties.(Pradhan et al., 2013) These compounds may reduce the metabolic activity of acidogenic bacteria such as *Streptococcus mutans* and *Lactobacillus* spp., thereby decreasing acid production in the oral cavity. The observed alkalinizing effect is consistent with this mechanism, as the suppression of bacterial acidogenesis contributes to a more stable and neutral oral environment. Several previous studies have reported similar outcomes, where natural plant extracts were shown to elevate salivary pH and inhibit cariogenic microorganisms.(Saikia et al., 2024) The present results support the potential application of betel leaf

mouthwash as a complementary strategy in preventive dentistry, particularly in communities with limited access to conventional chemical mouthrinses.

CONCLUSIONS

Based on the results of the study, it can be concluded that gargling with betel leaf mouthwash (*Piper betle* L.) and chlorhexidine 0.2% can increase the pH of saliva in patients with periodontitis who smoke. Before gargling, the average pH was 5.89 with betel leaf and 5.75 with chlorhexidine. After gargling, the pH increased to 7.16 with betel leaf and 8.04 with chlorhexidine. Betel leaf stabilizes the pH within the normal range, while chlorhexidine makes it more alkaline, which can disrupt the balance of the oral microbiome if used over a long period. It is recommended to conduct further research with a larger sample and a longer period of time, and a balanced gender and age distribution. For periodontitis sufferers who smoke, using betel leaf mouthwash regularly as part of daily oral care can help balance salivary pH and reduce the risk of tooth decay and inflammation in periodontal tissues. It is also recommended to look at changes in pH by using betel leaf decoction water. In summary, gargling with betel leaf mouthwash significantly increased salivary pH, demonstrating both statistical and clinical relevance. This finding highlights its potential as a natural adjunct for maintaining oral pH balance, reducing caries risk, and promoting oral health.

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