Effect of Areca nut and Various Tobacco Products on Salivary pH

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Abstract

Background: Salivary pH plays a significant role in pathogenesis of various oral diseases and conditions. Chewing of Areca nut and various tobacco products changes salivary pH.

Aim: To measure the effect of habitual chewing of areca nut and various tobacco products on salivary pH.

Design: Cross sectional.

Setting: Outpatient Department of Chhattisgarh Dental College and Research Institute.

Participants: Chewers and non chewers attending the Department of Oral Medicine and Radiology. Measurement: Salivary pH.

Materials and Methods: The study included 360 individuals including chewers and nonchewers between 20 to 30 years age. The pH was measured with the help of digital pH meter before and after chewing areca nut and various tobacco products.

Results: It was observed that in all the groups of chewers, pH decreased after chewing except in the Gutkha and lime chewing group, where pH increased i.e. pH before chewing was 7.43 ± 0.41 and after chewing was 7.51 ± 0.399, the difference was strongly significant (p < 0.001). pH was found to be less in Lime and Tobacco chewers (6.83 ± 0.33) and more in Tobacco, betel nut and lime chewers (7.50 ± 0.41) in comparison to other groups before chewing, the difference was strongly significant (p < 0.001). In the Mean ± SD, increase in pH was found among chewers (7.32 ± 0.49) as compared to non chewers (6.99 ± 0.14) which is the control group and the data was statically significant (p < 0.001).

Conclusion: pH is altered in areca nut and various tobacco chewers, rendering the oral mucosa vulnerable to the toxic effects of areca nut and various tobacco products.

Keywords: Areca nut; Tobacco Products; Salivary pH

Introduction

Oral fluid is mainly composed of saliva. Other components of saliva include gingival cervical fluids, mucosal transudate, dead cells, bacteria and food remains [1]. Saliva is secreted from salivary glands. The source of saliva is interstitial fluid via blood capillaries which enters the salivary glands and gets modified from isotonic to hypotonic fluid [2]. Saliva is essential for protection, lubrication of oral mucosal tissues remineralisation of teeth, digestion, and taste sensation, stimulation, washed out effect, pH balance and phonation [4].
nucleus in the medulla oblongata is the salivary centre which is regulated by the control centre in the hypothalamus [3]. As the salivary gland is innervated by ANS, it responds to both parasympathetic and sympathetic stimulus but differently. Parasympathetic impulses are more common, and mostly isolated, with varying degree of expulsion from the acinar cells causing salivary secretion. It also promotes myoepithelial cells contraction causing vasodilatation thereby increasing serous salivary secretion. On the other hand sympathetic stimulus causes the production of thick concentrated saliva by altering the fluid component [5-7].

It has been estimated that, worldwide, ~600 000 000 people are are nut chewers [8]. It is the fourth most commonly abused social drug, ranking after nicotine, ethanol and caffeine [9]. The areca fruits are sun dried for several weeks, after which the fibrous shells are removed and the hard, dry nuts, commonly called Betalnut or ‘supari’ in India, are ready for use. Such sun dried varieties of BN are very hard, and are cut into small pieces to make it easier to masticate [10]. A flavoured and sweetened dry mixture of BN, catechu and slaked lime have become increasingly popular either with tobacco (gutkha or khaini) or without tobacco (paan masala). These products are packaged in small, attractive and inexpensive sachets [8]. BN chewing leads to increased salivary secretion in chewers only by chemical stimulation, but not on mechanical. The chewers showed lower levels of potassium, sodium and salivary amylase. These changes in salivary components were thought to be due to increased salivary flow with its dilutional effect [11]. Areca Nut contains many minerals namely copper, manganese, zinc, nickel and lead. Within moments of chewing, gutkha begins to dissolve and turn deep red in colour. Copper content of BN products is strongly associated with OSMF. AN also contains four very important alkaloids namely, Arecoline, Arecaidine, Guvacoline, and Guvacine. Arecoline has parasympathomimetic activity which increases salivary flow rate in AN chewers which further increases the pH of saliva [9,12]. The common oral lesions associated with AN chewing include dental attrition, staining, dental caries, periodontal diseases, lichenoid lesions, betel chewers mucosa, oral leukoplakia, oral submucous fibrosis and oral squamous cell carcinoma [13].

As saliva is easily available, is reliable and non-invasively collected, it is widely being used as diagnostic medium in various diseases [3,14]. Very few studies are available on the relationship of AN chewing and salivary parameters [11,14,15]. The present study attempts to document the alteration in salivary pH among five selected groups of chewers and compare them with those in healthy controls.

Materials and Methods

The duration of study was a month (during September 2014). Subjects included in the study were the chewers and non chewers attending the OPD of Oral Medicine and Radiology of our institution. Three hundred healthy adult subjects who gave a history of habitual chewing of arecanut and various tobacco products for at least 4 years before the time of study and sixty healthy adults, who were non-chewers, volunteered to undergo the present study. Only male individuals between the ages of 20 - 30 years of age were selected. Those with the habit of alcohol consumption, history of any other habits, history of trauma to the head and neck, denture wearers, history of radiotherapy, patients with systemic or salivary gland diseases or under any drug therapy and patients with any lesions in the oral cavity were excluded [11,14,15]. Chewers are divided into 5 groups, 60 individuals in each group. Group I- Betel nut, group II- Tobacco, betel nut and lime, group III- Tobacco and lime, group IV- gutkha and lime and group V- only gutkha. Arecanut and tobacco products pouches were made weighing 2.10 gm each with the help of electronic weight machine, given to habitual chewers (Figure 1). Samples were collected between 9:00 am to 12:00 pm to avoid the diurnal variation in the beaker. Each subject were requested not to eat, drink or chew 60 minutes before the entire study. Subjects were seated in the dental chair and asked to chew on paraffin tablets. The stimulated saliva produced was collected in a graduated container every 1 minute for 10 minutes to both non chewers and chewers (Figure 1) and the baseline pH was immediately measured. After 5 minutes instead of paraffin tablets arecanut and tobacco products were given to habitual chewers and again the stimulated saliva was produced and pH was measured by following the previous step. In both the cases pH was measured using digital pH meter (Figure 2).

Statistics

Descriptive and inferential statistical analysis has been carried out in the present study. Analysis of variance (ANOVA) has been used to find the significance of study parameters between three or more groups of patients, Student t test (two tailed, independent) has been
Results

In comparison to all the groups of chewers, salivary pH was found to be increased in group IV chewers only i.e. 7.43 ± 0.41 on paraffin stimulated saliva and after chewing the arecanut and tobacco product it was found to be 7.51 ± 0.399 and the difference was strongly significant (p < 0.001) (Table 1 and graph 1). In group III chewers less pH was found (6.83 ± 0.33) and in group II chewers more pH was found (7.50 ± 0.41) in comparison with the other groups on paraffin stimulated saliva and the difference was strongly significant (p <

There was a significant (p < 0.001) increase in salivary pH amongst chewers as compared to non-chewers group (Table 3 and graph 2).

<table>
<thead>
<tr>
<th>pH</th>
<th>Group-I</th>
<th>Group-II</th>
<th>Group-III</th>
<th>Group-IV</th>
<th>Group-V</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BC</td>
<td>7.38 ± 0.53</td>
<td>7.50 ± 0.41</td>
<td>6.83 ± 0.33</td>
<td>7.43 ± 0.41</td>
<td>7.44 ± 0.45</td>
<td>&lt; 0.001**</td>
</tr>
<tr>
<td>AC</td>
<td>7.27 ± 0.52</td>
<td>7.40 ± 0.42</td>
<td>6.51 ± 0.31</td>
<td>7.51 ± 0.39</td>
<td>7.31 ± 0.46</td>
<td>&lt; 0.001**</td>
</tr>
</tbody>
</table>

**Table 1: Comparison of pH in five groups studied.**

**Graph 1: Comparison of pH in five groups studied. Red bar- Before chewing, Blue bar- After chewing.**

<table>
<thead>
<tr>
<th>pH</th>
<th>Before chewing</th>
<th>After chewing</th>
<th>Difference</th>
<th>t value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group-I</td>
<td>7.38 ± 0.53</td>
<td>7.27 ± 0.52</td>
<td>0.108</td>
<td>5.118</td>
<td>&lt; 0.001**</td>
</tr>
<tr>
<td>Group-II</td>
<td>7.50 ± 0.41</td>
<td>7.40 ± 0.42</td>
<td>0.108</td>
<td>9.653</td>
<td>&lt; 0.001**</td>
</tr>
<tr>
<td>Group-III</td>
<td>6.83 ± 0.33</td>
<td>6.51 ± 0.31</td>
<td>0.323</td>
<td>12.247</td>
<td>&lt; 0.001**</td>
</tr>
<tr>
<td>Group-IV</td>
<td>7.43 ± 0.41</td>
<td>7.51 ± 0.39</td>
<td>0.075</td>
<td>3.866</td>
<td>&lt; 0.001**</td>
</tr>
<tr>
<td>Group-V</td>
<td>7.44 ± 0.45</td>
<td>7.31 ± 0.46</td>
<td>0.127</td>
<td>13.378</td>
<td>&lt; 0.001**</td>
</tr>
</tbody>
</table>

**Table 2: Comparison of pH in before and after chewing in all the groups (Within group Analysis).**

<table>
<thead>
<tr>
<th>pH</th>
<th>Chewers</th>
<th>Non-Chewers</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min-Max</td>
<td>6.20 - 8.30</td>
<td>6.60 - 7.30</td>
<td>-</td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>7.32 ± 0.49</td>
<td>6.99 ± 0.14</td>
<td>&lt; 0.001**</td>
</tr>
<tr>
<td>95% CI</td>
<td>7.25 - 7.37</td>
<td>6.96 - 7.01</td>
<td>-</td>
</tr>
</tbody>
</table>

**Table 3: Comparison of pH in before and after chewing in all the groups (Between Chewers vs. non-chewers).**

Discussion

The present study shows among chewers alkaline pH was found but among non-chewer's acidic pH remains which is the normal condition. In chewers the pH becomes more alkaline after chewing. Rooban, et al. [14] found that with chewing raw AN, an increase in frequency and exposure time increased pH respectively. In processed AN chewers, increase in duration and frequency of consumption decreases pH respectively. For chewers with betel quid with tobacco, increase in duration was significantly associated with decrease in salivary pH. Kanwar, et al. [15] taken 60 subjects divided equally to tobacco smokers A, Chewers B and controls C. The mean pH for group A- 6.8, B- 6.7 and C- 7.04 when compared and a non significant relation was obtained though, group A and B showed lower salivary pH. The results shows that normal salivary pH is changed to alkaline in chewers because process of chewing itself brings copious amounts of saliva to the mouth and in the presence of added slaked lime may increase the pH in the oral environment [9,17]. Thus making it alkaline and secondarily due to parasympathomimetic activity of arecoline, arecanut chewers have high salivary flow rate which also influences the pH of saliva [12,18]. During chewing it was observed that pH changed from slightly acidic to neutral. These conditions will facilitate the formation of nitrosamines from arecoline which promotes oral cancer [19]. Alkaline pH is essential for plaque growth that causes periodontal disease [20]. Kang, et al. [21] found that salivary pH was significantly lower in cancer patients. Lime which is a major component of betel quid preparation causes changes of oral environment of chewers. It changes the pH from neutral to alkaline. Arecanut ingredients release reactive oxygen species (ROS) under alkaline conditions. These ROS are capable of inducing nucleotide modification by forming a compound called 8-hydroxydeoxyguanosine. This compound is responsible for the formation of mutated initiated cells during replication [10,16,18,22-24] among the areca alkaloids such as arecoline, guvacoline, guvacine, arecoline is the main ingredient responsible for fibroblast proliferation. Under the influence of slaked lime (Ca(OH)₂), arecoline get hydrolyzed to arecadine, which has pronounced effects on fibroblasts [22]. Anwar, et al. [25] found that the pH of saliva in patients who have leukoplakia are acidic and this pH act as good media for candida growth, while the majority saliva pH in normal individuals are alkaline, which does not shows a significant evidence of candida growth.

Conclusion

Alterations in salivary pH are observed in habitual AN and tobacco chewers. The alteration is dependent on the type of AN and tobacco chewed. The alteration in pH is vital in causation of various oral diseases.
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Bibliography


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