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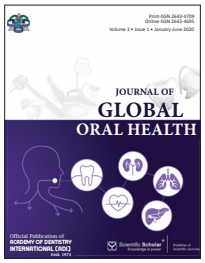

Research Article

Effect of chewing betel leaves on salivary pH – A randomized controlled trial

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ABSTRACT

Betel leaves have been described from the ancient time as an astringent, anti-microbial, and anti-oxidant. Saliva plays an important role in the maintenance of good oral health. Sucrose is the most cariogenic dietary carbohydrate, because it is fermentable and also serves as a substrate for the synthesis of extracellular and intracellular polysaccharides in dental plaque. The effect of betel leaves over sugar solution has been least explored. The study aimed at comparing the effect of betel leaves chewing on the salivary pH. A randomized controlled trial was conducted among $n = 20$ participants. The participants were asked to chew fresh betel leaves for 1 min after taking sugar solution and the pH was assessed at following time intervals baseline, 10, 30, and 45 min, respectively. Chewing betel leaves after intake of sugar solution tends to neutralize salivary pH within 10 min after consumption, thereby reducing the acid attack on the tooth surface by plaque bacteria. Betel leaves are effective in neutralizing the salivary pH after intake of sugar solution; therefore, it is suggested to consume plain betel leaves after a meal to neutralize the salivary pH and, thus, reduce the acid attack on the tooth which causes demineralization.

Keywords: Caries, Saliva, pH, Sugar, Betel leaves

INTRODUCTION

Dental caries is a multifactorial disease that begins with microbiological shifts within the complex biofilm and is influenced by salivary flow and composition, fluoride exposure, dietary sugar consumption, and preventive behaviors (tooth brushing). It forms over time through a complex interaction between acid-producing bacteria and fermentable carbohydrates and many host factors, including teeth and saliva.[1] Saliva present in the oral cavity, particularly its acidic component, is an important factor in the development of dental caries. Saliva's role in self-cleaning the tooth surface, regulating pH, and controlling oral microflora can reduce the cariogenic potential of dental plaque.[2] The constant flow of saliva is one such mechanism that can effectively dilute and eliminate the products of bacterial metabolism in the oral cavity. Saliva also has a buffering capacity; the pH of saliva is between 6.2 and 7.6, which neutralizes acids in the mouth.[3] Sucrose is considered the most cariogenic dietary carbohydrate, because it is fermentable and also serves as a substrate for the synthesis of extracellular (EPS) and intracellular polysaccharides (IPS) in dental plaque. Thus, a low pH caused by the fermentation of sucrose leads to a shift in the balance of the resident plaque microflora toward a more cariogenic microflora, according to the ecological plaque hypothesis.[4]

Pharmacological properties of the betel leaf include antioxidant, anti-inflammatory, and antimicrobial properties. The leaf produces an aromatic essential oil that contains a phenol called

chavicol, which has a strong antiseptic effect. It also causes abundant salivation, temporarily blunted taste perception, and stimulation of muscular and mental performance.[5] The present study was conducted to evaluate the changes in salivary pH after chewing betel leaves.

MATERIALS AND METHODS

A randomized controlled trial was conducted to investigate the effect of chewing betel leaves on salivary pH. The sample size for the present study was estimated to be n = 20 (90% – power and 95% – confidence interval) calculated using G Power version 3.1 based on the study by Senthilkumar *et al*.[6] Approval was obtained from the Institutional Scientific Review Committee (AMDECH/ISRC – 2021) of Asan Memorial Dental College and Hospital before commencement of the study. Study participants with a Decayed, Missing, Filled Teeth (DMFT) score (zero)[4] who had no history of systemic disease and were not taking medications that affect salivary flow were included in the study. Individuals with a DMFT score >1 who were undergoing orthodontic treatment and were being treated for systemic diseases were excluded from the study. Figure 1 depicts the flowchart of study design.

Preparation of sugar solution: White sugar – 10 g dissolved in 100 mL of water (10% – concentration solution).

1. Betel leaves (fresh – obtained from the market)
2. pH meter (Brand name: KONVIO NEER).

Methods

Study participants were asked to maintain a stable diet during the study days. They were asked not to consume any food or drink for 1 h before the start of the study.

Day – 1: Saliva is collected from the patient in a sterile cup and a sample is taken for determination of pH at the beginning of the study. Patients are then administered 50 mL of a 10% sugar solution and asked to rinse and swallow for 1 min; pH is determined again at subsequent time intervals of 10, 30, and 45 min.

Day – 2: Saliva is collected from the patients in a sterile cup and a sample is taken for pH assessment at the beginning of the study. Then, 50 mL of 10% sugar solution is given to the patients and they are asked to rinse and swallow for 1 min, then 1 g of fresh betel leaves is given to the participants and they are asked to chew and swallow the leaves for 1 min. The pH was noted at the different time intervals and the comparison of the mean pH at the different time intervals was performed using the independent samples t-test. SPSS version 23, IBM Corporation, Chicago, USA, was used for statistical analysis.

RESULTS

A randomized controlled trial was carried out to assess the effect of chewing betel leaves on salivary pH. Table 1 depicts the comparison of salivary pH at varying time intervals following ingestion of betel leaves among the study population. Results showed that chewing betel leaves after intake of sugar tend to neutralize pH within 10 min after consumption, thereby reducing the acid attack on the tooth surface by plaque bacteria.

DISCUSSION

Sucrose promotes an increase in mutans streptococci and lactobacilli and, at the same time, a decrease in *Streptococcus sanguinis* as a result of the pH drop that occurs during fermentation of this carbohydrate. This observation suggests that acid production by sucrose metabolism disturbs the balance of the microbial community and favors the growth of cariogenic species.[4] Saliva has a normal pH range of 6.2 to 7.6, with 6.7 being the average pH. The resting pH in the mouth does not fall below 6.3. In the oral cavity, saliva maintains pH close to neutrality (6.7–7.3).[7] Saliva contributes to the maintenance of pH by two mechanisms. First, salivary flow eliminates carbohydrates that could be metabolized by bacteria and remove acids produced by bacteria. Second, the acidity of beverages and foods, as well as bacterial activity, is neutralized by the buffering action of saliva. Saliva contains a variety of host defense factors.[7]

Mechanical, gustatory, olfactory, or pharmacological stimuli increase saliva production and secretion. Salivary pH and the buffering capacity of saliva are determined by the hydrogen bicarbonate balance in saliva. Salivary pH and buffering capacity may contribute to ion exchange during enamel remineralization and demineralization. Dental caries result from the dissolution of minerals from the tooth surface by organic acids produced during bacterial fermentation of sugars. The ability of saliva to flush out microorganisms and substrates and maintain the cleanliness of the mouth can be influenced by its consistency and flow rate.[8] An acidic pH is the main problem for teeth, as it leads to demineralization of enamel, causing tooth decay. The pH is maintained by two mechanisms, salivary flow and buffering capacity.[3]

Table 1: Comparison of salivary pH at varying time intervals among the study population.

Group	Salivary pH (Mean±SD)*			
	Baseline	10 min	30 min	45 min
Sugar*	6.17±0.75	6.04±0.61	6.22±0.44	6.31±0.51
Sugar+Betel*	6.67±0.45	6.48±0.45	6.51±0.49	6.60±0.48
P-value	0.18	0.024	0.18	0.45

*Independent samples t-test (P<0.05 – Statistically significant).

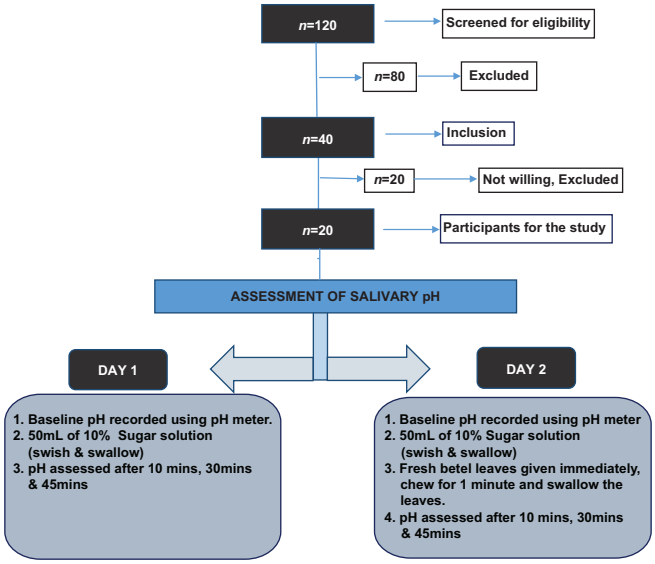

Figure 1: Flowchart of the study design.

Betel leaves are very nutritious and contain a large number of vitamins and minerals. The leaves also contain enzymes such as diastase and catalase and a considerable amount of various essential amino acids such as lysine, histidine, and arginine. Widely used in South Asian countries, the Piper betel leaf contains a variety of biophenols such as hydroxychavicol, eugenol, chavibetol, and piperols.[9]

CONCLUSION

Betel leaves are effective in neutralizing salivary pH after ingestion of sugar solution; thus, it is recommended to consume betel leaves after a meal to neutralize salivary pH and thereby reduce acid attack on the tooth causing demineralization.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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