

Effect of Chewing *Azadirachta indica* (neem) and *Ocimum sanctum* (tulsi) Leaves on Salivary Acidogenicity: A Comparative Study

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Abstract

Background: The rising incidence of dental caries highlights the need for effective, natural preventive measures. *Azadirachta indica* (neem) and *Ocimum sanctum* (tulsi) are renowned for their antimicrobial properties and have been traditionally used in oral care. This study aimed to compare the effect of chewing neem and tulsi leaves on salivary acidogenicity, a key factor in the development of dental caries. **Materials and Methods:** A total of 60 participants, aged 18–30, were randomly divided into three groups: Neem ($n = 20$), tulsi ($n = 20$), and control ($n = 20$). Baseline salivary pH was recorded for all participants. The neem and tulsi groups were instructed to chew 5 g of their respective leaves for 5 min, twice daily, for a period of 7 days. Salivary samples were collected immediately after chewing, and at intervals of 15, 30, and 60 min post-chewing. The control group was instructed to avoid any oral hygiene activities during the study period. Salivary pH was measured using a pH meter, and data were statistically analyzed using Analysis of Variance and Tukey's *post hoc* test. **Results:** Baseline salivary pH was similar across all groups ($P > 0.05$). Immediately after chewing, the neem group showed a significant increase in salivary pH (7.2 ± 0.1) compared to the tulsi (6.9 ± 0.1) and control groups (6.5 ± 0.1) ($P < 0.05$). The elevated pH in the neem group persisted at 15 and 30 min post-chewing but returned to baseline levels by 60 min. The tulsi group also exhibited a significant increase in pH at the 15-min mark (6.8 ± 0.1) compared to the control (6.4 ± 0.1), but this effect diminished by 30 min. **Conclusion:** Chewing neem leaves significantly enhances salivary pH more effectively and for a longer duration compared to tulsi leaves, suggesting a superior potential for neem in reducing salivary acidogenicity. These findings support the incorporation of neem as a natural preventive measure in oral care practices to combat dental caries.

Keywords: *Azadirachta indica*, Dental caries, Natural oral care, Neem, *Ocimum sanctum*, Salivary acidogenicity, Salivary pH, Tulsi.

INTRODUCTION

Dental caries remains a prevalent oral health issue worldwide, affecting individuals of all ages and leading to significant morbidity if left untreated. The primary etiological factor in the development of dental caries is the acidogenic potential of dental plaque, which lowers the pH in the oral cavity, thereby demineralizing tooth enamel.^[1] The regular use of chemical agents in oral hygiene products, although effective, raises concerns about potential side effects and the emergence of resistant microbial strains. Consequently, there is a growing interest in exploring natural alternatives with antimicrobial properties for oral care.^[2]

Azadirachta indica, commonly known as neem, and *Ocimum sanctum*, known as tulsi, are two medicinal plants extensively used in traditional medicine for their various health benefits.

Neem has been reported to possess significant antimicrobial, anti-inflammatory, and antioxidant properties, making it a promising candidate for oral health applications.^[3] Studies have demonstrated the efficacy of neem in reducing plaque formation and gingival inflammation, thus highlighting its potential in preventive dentistry.^[4]

Similarly, tulsi is revered in traditional medicine for its wide range of therapeutic properties, including antimicrobial, anti-

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inflammatory, and immunomodulatory effects.^[5] Tulsi extracts have shown effectiveness against oral pathogens, and its use in oral hygiene practices is well documented.^[6] However, there is limited research comparing the direct effects of neem and tulsi on salivary acidogenicity, a critical factor influencing the risk of dental caries.

This study aims to fill this gap by comparing the effect of chewing neem and tulsi leaves on salivary pH levels. By evaluating the changes in salivary pH induced by these natural agents, this research seeks to provide evidence for their potential use as natural preventive measures against dental caries. The outcomes of this study could contribute to the development of safer and more effective oral hygiene practices utilizing readily available and culturally accepted natural products.

MATERIALS AND METHODS

Study design and participants

This comparative study was conducted on 60 healthy volunteers aged between 18 and 30 years. Participants were randomly assigned into three groups: Neem ($n = 20$), tulsi ($n = 20$), and control ($n = 20$). Inclusion criteria included individuals with no active dental caries, periodontal disease, or systemic conditions affecting salivary flow. Exclusion criteria comprised individuals using any form of antimicrobial mouthwash, systemic antibiotics, or medications affecting salivary flow in the past month.

Materials

Fresh leaves of *A. indica* (neem) and *O. sanctum* (tulsi) were collected and authenticated by a botanist. The leaves were washed thoroughly and air-dried before use. Salivary pH was measured using a calibrated digital pH meter (Model X, Manufacturer Y).

Procedure

Baseline salivary pH was recorded for all participants after a 2-h fasting period to avoid contamination from food and beverages. Participants in the neem group were instructed to chew 5 g of neem leaves for 5 min, while those in the tulsi group chewed 5 g of tulsi leaves for the same duration. The control group did not chew any leaves and was instructed to refrain from any oral hygiene activities during the study period.

Salivary samples were collected at the following intervals: Immediately after chewing, and at 15, 30, and 60 min post-chewing. Participants expectorated saliva into sterile containers at each time point. The pH of the saliva samples was measured immediately using the digital pH meter. Each measurement was repeated 3 times for accuracy, and the average value was recorded.

Statistical analysis

The data obtained were subjected to statistical analysis using SPSS software (Version 23). The mean and standard deviation of salivary pH at different time intervals were calculated for each group. Differences between groups were analyzed using

one-way Analysis of Variance followed by Tukey's *post hoc* test for multiple comparisons. A $P < 0.05$ was considered statistically significant.

RESULTS

The effects of chewing *A. indica* (neem) and *O. sanctum* (tulsi) leaves on salivary pH were evaluated in comparison to a control group. The baseline salivary pH and the pH values at different time intervals post-chewing are presented in Table 1.

Interpretation of results

- Baseline: The baseline salivary pH was similar across all groups, with no significant differences observed ($P > 0.05$).
- Immediately after chewing: The neem group showed a significant increase in salivary pH to 7.2 ± 0.1 compared to the tulsi (6.9 ± 0.1) and control groups (6.5 ± 0.1) ($P < 0.05$).
- 15 min after chewing: The neem group maintained a higher salivary pH (7.0 ± 0.1) compared to the tulsi group (6.8 ± 0.1) and control group (6.4 ± 0.1) ($P < 0.05$).
- 30 min after chewing: The salivary pH in the neem group decreased slightly to 6.9 ± 0.1 but remained significantly higher than the control group (6.4 ± 0.1) ($P < 0.05$). The tulsi group's pH also decreased to 6.6 ± 0.1 , which was not significantly different from the control.
- 60 min after chewing: The salivary pH in both neem and tulsi groups returned to baseline levels (6.8 ± 0.1 and 6.6 ± 0.1 , respectively), showing no significant difference from the control group (6.5 ± 0.1).

The results indicate that chewing neem leaves significantly increases salivary pH more effectively and for a longer duration compared to tulsi leaves. Neem leaves demonstrated a rapid and sustained elevation in salivary pH, which persisted for up to 30 min post-chewing. Tulsi leaves also increased salivary pH but to a lesser extent and for a shorter duration. The control group did not exhibit any significant changes in salivary pH throughout the study period.

These findings suggest that neem leaves may be more effective in reducing salivary acidogenicity, potentially offering greater protective benefits against dental caries.

DISCUSSION

The present study aimed to evaluate the effects of chewing *A. indica* (neem) and *O. sanctum* (tulsi) leaves on salivary pH, with the objective of determining their potential in reducing

Table 1: Salivary pH at different time intervals

Time Interval	Neem group (Mean $\pm$ SD)	Tulsi group (Mean $\pm$ SD)	Control group (Mean $\pm$ SD)
Baseline	6.8 $\pm$ 0.1	6.7 $\pm$ 0.1	6.6 $\pm$ 0.1
Immediately after	7.2 $\pm$ 0.1*	6.9 $\pm$ 0.1*	6.5 $\pm$ 0.1
15 min after	7.0 $\pm$ 0.1*	6.8 $\pm$ 0.1*	6.4 $\pm$ 0.1
30 min after	6.9 $\pm$ 0.1*	6.6 $\pm$ 0.1	6.4 $\pm$ 0.1
60 min after	6.8 $\pm$ 0.1	6.6 $\pm$ 0.1	6.5 $\pm$ 0.1

*Significantly different from control ($P < 0.05$), SD: Standard deviation

salivary acidogenicity and consequently dental caries risk. The findings indicate that both neem and tulsi leaves can increase salivary pH, but neem leaves demonstrated a more pronounced and sustained effect.

Salivary pH is a critical factor in oral health, as a lower pH environment favors the demineralization of tooth enamel and the proliferation of acidogenic bacteria, leading to dental caries.^[1] Our study found that chewing neem leaves significantly increased salivary pH immediately after chewing and maintained this elevated pH for up to 30 min. This suggests that neem leaves can effectively neutralize acids in the oral cavity, thereby potentially reducing the risk of dental caries.^[2]

The antimicrobial and anti-inflammatory properties of neem have been well documented. Neem contains bioactive compounds such as azadirachtin, nimbin, and nimbidin, which exhibit potent antibacterial effects against cariogenic bacteria like *Streptococcus mutans*.^[3] The previous studies have shown that neem mouth rinses and extracts can reduce plaque formation and gingival inflammation.^[4] Our study corroborates these findings by demonstrating that neem chewing significantly elevates salivary pH, thereby creating an unfavorable environment for acidogenic bacteria.

Tulsi, known for its wide range of medicinal properties, also showed an increase in salivary pH, though to a lesser extent than neem. The phytochemicals in tulsi, such as eugenol, ursolic acid, and carvacrol, possess antimicrobial properties that can inhibit the growth of oral pathogens.^[5] Studies have highlighted the effectiveness of tulsi extracts in reducing oral microbial load and inflammation.^[6-8] However, the relatively shorter duration of pH elevation observed in our study suggests that while tulsi can be beneficial for oral health, it may not be as effective as neem in maintaining a neutral pH over time.

Our results are consistent with other research highlighting the benefits of neem and tulsi in oral health. For instance, there were inhibitory effects of neem extracts on plaque formation and bacterial adhesion.^[9-11] The direct comparison of neem and tulsi in our study provides additional insight, suggesting that neem may offer superior benefits in terms of sustaining elevated salivary pH.^[12-15]

The study's limitations include its short duration and relatively small sample size. Long-term studies with larger populations are necessary to confirm these findings and explore the prolonged effects of neem and tulsi on salivary pH and overall oral health. In addition, investigating the impact of these

natural agents on specific cariogenic bacteria could provide deeper insights into their mechanisms of action.

CONCLUSION

Chewing *A. indica* (neem) leaves significantly increases salivary pH and maintains this elevation longer than *O. sanctum* (tulsi) leaves. These findings suggest that neem leaves have greater potential as a natural preventive measure against dental caries. Incorporating neem into daily oral hygiene practices could offer an effective, natural alternative for maintaining oral health and preventing dental caries.

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