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Gargling with Boiled Red Ginger *(Zingiber Officinale Var. Rubrum)* Water on Changes in Saliva pH

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ABSTRACT

Salivary pH plays an important role in maintaining the balance of the oral environment and preventing dental caries. A decrease in salivary pH accelerates enamel demineralization; therefore, efforts to increase salivary pH are needed. Red ginger) contains bioactive compounds with antibacterial properties and can stimulate salivary secretion, making it a potential natural mouthwash. This study aimed to analyze the effect of gargling with boiled red ginger water on changes in salivary pH among residents of Dilib Lamteungoh Village, Aceh Besar Regency. Methods A quasi-experimental study with a pretest-posttest control group design was conducted involving 54 respondents selected through purposive sampling. Participants were divided into an intervention group and a control group. The intervention group gargled with 10 ml of boiled red ginger water for 30 seconds, while the control group gargled with mineral water. Salivary pH was measured. before and after treatment using a digital pH meter. Data were analyzed using Paired t-test and Independent t-test with a significance level of 0.05. The mean salivary pH in the intervention group increased from 6.0 ± 0.2 to 7.1 ± 0.2, while the control group increased from 5.7 ± 0.5 to 6.6 ± 0.1. Statistical analysis showed a significant difference before and after treatment, with a greater increase in salivary pH observed in the intervention group (p=0.000). Gargling with boiled red ginger water significantly increased salivary pH and was more effective than gargling with mineral water. Boiled red ginger water may be considered a natural alternative for maintaining oral health.

INTRODUCTION

Oral health is an integral component of overall health that enables individuals to eat, speak, and interact socially without disruption. One of the primary factors contributing to various oral diseases is dental plaque, a soft deposit attached to the tooth surface composed of an accumulation of microorganisms within a cellular matrix (Pay et al., 2017). Uncontrolled plaque accumulation increases the bacterial load in the oral cavity, thereby triggering enamel demineralization and eventually leading to dental caries (Sitanaya et al., 2023; Rahma et al., 2025). The World Health Organization reported that approximately 3.5 billion people worldwide suffer from oral diseases, with approximately 2.3 billion individuals affected by permanent tooth caries and over 514 million children suffering from primary tooth caries (World Health Organization, 2022). These data indicate that dental caries remains a major public health problem with a remarkably high prevalence.

Indonesia continues to face a heavy burden of oral diseases. The results of the 2018 National Basic Health Research showed that 57.6% of the population experienced dental and oral health issues, with 45.3% suffering from active caries and an overall caries experience prevalence reaching 88.8% (Kemenkes RI, 2018). Aceh Province presents a similar trend, with a prevalence of oral health problems standing at 55%. An oral health examination conducted on the community of Dilib Lamteungoh Village revealed that 59 out of 65 respondents had caries, yielding a prevalence of 90.77% (Nazilla et al., 2025). Furthermore, preliminary survey findings demonstrated an average salivary pH of 5.83 among residents, with 70% of respondents exhibiting salivary pH levels below the normal range (<6.7). An acidic salivary environment elevates the risk of enamel demineralization and accelerates the onset of dental caries (Sitanaya et al., 2023).

Salivary pH plays an essential role in preserving the balance of the oral cavity ecosystem. Saliva functions as a buffer system, aids in the mechanical clearance of the oral cavity, and supplies essential minerals required for enamel remineralization (Annapoorna & Datta, 2020). A decline in salivary pH to a critical threshold of approximately 5.5–5.7 causes demineralization to proceed faster than

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remineralization, thereby heightening caries risk (Sitanaya et al., 2023). A neutral or slightly alkaline salivary pH suppresses the proliferation of cariogenic bacteria, including Streptococcus mutans, thereby reducing acid formation within dental plaque (Vahira et al., 2025).

Plaque control is primarily achieved through tooth brushing, which can be augmented by the use of mouthwash. Chemical mouthwashes are proven effective in inhibiting microbial growth and reducing plaque accumulation; however, long-term use may induce adverse effects, such as mucosal irritation, taste alteration, and disruption of normal oral microflora balance (Deshpande et al., 2021). Consequently, the utilization of natural ingredients as mouthwash alternatives has gained increasing attention, as they are considered safer, readily accessible, and associated with lower risks of side effects. Boiled red ginger (Zingiber officinale var. rubrum) water represents one such natural material with potential application in oral healthcare.

Red ginger contains various bioactive compounds, such as gingerol, shogaol, flavonoids, oleoresin, and essential oils, which display antibacterial activity against various microorganisms responsible for plaque formation and oral diseases (Ahmed et al., 2022; Lukita, S. et al., 2021). A study by (Isramilda & Nisa, 2024) demonstrated that red ginger extract effectively inhibits the growth of Staphylococcus aureus. Moreover, the distinct aroma of essential oils in red ginger can stimulate salivary flow rate, thereby assisting in maintaining oral pH balance (Sitanaya et al., 2023; Rahma et al., 2025). Research by (Sitanaya et al., 2023) indicated that gargling with boiled red ginger water increased salivary pH, while (Oak et al., 2023) reported an increase in mean salivary pH from 6.647 to 7.274 after gargling with infused red ginger water.

Despite these benefits, the practical application of boiled red ginger water as a natural mouthwash in rural communities remains relatively limited. Residents of Dilib Lamteungoh Village generally recognize red ginger only as a warming beverage and a traditional remedy for colds, coughs, or pain, remaining unaware of its utility as a gargling solution to elevate salivary pH. Furthermore, studies investigating the effect of gargling with boiled red ginger water on salivary pH changes in this specific community have not been previously reported. This underscores the necessity for research to provide scientific evidence regarding the utilization of red ginger as a simple, safe, and viable promotive and preventive alternative for maintaining oral health. This study aimed to determine the effect of gargling with boiled red ginger (Zingiber officinale var. rubrum) water on changes in salivary pH among residents of Dilib Lamteungoh Village, Sukamakmur District, Aceh Besar Regency. The findings are expected to establish a foundation for utilizing natural materials as an accessible and safe strategy to increase salivary pH and support oral health maintenance in the community.

METHOD

This study employed a quasi-experimental design with a pretest-posttest control group approach to evaluate the effect of gargling with boiled red ginger (*Zingiber officinale* var. *rubrum*) water on salivary pH changes. The investigation was conducted in Dilib Lamteungoh Village, Sukamakmur District, Aceh Besar Regency, from April 30 to May 2, 2026. The target population comprised productive-age individuals (15–64 years) meeting specified inclusion and exclusion criteria. A sample size of 54 respondents was selected using purposive sampling, calculated using Lemeshow's formula with a finite population correction. Participants were assigned into two equal groups: an intervention group that gargled with boiled red ginger water and a control group that gargled with mineral water as a comparative standard.

The boiled red ginger water was prepared by washing and crushing 50 g of fresh red ginger rhizomes, which were subsequently boiled in 500 mL of water for approximately 25 minutes. The preparation was filtered and allowed to cool to room temperature. Each participant in the intervention group gargled with 10 mL of the boiled red ginger solution for 30 seconds, while participants in the control group gargled with 10 mL of mineral water for the same duration. Salivary pH levels were measured immediately before (pretest) and after (posttest) intervention using a digital pH meter. Saliva collection was carried out using the spitting method, wherein respondents accumulated unstimulated saliva in the floor of the mouth and spat it into a sterile container for immediate pH evaluation.

RESULT

Table 1. Frequency Distribution of Respondents by Age

Age Group (Years)	Frequency (f)	Percentage (%)
15–25	15	27.78
26–35	18	33.33
36–45	19	35.19
46–55	2	3.70
56–65	0	0.00
Total	54	100.00

As presented in Table 1, the majority of respondents belonged to the 36–45 age bracket (35.19%, *n* = 19), followed by the 26–35 age group (33.33%, *n* = 18), and the 15–25 age group (27.78%, *n* = 15). Only 2 respondents (3.70%) were aged 46–55 years, and no participants were in the 56–65 age range. This distribution indicates that all participants were in their productive years, a period during which salivary gland function remains physiologically preserved, rendering them suitable subjects for evaluating salivary pH changes.

Table 2. Frequency Distribution of Respondents by Sex

Sex	Frequency (f)	Percentage (%)
Male	1	2.0
Female	53	98.0
Total	54	100.0

Table 2 shows that the vast majority of participants were female (98.0%, *n* = 53), while male participants accounted for only 2.0% (*n* = 1). This indicates a predominant female representation in the study sample.

Table 3. Distribution of Salivary pH Categories Pre- and Post-Treatment

Group	pH Category	Frequency (f)	Percentage (%)
Control (Pre-test)	Acidic	27	100.0
	Neutral	0	0.0
	Alkaline	0	0.0
Control (Post-test)	Acidic	18	66.7
	Neutral	9	33.3
	Alkaline	0	0.0
Intervention (Pre-test)	Acidic	27	100.0
	Neutral	0	0.0
	Alkaline	0	0.0
Intervention (Post-test)	Acidic	0	0.0
	Neutral	19	70.4
	Alkaline	8	29.6

Table 3 illustrates that prior to intervention, 100% of respondents in both the control and intervention groups exhibited acidic salivary pH levels. Following gargling with mineral water, the control group remained predominantly acidic (66.7%, *n* = 18), though 33.3% (*n* = 9) shifted to the neutral category; no participants reached alkaline status. In contrast, following gargling with boiled red ginger water, all respondents in the intervention group showed an elevation in salivary pH, with 70.4% (*n* = 19) achieving neutral pH and 29.6% (*n* = 8) shifting to the alkaline category. These results demonstrate a more pronounced favorable shift in salivary pH categorization following red ginger gargling compared to mineral water.

Table 4. Shapiro–Wilk Normality Test Results

Variable	p-value	Interpretation
Intervention (Pre-test)	0.755	Normally Distributed
Intervention (Post-test)	0.760	Normally Distributed
Control (Pre-test)	0.379	Normally Distributed
Control (Post-test)	0.998	Normally Distributed

Based on the Shapiro–Wilk normality test results in Table 4, all datasets yielded *p*-values greater than 0.05 (0.755 and 0.760 for the intervention group; 0.379 and 0.998 for the control group). These findings confirm that the data were normally distributed, thereby meeting the assumptions for parametric statistical testing using *t*-tests.

Table 5. Comparison of Mean Salivary pH Between Intervention and Control Groups

Group	Mean	Standard Deviation (SD)	p-value
Intervention (Pre-test)	6.0315	0.22576	0.001
Control (Pre-test)	5.6596	0.46533	
Intervention (Post-test)	7.1152	0.15210	0.000
Control (Post-test)	6.6041	0.12995	

As detailed in Table 5, the baseline mean salivary pH was 6.03 in the intervention group and 5.66 in the control group. Following treatment, the mean salivary pH rose to 7.12 in the intervention group and 6.60 in the control group. The Independent *t*-test revealed a statistically significant difference between the two groups post-treatment ($p < 0.05$), indicating that gargling with boiled red ginger water produced a significantly higher elevation in salivary pH than gargling with mineral water.

Table 6. Mean Salivary pH Changes Pre- and Post-Treatment (Paired *t*-test)

Group	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	Mean Difference	t-value	p-value
Intervention (Red Ginger)	6.0315 ± 0.22576	7.1152 ± 0.15210	1.08370	-47.485	0.000
Control (Mineral Water)	5.6596 ± 0.46533	6.6041 ± 0.12995	0.94444	-12.812	0.000

The Paired *t*-test analysis in Table 6 demonstrates that the mean salivary pH in the intervention group increased from 6.0 ± 0.2 prior to treatment to 7.1 ± 0.2 after gargling with red ginger water, representing a mean increase of 1.08. This change was statistically significant ($p = 0.000$). In the control group, the mean salivary pH also increased from 5.7 ± 0.5 to 6.6 ± 0.1 after gargling with mineral water, with a mean difference of 0.94 ($p = 0.000$). Although both interventions yielded statistically significant increases, the magnitude of pH elevation was markedly higher in the red ginger intervention group, establishing its superior efficacy.

DISCUSSION

The results of this study demonstrate a significant increase in mean salivary pH after respondents gargled with boiled red ginger water compared to the control group gargling with mineral water. Shapiro–Wilk testing confirmed the normal distribution of the data ($p > 0.05$), justifying the application of parametric Independent *t*-tests. The statistical analysis yielded a *p*-value of 0.000 ($p < 0.05$), confirming a significant difference in salivary pH changes between the intervention and control groups. These findings affirm that gargling with boiled red ginger water significantly enhances salivary pH among residents in Dilib Lamteungoh Village, Aceh Besar Regency. In the intervention group, baseline salivary pH averaged 6.0 (acidic status). Post-intervention, the mean pH rose to 7.1, shifting into the neutral-to-slightly-alkaline range. While the control group also experienced an increase in mean pH from 5.7 to 6.6, the magnitude of change was less pronounced. This highlights that boiled red ginger water exhibits superior efficacy in elevating salivary pH compared to standard mineral water.

The marked increase in salivary pH within the intervention group is attributed to active bioactive compounds in red ginger that stimulate salivary secretion, thereby enhancing salivary buffering capacity (Jumain et al., 2022). Saliva houses essential buffer systems—principally bicarbonate, phosphate, and

protein systems—that act to maintain intraoral pH equilibrium. As salivary output increases, its capacity to neutralize organic acids improves, prompting a shift toward neutral or alkaline conditions (Can & Güvenç, 2025). The characteristic pungency and thermal sensation of red ginger are presumed to act as gustatory stimuli that trigger salivary gland activity. Enhanced salivary flow rates elevate bicarbonate concentrations, strengthening buffer capacity and promoting intraoral stability.

Furthermore, the bioactive constituents of red ginger—including gingerol, shogaol, flavonoids, and essential oils—exhibit distinct antibacterial properties capable of inhibiting acidogenic oral bacteria, notably *Streptococcus mutans* (Nuraini et al., 2024). Suppressing acid-producing bacterial activity reduces acid accumulation in plaque, favoring a more neutral oral environment. Concurrently, the aroma of red ginger essential oils acts via olfactory and gustatory pathways to stimulate salivary flow. Higher flow rates systematically enhance the mechanical and chemical clearance of acids. These findings align with (Sitanaya et al., 2023), who reported that gargling with boiled red ginger water successfully elevated intraoral salivary pH. Similarly, (Rahma et al., 2025) confirmed the efficacy of red ginger decoction as a natural mouthwash for increasing salivary pH. Thus, the current study reinforces existing evidence supporting the physiological benefits of red ginger in regulating oral pH.

Maintaining optimal salivary pH is clinically relevant for dental caries prevention. An acidic intraoral environment accelerates enamel demineralization, elevating caries risk. Conversely, a neutral or slightly alkaline pH favors mineral precipitation, facilitating enamel remineralization and preserving hard tissue integrity (Can & Güvenç, 2025). Thus, utilizing red ginger decoction as a gargling agent represents a viable preventive strategy against dental caries in community settings. The slight pH increase observed in the control group can be attributed to mechanical rinsing action, which transiently stimulates minor salivary flow. However, lacking the bioactive and antimicrobial attributes of red ginger, mineral water could not produce an equivalent therapeutic effect. These outcomes highlight red ginger as a safe, cost-effective, and accessible phytotherapeutic mouthwash alternative.

CONCLUSION

Based on the research findings, it can be concluded that Gargling with boiled red ginger (*Zingiber officinale* var. *rubrum*) water significantly increases salivary pH among residents of Dilib Lamteungoh Village, Aceh Besar Regency.

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