

Assess the Salivary Flow Rate (SFR) and salivary pH of individuals with habit of areca nut and tobacco in Bhubaneswar city.

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ABSTRACT

Introduction: Tobacco and areca nut consumption are widely prevalent habits with significant adverse effects on oral health. This study aims to evaluate the impact of these habits on salivary flow rate (SFR) and salivary pH, which are critical indicators of oral health. Tobacco contains harmful compounds that contribute to oxidative stress, and can alter the oral environment. Understanding these impacts can aid in early detection and prevention of related oral diseases.

Materials and Methods: A cross-sectional study was conducted among 120 participants aged 20-50 years, divided into three groups: control (no habit), areca nut consumers, and tobacco consumers. Saliva samples were collected between 9 AM and 12 PM for SFR and pH analysis. Statistical analysis was performed using ANOVA and Tukey HSD post hoc tests, with a significance threshold of $p < 0.05$.

Results: The study found a significant reduction in SFR and salivary pH among areca nut and tobacco users compared to the control group. The mean SFR was highest in the control group (3.45 mL/5 min), followed by tobacco users (2.69 mL/5 min) and areca nut users (1.95 mL/5 min). Salivary pH was significantly lower in the habit groups, with mean values of 5.60 (areca nut) and 5.83 (tobacco) compared to 6.98 in controls ($p < 0.001$).

Conclusion: Long-term use of areca nut and tobacco significantly affects salivary parameters, indicating early oral health deterioration. Non-invasive assessments of SFR and pH can serve as valuable diagnostic tools for monitoring at-risk individuals, reinforcing the importance of preventive measures and public awareness campaigns.

Keywords: tobacco, arecanut, salivary flow rate

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INTRODUCTION

Tobacco is a harmful and addictive plant available in smoking and chewing forms. It contains numerous toxic compounds, such as free radicals and reactive oxygen species (ROS), that can alter cells and promote cancer.^[1] Many users continue to consume tobacco despite issues like receding gums or bleeding caused by its constricting effects on blood vessels. These toxins can impair the body's natural tumor suppressors, p53 and Rb, while

nitrosamines and cancer-causing hydrocarbons target various tissues without resistance.^[2]

Every cigarette smoked or chewed brings the person closer to getting cancer.^[3] Arecoline is one alkaloid found in betel quid, which contains four different types of alkaloids overall, but areca nut may be most known for its use as an energy booster across Asia, where this fruit is widely recognized as a favorite stimulant among locals because while eating raw nuts can give someone a quick

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burst of energy, too much consumption comes with consequences since some such compounds, like those containing arecoline, have cytotoxic effects themselves or through metabolites produced by them so that these substances could damage genetic materials directly (genotoxicity).^[4, 5] They lower immune defenses by depleting GSH levels, thereby facilitating ROS production, leading to oral tissue oxidative stress, thus reducing systemic immunity locally. With frequent use, areca nuts may cause hallucinations, delusions, increased secretions, gastrointestinal distress, and more. The symptoms of areca nut overdose can resemble insecticide poisoning.^[4]

The physical effects of areca nut consumption are concerning. Users may develop reddened, crusty lesions in the mouth, and the nut is linked to pre-cancerous conditions such as leukoplakia and submucous fibrosis. Severe fibrosis can restrict mouth opening due to the proliferation and thickening of collagen fibers. While small doses of the areca nut may produce a pleasant buzz, regular use leads to a range of harmful health effects. This seemingly innocuous nut has a toxic impact on health.^[5, 6, 7]

The effects of tobacco and areca nut use on saliva are quite complex. Let's break it down. In the short term, tobacco can increase saliva flow and sodium levels. But over time, it actually decreases flow, pH, and calcium.⁸ Arecoline in areca nuts can initially boost saliva flow and pH due to its parasympathetic stimulation. However, acidic pH from tobacco promotes enamel demineralization and decay, while alkaline pH promotes calculus build-up. Just a one-unit pH change means a huge 10-fold difference in acidity!⁹

Demineralization and tooth decay happen when plaque pH dips under 5.5. The battle between demineralization and remineralization determines if a lesion forms and demineralization is usually faster. Low saliva pH also allows acid-loving bacteria to thrive while killing off the acid-sensitive ones.¹⁰ Saliva flow naturally declines with age as salivary glands atrophy and men generally have higher flows than women.¹¹ There's an intricate relationship between plaque pH, sugar clearance, and saliva flow and buffering that Stephan's curve demonstrates.^{12, 13} So in summary, tobacco and areca nut use disrupt optimal saliva flow, pH, and mineral balance in the mouth. This leads to an environment ripe for decay, acidic damage, and unbalanced oral bacteria¹⁴ is pretty nasty right? That's why this study compared saliva in tobacco, areca nut, and healthy users - to unravel these complex effects.

MATERIALS AND METHODS:

The research was carried out in a medical facility. Participants in the study were chosen from among those who visited the Tobacco Cessation Center (TCC) and Out-Patient Department (OPD) and ranged in age from 20 to 50. Ethical permission was obtained from the

Ethical Committee of the Institute of Dental Sciences via letter no.

Sample size estimation: G Power Analysis version 3.1.9 was used to estimate the sample size. The effect size was adjusted to 0.25, with a significance level (α) of 0.05 and a power level (β) of 0.80. The sample size was calculated to be 120.

Subjects with a habit of areca nut chewing and tobacco chewing for more than 1 year and apparently healthy subjects without any of these habits were included in the study. All the study participants were informed about the study, and written informed consent was obtained.

Informed consent was gained from each patient to participate in the research after they were informed about the study protocol. Three groups of patients were segregated into Group I (control group), Group II (Areca Nut Consumers) & Group III (Tobacco consumers). The questionnaire was designed based on the TCC Patient Registration Performa given by Government of India and Dental Council of India.²³ The questionnaire was evaluated for consistency using Cronbach's Alpha, which was found to be 0.87.

Salivary Flow rate assessment: The whole mouth resting saliva was collected in graduated sterile bottle between 9 and 12 AM. Salivary pH assessment was determined using the indicator (Indikrom Paper).

Statistical analysis: Descriptive statistics were computed. The study group subjects' mean pH and mean SFR were compared using the Tukey HSD post hoc test. The mean difference between SFR and pH was determined using the analysis of variance (ANOVA) test. It was determined that a "p" value of less than 0.05 was statistically significant.

OBSERVATION AND RESULTS

The goal of this study was to evaluate the salivary pH and flow rate (SFR) in patients who habitually use tobacco and areca nut products. Most patients were male: among areca nut users, 38 (31.7%) were male and 2 (1.7%) female; among tobacco chewers, 34 (28.3%) were male and 6 (5%) female. Table 1 details age, occupation, and educational levels. Average areca nut use was 4 packets/day, while tobacco use averaged 5 packets/day, with a maximum consumption of up to 8 packets/day by a tobacco user (Table 2).

All study participants were screened for lesions; only a few lesions were found, so only descriptive statistics were calculated (Table 2).

DISCUSSION

Chewing tobacco and areca nuts significantly alter salivary pH and flow rate (SFR). Long-term use has been linked to reduce SFR due to increased salivary gland activity and tolerance. Elevated adrenaline and norepinephrine levels from chewing gutka, pan masala,

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and khaini affect the autonomic nervous system, lowering salivary flow and causing degenerative changes in minor salivary glands. Additionally, there is a notable decrease in average salivary pH.^{1, 25} The content in packets may result in a high alkaline content or damage from free radicals; It most likely modifies pH by interfering with the salivary buffering system. Enhanced flow rate lead to higher buffering capacities, which in turn raise pH levels, and vice versa.²⁶ Plaque mineralization is facilitated by alkaline pH, which is suitable for calcium phosphate deposition. Reduced pH (acidic pH), which is conducive to enamel demineralization, is the cause of dental caries.¹⁰

Studies show that when tobacco is consumed for a brief period, SFR initially rises. It has been suggested by other studies that long-term use of dry tobacco lowers SFR.²⁵ While stimulated saliva helps study functional reserve, unstimulated salivary production provides an accurate way to analyze the state of the salivary glands.²⁶ Lower pH levels and increased acidity have been linked to the development of cancer, particularly in relation to complications from radiation therapy and buccal mucosal carcinoma. This occurs when tumor cells grow uncontrollably, leading them to absorb large amounts of glucose. This process results in anaerobic glycolysis, which produces lactic acid and raises the acidity of the surrounding environment.²⁹ This study involved 120 subjects: 40 who chewed tobacco, 40 who chewed areca nuts, and 40 controls [Figure 2]. Among the participants, 21.7% were female and 78.3% were male [Figure 3]. The results showed a decrease in saliva flow rate (SFR) for groups II (1.95 ml/5 mins) and III (2.96 ml/5 mins) compared to group I (3.45 ml/5 mins). Notably, participants in group II had the lowest SFR, suggesting they were the most affected. Further research is needed to explore potential causes and develop interventions [Table III]. A significant statistical difference was observed between group I and group II, as shown in Table III. A significant statistical difference ($P < 0.001$) was observed in the salivary pH levels among all three groups. A study conducted by Jain et al. revealed that Group I and Group II both experienced a decrease in their Salivary Flow Rate (SFR), measuring 11.75 ml/20 minutes for each group, in comparison to Group III, which had an SFR of 13.23 ml/20 minutes. Notably, Group I was the most affected, reporting the lowest SFR at 10.48 ml/20 minutes.¹⁹ The findings aligned with a 2018 study by G. Shubha et al., which compared salivary flow rates (SFR) among a control group and users of smoking and smokeless tobacco. The control group was Group IV, while Groups I, II, and III represented smoking, smokeless tobacco, and a combination of both, respectively. The study noted that Group III had a lower SFR than Group II but higher than Group I.¹ These results were also highlighted by Preetika Parmar et al., who divided their participants into three groups: tobacco chewers (group B), smokers (group A), and controls (group C).⁴ Their study found that both chewing and smoking tobacco leads to a decrease in pH and SFR. The

studies conducted by Alpana Kanwar et al., analyzed the long-term effects of tobacco on pH and SFR, and compared them with a control group. The results showed a significant decrease in the consumption of smokeless tobacco in group II, which led to a substantial drop in SFR on comparison of salivary pH.³⁰ These findings were further supported by Preetika Parmar et al., who categorized their sample of participants into three groups: tobacco chewers (group B), smokers (group A), and controls (group C). Their investigation revealed that chewing or smoking tobacco resulted in decreased pH and SFR levels.⁴ Overall; these studies suggest that tobacco use negatively impacts salivary pH and SFR in the long-term.

Researchers discovered that whereas salivary pH was more affected in areca nut chewers, SFR was altered less in them. In a cross-sectional study conducted by T. Rooban et al., both pH and SFR (measured in milliliters per minute) were obtained. While the mean pH difference was statistically significant, the difference in the mean SFR between areca nut chewers and non-chewers was not. The pH of the mouth mucosa became lower in advanced areca nut chewers, making it more susceptible to the harmful effects of areca nuts.¹⁸ The changes in SFR and pH parameters were evaluated by Indrani Barman et al. amongst groups I, II, and III, which included tobacco users (smoking or not), raw/betel leaf chewers, and group I.³¹ Different types of areca nut chewers (group I) and tobacco users (group II) showed changes in salivary parameters. The change was dependent on the nicotine's effect, which is correlated with the length of use. The statistical significance was observed in the mean SFR between raw areca nut chewers and non-chewers, but the SFR between areca nut chewers (pan) and non-chewers was statistically non-significant. The mean pH of both areca nut chewers and non-chewers was found to be statistically non-significant. Additionally, the mean pH of non-smokers and the tobacco user group's smoking and non-smoking forms was statistically non-significant. In Saraswathi Gopal, K. et al., the long-term effects of tobacco on SFR and pH were analyzed and compared between tobacco chewers/smokers and controls.³² Three subgroups of patients were identified: those who chewed tobacco but did not smoke, those who chewed tobacco, and those who smoked tobacco. It was established from this study that long-term tobacco usage dramatically lowers salivary pH and SFR.³² These changes in parameters can be a precursor of oral mucosal degradation. The prolonged use of tobacco and the enhanced epinephrine effect of areca nuts, which alters the autonomic nervous system by raising the plasma level of epinephrine and norepinephrine, are the reasons for the decrease in SFR of tobacco chewers and areca nut chewers compared to normal subjects.

Degenerative alterations in small salivary glands on acinar cells at the placement site are also brought on by prolonged use. Additionally, smoking causes nicotine to inactivate taste receptors, which lowers the salivary

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reaction.^{1,27,30,33} Nicotine also changed salivary production by activating particular cholinergic receptors in the brain and other organs.^{23,28} Further investigation revealed that the brain and circulation both absorb the quantity of active chemicals generated during the chewing of areca nuts. The SFR may be impacted by intricate interactions between several absorbed active substances in the brain and the autonomic nervous system.¹⁸ Chewing tobacco and areca nuts can lower pH levels because they contain smokeless lime, which can react with the bicarbonate buffering mechanism and cause bicarbonate ions to be lost, making saliva more acidic. When electrolytes and ions interact with saliva's buffering systems, the pH is changed.^{4,5, 9} Age and salivary pH have a negative correlation, meaning that as age rises, salivary pH falls.¹² Chewing betel quid causes the production of reactive oxygen species in the oral cavity, which also lowers pH. A reduction in SFR also causes a drop in pH and vice versa, altering the electrolyte and ion components of saliva and lowering its bicarbonate content.^{18, 25,26,33} Generally speaking, females exhibit a lower SFR and buffer capacity.¹² The smaller salivary gland size in women accounts for this discrepancy. Reduced salivary flow is also linked to a higher incidence of mouth dryness in women. It has been discovered that males have higher pH values than females.¹² Areca nuts and other tobacco chewers can cause changes in salivary pH, which can affect the oral mucosa and make it more vulnerable to the toxins that they produce.³⁴

CONCLUSION

The investigation found that long-term use of areca nuts and tobacco significantly decreases salivary pH and saliva flow rate (SFR). These reductions may indicate early damage to the oral mucosa. Non-invasive measurements of SFR and salivary pH can assess these changes, allowing for early intervention to prevent further health issues.

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CONFLICT OF INTEREST

There is no conflict of interest among the authors.

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REFERENCES:

1. Shubha G, Fasalkar SS, Praveen BN, Patrick S, Shubhasini AR, Keerthi G. Assessment of salivary flow rate and salivary pH in subjects with smoking and

smokeless form of tobacco habits. *J Med Radiol Pathol Surg* 2018;5:11–5.

2. Shwetha S, Reddy Chandra Sekhara V, Sudhir KM, Kumar Krishna RVS, Srinivasulu G. Influence of tobacco chewing and smoking on salivary total antioxidant power—A Clinical Comparative study. *J Clin Diagnostic Res* 2018;12:ZC09-12.

3. Sham AS, Cheung LK, Jin LJ, Corbet EF. The effects of tobacco use on oral health. *Hong Kong Med J* 2003;9:271-7.

4. Parmar P, Radha G, Rekha R, Pallavi SK. Assessing salivary flow rate, salivary pH and oral candidiasis among tobacco chewers, smokers and healthy controls-A Cross Sectional study. *Asian J Med Health* 2017;7:1-8.

5. Grover N, Sharma J, Sengupta S, Singh S, Singh N, Kaur H. Long term effect of tobacco on unstimulated salivary pH. *J Oral Maxillofac Pathol* 2016;20:16-9.

6. Kumar AM, Sravani K, Prassanna KN, Rao JN, Chatra L, Prabhu R, et al. Arecanut and its effects on the human body. *Am J Oral Med Radiol* Downloaded from <http://journals.lww.com/jpat> by BhDMf5ePHKav1zEoum1tQfn4a+kJLhEZgbsIH04XMi0hCywCX1AWnYQp/IIQrHD3i3D0OdRyi7TvSF14Cf3VC1y0abggQZXdgGj2MwlZLeI= on 02/22/2024

7. Trivedy CR, Craig G, Warnakulasuriya S. The oral health consequences of chewing arecanut. *Addict Biol* 2002;7:115–25.

8. Khan GJ, Mahmood R, Ihtesham-ul-Haq, Salah-ud-Din. Secretion of total solids (solutes) in the saliva of long-term tobacco users. *J Ayub Med Coll Abbottabad* 2008;20:20-2.

9. Chakrabarty S, Patil S, Bandalore SRH, Kempegowda RT, Shivu, Pawa S. A comparative study of long term effect of tobacco on resting whole mouth salivary flow rate and pH. *J Indian Acad Oral Med Radiol* 2015;27:549-52.

10. Rajesh KS, Zareena, Hegde S, Arun Kumar MS. Assessment of salivary calcium, phosphate, magnesium, pH, and flow rate in healthy subjects, periodontitis, and dental caries. *Contemp Clin Dent* 2015;6:461-5.

11. Jeong SJ, Jankulovska SAM, Angelova D, Nares S. Dental caries risk can be predicted by simply measuring the pH and buffering capacity of saliva. *J Dent Hyg Sci* 2006;6:159-62.

12. Fenoll-Palomares C, Muñoz Montagud JV, Sanchiz V, Herreros B, Hernández V, Mínguez M, et al. Unstimulated salivary flow rate, pH and buffer capacity

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of saliva in healthy volunteers. *Rev Esp Enferm Dig* 2004;96:773-83.

13. Llana-Puy C. The rôle of saliva in maintaining oral health and as an aid to diagnosis. *Med Oral Patol Oral Cir Bucal* 2006;11:E449-55.

14. Humphrey SP, Williamson RT. A review of saliva: Normal composition, flow, and function. *J Prosthet Dent* 2001;85:162-9.

15. Venkatesan M, Jose M, Prabhu S. Evaluation of Effect of Duration of Gutkha Chewing Habit on Different Salivary Parameters- A Cross Sectional Study. *Oral Maxillofac Pathol J* 2021;12(2): 52-55.

16. Muthukumaran RB, Bhattacharjee P, Bhowmick P, Zote L, Malsawmtluangi, Kumar NS, Jahau L, Cooke MS, Hu CW, Chao MR. Genetic and epigenetic instability induced by betel quid associated chemicals. *Toxicol Rep.* 2023 Feb 4;10:223-234. doi: 10.1016/j.toxrep.2023.02.001. PMID: 36845258; PMCID: PMC9945799.

17. Shirzaiy, M & Neshat, F. (2020). Effect of Areca Nut on Oral Health: A Review. *Journal of Research in Dental and Maxillofacial Sciences.* 5. 1-6. 10.29252/jrdms.5.3.1.

18. Rooban T, Mishra G, Elizabeth J, Ranganathan K, Saraswathi TR. Effect of habitual arecanut chewing on resting whole mouth salivary flow rate and pH. *Indian J Med Sci* 2006;60:95-105.

19. Jain K, Gakhar R, Bhatia S, Manjunatha BS, Jindal D, Jindal V. Comparison of salivary flow rate and pH between healthy subjects and tobacco and areca nut chewers. *J Oral Maxillofac Pathol* 2023;27:599-600.

20. Rimal J, Shrestha A, Maharjan IK, Shrestha S, Shah P. Risk Assessment of Smokeless Tobacco among Oral Precancer and Cancer Patients in Eastern Developmental Region of Nepal. *Asian Pac J Cancer Prev.* 2019 Feb 26;20(2):411-415. doi: 10.31557/APJCP.2019.20.2.411. PMID: 30803200; PMCID: PMC6897013.

21. Lee CH, Ko YC, Huang HL, Chao YY, Tsai CC, Shieh TY, Lin LM. The precancer risk of betel quid chewing, tobacco use and alcohol consumption in oral leukoplakia and oral submucous fibrosis in southern Taiwan. *Br J Cancer.* 2003 Feb 10;88(3):366-72. doi: 10.1038/sj.bjc.6600727. PMID: 12569378; PMCID: PMC2747536.

22. Li YC, Cheng AJ, Lee LY, Huang YC, Chang JT. Multifaceted Mechanisms of Areca Nuts in Oral Carcinogenesis: the Molecular Pathology from Precancerous Condition to Malignant Transformation. *J*

Cancer. 2019 Jul 8;10(17):4054-4062. doi: 10.7150/jca.29765. PMID: 31417650; PMCID: PMC6692602.

23. Gov.in. [cited 2024 May 13]. Available from: <https://dciindia.gov.in/Download/Reference%20Manual%20for%20Tobacco%20Cessation.pdf>.

24. Dalvi, Tanushri & Kalghatgi, Shrivardhan. (2023). A 2023 Update of Kuppaswamy Socioeconomic Status Classification Scale for the Indian Population. *Journal of Indian Association of Public Health Dentistry.* 21. 282-283. 10.4103/jiaphd.jiaphd_173_23.

25. Gupta J, Wesly SJ, Gupta K. Prevalence of tobacco in Darbhanga district: Ahospital-based cross-sectional study. *J Cancer Res Ther* 2017;13:576-9.

26. Qamar A, Baig S, Ali A, Zehra N, Memon MA, Gupta VK. Resting salivary flow rate and pH decreases in chewable tobacco users. *Br J Med Med Res* 2016;11:1-9.

27. Rehan F, Khan RS, Khurshid Z, Memon MS, Naqwi S, Zafar MS. Analysis of resting mouth salivary flow rate and salivary pH of tobacco chewers and smokers. *J Pak Dent Assoc* 2016;25:158-63.

28. Kailasam S, Santana N, Leena D, Geetha R, Ezhil Pallavi S. A comparative study of alteration in salivary pH among tobacco users and healthy controls. *Int J Sci Res* 2019;8:24-5.

29. Ilankizhai RJ, VishnuPriya V, Gayathri R. Analysis of pH and variation in buffering capacity of saliva in normal and patients with carcinoma of buccal mucosa - A pilot study. *Drug Invent Today* 2018;10:1856-9.

30. Kanwar A, Sah K, Grover N, Chandra S, Singh RR. Long-term effect of tobacco on resting whole mouth salivary flow rate and pH: An institutional based comparative study. *Europ J General Dent* 2013;2:296-9.

31. Barman I, Umesh CPG. Effects of habitual arecanut and tobacco chewing on resting salivary flowrate and pH. *Int J Oral Health Med Res* 2015;2:13-8.

32. Saraswathi Gopal K, Amala M, Harshwardhan B. Effect of smoking and chewing tobacco on resting salivary flowrate and pH. *Int J Curr Res* 2016;8:44344-8.

33. Abdul Khader NF, Dyasanoor S. Assessment of salivary flow rate and pH among areca nut chewers and oral submucous fibrosis subjects: A comparative study. *J Cancer Prev* 2015;20:208-15.

34. Sahu RK, Patro S, Nayak B, Bardhan D, Panda S, Rajguru JP. Habit-associated salivary pH changes in oral submucous fibrosis: A cross-sectional study. *Natl J Maxillofac Surg* 2021;12:78-82.

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