

Comparative Evaluation of the Effect of Colgate Toothpaste and Miswak on Salivary pH: An In Vivo Study

Abstract

Aim: This in vivo study was conducted to evaluate the comparative effect of Colgate toothpaste and Miswak toothpaste on salivary pH.

Methodology: In this 40 participants were selected based on the inclusion criteria and were divided into two groups. Group 1 was allotted to Colgate [strong teeth] which consisted of 20 participants and Group 2 was allotted to Dabur Miswak toothpaste which consisted of 20 participants. Unstimulated saliva samples were collected at baseline, 5 days and 10 days under standardized conditions.

Result: At baseline, the mean pH was 7.28 ± 0.15 in the Miswak group compared to 7.22 ± 0.17 in the Colgate group (mean difference = 0.06, $p = 0.041$). At 5 days, the mean pH was 7.32 ± 0.14 in the Miswak group and 7.15 ± 0.16 in the Colgate group (mean difference = 0.17, $p < 0.001$). At 10 days, the mean pH was 7.21 ± 0.15 in the Miswak group compared to 7.08 ± 0.16 in the Colgate group.

Conclusion: Participants of Group 2 showed increase in the level of salivary pH after brushing with Dabur Miswak toothpaste as compared to Group 1.

Keywords: fluoridated toothpaste, herbal toothpaste, salivary Ph

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I. Introduction

Saliva is a complex biological fluid that plays a pivotal role in maintaining oral homeostasis. It serves multiple protective functions, including lubrication of oral tissues, facilitation of mastication and swallowing, antimicrobial defense, and maintenance of the integrity of dental hard tissues. Among these functions, the regulation of salivary pH is particularly critical, as it governs the dynamic balance between demineralization and remineralization processes occurring on the enamel surface.¹

The oral environment is constantly subjected to fluctuations in pH, especially following the intake of fermentable carbohydrates. Acidogenic bacteria within dental plaque metabolize these substrates to produce organic acids, resulting in a rapid decrease in salivary pH. When the pH falls below the critical threshold of approximately 5.5, enamel dissolution occurs due to the loss of calcium and phosphate ions, initiating the caries process.² The ability of saliva to neutralize these acids through its buffering systems, primarily bicarbonate, phosphate, and protein buffers, is therefore essential in preventing dental caries.

Maintenance of an optimal salivary pH is largely dependent on both intrinsic and extrinsic factors. Intrinsic factors include salivary flow rate, composition, and buffering capacity, while extrinsic factors encompass dietary habits and oral hygiene practices. Among these, oral hygiene measures play a significant role in modulating the oral environment by reducing plaque accumulation and altering microbial activity.³

Toothbrushing with fluoridated dentifrices is widely regarded as the cornerstone of oral hygiene. Commercial toothpastes, such as Colgate, contain fluoride along with abrasives, detergents, and buffering agents that collectively contribute to plaque removal, acid neutralization, and enhancement of enamel remineralization. Fluoride promotes the formation of fluorapatite, which is more resistant to acid dissolution, thereby increasing the tooth's resistance to caries.⁴

Miswak (*Salvadora persica*), a natural chewing stick, has been employed for centuries due to its mechanical and therapeutic properties. The use of Miswak not only facilitates mechanical plaque removal but also introduces biologically active compounds into the oral cavity, which exert antimicrobial and anti-inflammatory effects.⁵

The chemical composition of Miswak includes silica, tannins, alkaloids, essential oils, and naturally occurring fluoride, all of which contribute to its oral health benefits. These constituents have been shown to inhibit the growth of cariogenic bacteria, stimulate salivary flow, and enhance the buffering capacity of saliva.⁶ The mechanical stimulation during its use further increases salivary secretion, thereby promoting a rise in salivary pH and improving the overall oral environment.

Although both fluoridated toothpaste and Miswak have been independently shown to improve salivary pH and reduce caries risk, their mechanisms of action differ significantly. Toothpaste primarily acts through

chemical agents such as fluoride, whereas Miswak provides a combined mechanical and biochemical effect. Comparative evaluation of these two modalities is essential to determine their relative effectiveness, especially in populations where traditional practices coexist with modern oral hygiene methods. ⁷

Furthermore, evaluating changes in salivary pH overtime provides insight into the sustainability of these effects and their potential role in long-term caries prevention. Despite the availability of several studies, there remains a need for well-structured investigations that directly compare these oral hygiene aids under standardized conditions.

Therefore, the present study was undertaken to evaluate and compare the effect of Colgate toothpaste and Miswak on salivary pH at baseline, 5 days, and 10 days. The findings of this study may help in identifying effective oral hygiene practices and contribute to the development of preventive strategies aimed at maintaining optimal oral health.

II. Methodology

This in vivo study was conducted among 40 participants in which there were 28 males and 12 females. Participants aged between 18 to 25 years. Participants were divided into two groups based on the oral hygiene aid used: Group 1 consisted of 20 participants who were given Colgate toothpaste and Group 2 consisted of 20 participants who were given Miswak toothpaste. Consent of all the participants were taken before the start of the study.

Criterion:

Participants who were free from dental caries and were not suffering from any periodontal disease and were not on any systemic medications were included in this study. Participants who were undergoing any orthodontic treatment and had caries or any periodontal disease or systemic diseases were excluded from this study.

Unstimulated saliva samples were collected at baseline, 5 days, and 10 days under standardized conditions. Salivary pH was recorded before and after the use of the respective oral hygiene aid using a calibrated digital pH meter. Participants were instructed to maintain consistent oral hygiene practices throughout the study period. The collected data were entered into Microsoft Excel and analyzed using the Statistical Package for the Social Sciences (SPSS). The results were presented in the form of tables and graphs. Statistical analysis was performed using paired t-test for intra-group comparison and independent t-test for inter-group comparison. The level of significance was set at $p < 0.05$.

III. RESULT

A total of 40 participants were included in the study, with a mean age of 22.9 ± 1.72 years. The study population comprised 28 males and 12 females.

Table 1: Changes in salivary pH after the use of Colgate [strong teeth] toothpaste among study population.

Interval	Salivary pH pre brushing (Mean $\pm$ SD)	Salivary pH post brushing (Mean $\pm$ SD)	Mean Diff	p-value
Baseline	6.67 $\pm$ 0.16	7.22 $\pm$ 0.17	0.55	<0.001
5 Days	6.66 $\pm$ 0.18	7.15 $\pm$ 0.16	0.49	<0.001
10 Days	6.64 $\pm$ 0.17	7.08 $\pm$ 0.16	0.44	<0.001

Paired t-test applied. $P < 0.05$ significant.

Table 1 shows in the Colgate group, a statistically significant increase in salivary pH was observed at all time intervals following the intervention. The mean salivary pH increased from 6.67 ± 0.16 at baseline to 7.22 ± 0.17 post-intervention, with a mean difference of 0.55 ($p < 0.001$). At 5 days, the mean pH increased from 6.66 ± 0.18 to 7.15 ± 0.16 (mean difference = 0.49, $p < 0.001$), and at 10 days from 6.64 ± 0.17 to 7.08 ± 0.16 (mean difference = 0.44, $p < 0.001$).

Table 2: Changes in salivary pH after the use of Dabur Miswak toothpaste among study population.

Interval	Salivary pH pre brushing (Mean $\pm$ SD)	Salivary pH post brushing (Mean $\pm$ SD)	Mean Diff	p-value
Baseline	6.65 $\pm$ 0.18	7.28 $\pm$ 0.15	0.63	<0.001
5 Days	6.68 $\pm$ 0.17	7.32 $\pm$ 0.14	0.64	<0.001
10 Days	6.69 $\pm$ 0.16	7.21 $\pm$ 0.15	0.52	<0.001

Paired t-test applied. $P < 0.05$ significant.

Table 2 shows in the Miswak group, a greater increase in salivary pH was observed compared to the Colgate group. The mean salivary pH increased from 6.65 ± 0.18 at baseline to 7.28 ± 0.15 post-intervention, with a

mean difference of 0.63 ($p < 0.001$). At 5 days, the mean pH increased from 6.68 ± 0.17 to 7.32 ± 0.14 (mean difference = 0.64, $p < 0.001$), and at 10 days from 6.69 ± 0.16 to 7.21 ± 0.15 (mean difference = 0.52, $p < 0.001$).

Table 3: Comparison of changes in salivary pH after using Colgate (strong teeth) and Dabar Miswak toothpaste.

Interval	Group 1	Group 2	Mean Diff	p-value
Baseline	7.22±0.17	7.28±0.15	0.06	0.041
5 Days	7.15±0.16	7.32±0.14	0.17	<0.001
10 Days	7.08±0.16	7.21±0.15	0.13	<0.001

Independent t-test applied. $P < 0.05$ significant.

Intergroup comparison of post-treatment salivary pH revealed that the Miswak group demonstrated significantly higher pH values compared to the Colgate group at all intervals. At baseline, the mean pH was 7.28 ± 0.15 in the Miswak group compared to 7.22 ± 0.17 in the Colgate group (mean difference = 0.06, $p = 0.041$). At 5 days, the mean pH was 7.32 ± 0.14 in the Miswak group and 7.15 ± 0.16 in the Colgate group (mean difference = 0.17, $p < 0.001$). At 10 days, the mean pH was 7.21 ± 0.15 in the Miswak group compared to 7.08 ± 0.16 in the Colgate group (mean difference = 0.13, $p < 0.001$). (Table 3, figure 1)

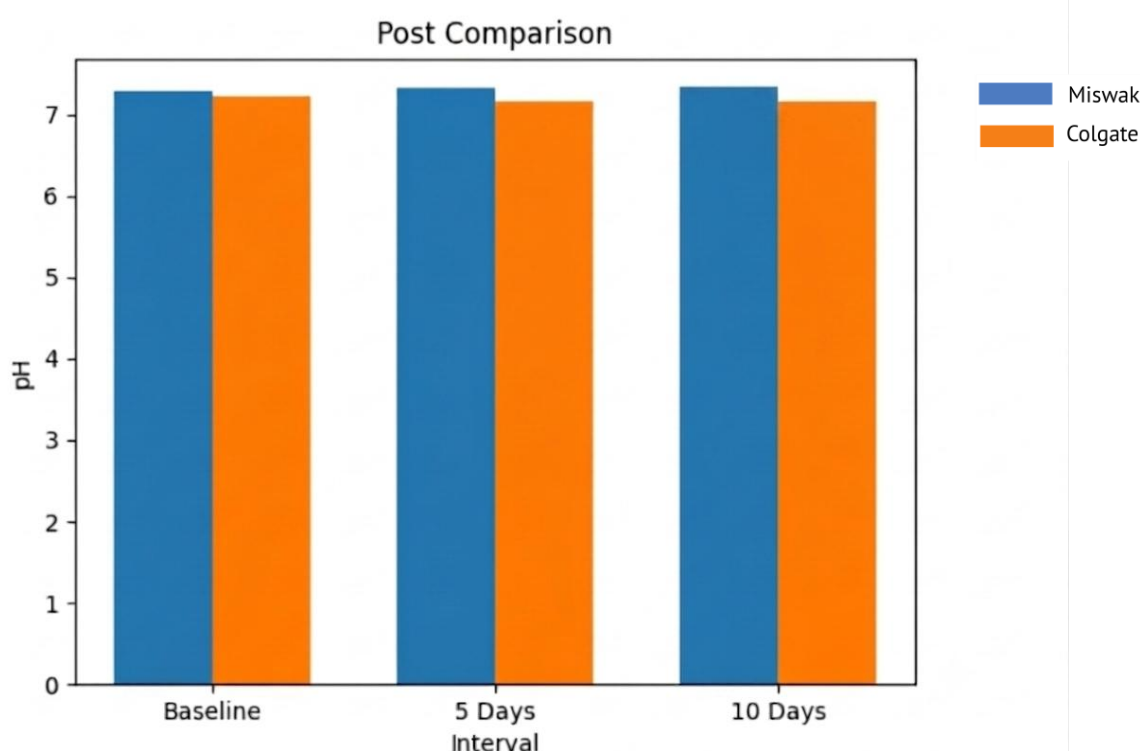


Figure1: Comparison of post-treatment mean salivary pH levels between Miswak and Colgate at baseline, 5 days, and 10 days. Miswak showed significantly higher values ($p < 0.05$).

Overall, both interventions resulted in a statistically significant increase in salivary pH; however, the increase was consistently greater in the Miswak group, indicating its superior efficacy in enhancing salivary pH

IV. Discussion

The present study evaluated and compared the effect of Colgate toothpaste and Miswak toothpaste on salivary pH and demonstrated that both interventions resulted in a statistically significant increase in salivary pH at all observed intervals. However, the magnitude of increase was consistently higher in the Colgate group, indicating its superior efficacy in enhancing salivary buffering capacity and maintaining a favorable oral environment.

The increase in salivary pH observed in the Colgate group can be primarily attributed to the presence of fluoride and other active components in the dentifrice. Fluoride promotes remineralization and inhibits the metabolic activity of acidogenic bacteria, thereby reducing acid production and increasing oral pH. In addition, toothbrushing stimulates salivary flow, contributing to dilution and neutralization of acids. These findings are

consistent with Alzahrani et al. (2021), who reported a significant increase in salivary pH following the use of fluoridated toothpaste, emphasizing its role in improving oral buffering mechanisms ⁸.

Although Miswak toothpaste also demonstrated a significant increase in salivary pH, the effect was comparatively lower than that observed with Colgate. Miswak-based dentifrices contain natural components such as flavonoids, alkaloids, and essential oils, which exhibit antimicrobial and salivary stimulatory effects. Nordin et al. (2020) reported that Miswak-containing products improve salivary parameters and reduce microbial load, supporting the findings of the present study ⁹.

However, the comparatively lower increase in salivary pH observed with Miswak toothpaste in the present study may be due to the absence or lower concentration of fluoride when compared to conventional dentifrices. Fluoride plays a critical role in enhancing remineralization and increasing resistance of enamel to acid attack, which may explain the superior performance of Colgate toothpaste. Similar observations were reported by Khan et al. (2022), who demonstrated that conventional fluoridated dentifrices showed greater improvement in salivary pH compared to herbal formulations ¹⁰.

Intergroup comparison revealed that Colgate toothpaste produced significantly higher salivary pH values than Miswak toothpaste at all time intervals. This suggests that while both agents are effective in improving oral pH, fluoridated dentifrices may provide a more pronounced effect due to their well-established chemical action. Alharbi et al. (2021) also reported that conventional toothpaste demonstrated better improvement in certain oral parameters compared to herbal alternatives ¹¹.

The antimicrobial properties of Miswak toothpaste still contribute positively to oral health by reducing acid-producing bacteria. Abdullah et al. (2023) reported that Miswak exhibits antibacterial activity against cariogenic microorganisms, which indirectly supports pH regulation ¹². However, this effect may not be as strong as the combined chemical and remineralization effects provided by fluoridated toothpaste.

Similarly, Rahman et al. (2022) reported that both herbal and conventional dentifrices improve salivary pH, but conventional products often demonstrate greater efficacy due to standardized composition and active ingredients ¹³. This aligns with the findings of the present study.

The findings of this study suggest that while Miswak toothpaste is beneficial and contributes to improvement in salivary pH, Colgate toothpaste demonstrates superior efficacy. This may be due to the presence of fluoride and other optimized chemical components that provide enhanced buffering, remineralization, and antimicrobial effects.

However, certain limitations of the present study should be considered while interpreting the results. The sample size was relatively small, which may limit the generalizability of the findings. Additionally, the duration of the study was limited to 10 days, and therefore, long-term effects could not be assessed. Variations in individual salivary flow rate, dietary habits, and oral microbiota were not controlled, which may have influenced the outcomes.

Further studies with larger sample sizes and longer follow-up periods are recommended to evaluate the long-term effects of different dentifrices on salivary pH and overall oral health. Future research should also include additional parameters such as plaque index, microbial analysis, and buffering capacity to provide a more comprehensive evaluation.

V. Conclusion

Within the limitations of the present study, it can be concluded that both Colgate toothpaste and Miswak toothpaste significantly increase salivary pH, thereby contributing to a more favorable oral environment. However, Dabur Miswak toothpaste demonstrated a greater and more consistent increase in salivary pH compared to Colgate [strong teeth] toothpaste.

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