Salivary caries parameters: Comparative study among Yemeni khat chewers and nonchewers

Khaled Rashad Al-Alimi a*, Abdul Aziz Abdul Razak a, Roslan Saub b

a Department of Restorative Dentistry, Faculty of Dentistry, University of Malaya, Kuala Lumpur, Malaysia
b Department of Community Oral Health and Clinical Prevention, Faculty of Dentistry, University of Malaya, Kuala Lumpur, Malaysia

Received 7 February 2014; Final revision received 25 March 2014
Available online 2 June 2014

KEYWORDS
khat; saliva flow rate; saliva pH; viscosity

Abstract  Background/purpose: Millions of people in Yemen and East African countries chew khat for more than 5 hours daily for its amphetamine-like effects. Previous studies have associated khat chewing with salivary glands enlargement, inflammation, and xerostomia. However, no information is available on the possible effects of this habit on salivary parameters. This comparative study aims to evaluate salivary parameters, such as salivary flow rate, pH, and viscosity among Yemeni khat chewers and nonchewers.

Materials and methods: Stimulated saliva was collected from 30 Yemeni male khat chewers and 30 nonchewers living in Sana’a City. Salivary flow rate, pH, and viscosity were measured. Data were analyzed using the Mann-Whitney test, an independent t test and the Chi-square test.

Results: The mean salivary flow rates (mL/minute) among khat chewers and nonchewers were 0.71 ± 0.07 mL/minute and 0.99 ± 0.09 mL/minute, respectively. The independent t test showed a significant difference in salivary flow rate between the two groups at (P < 0.05).

The mean pH values among khat chewers and nonchewers were 6.32 ± 0.44 and 6.78 ± 0.35, respectively. The Mann-Whitney test showed that khat chewers have significantly lower salivary pH compared to nonchewers at (P < 0.05). The salivary viscosity of khat chewers and nonchewers also differed significantly at (P < 0.05).
Introduction

The khat plant (*Catha edulis*) is widely cultivated in certain areas of East Africa and the Arabian Peninsula, particularly in Yemen. Several million people from these regions are habitual khat chewers. The main effects of continuously chewing khat for more than 5 hours daily, such as during a social-cultural meeting, are moderate euphoria and excitation, owing to the amphetamine-like effect of this plant. This effect is mainly attributed to the alkaloid cathinone, which can be considered "a natural amphetamine".2

Khat leaves are usually kept in the lower distal buccal fold of the mouth. Chewing khat has been linked to gingivitis, periodontal pocket formation, gingival recession, dental caries, and tooth mobility.3 Previous studies have associated khat chewing with salivary enlargement, inflammation, and xerostomia.3–5

Saliva helps to maintain the balance in the oral flora to promote the health and integrity of tooth surfaces.6–8 Saliva protects the teeth against caries with mechanisms including bacterial clearance, direct antibacterial activity, buffering, and remineralization. In general, saliva lubricates the oral cavity, keeps microorganisms and food debris off the tissues and teeth, and helps in balancing the demineralization and remineralization process on the tooth surface.9

An insufficient salivary flow rate causes an inadequate salivary buffering action, which results in decreased oral pH. Consequently, the inability of the host to counterbalance the acidic environment creates an ideal condition for cariogenic bacteria.13 Saliva has major antibacterial activity through its enzymes that could improve tooth health.14 Several medications, medical circumstances, and radiotherapy to the head and neck of patients cause xerostomia (dry mouth) resulting in rampant caries.14

Guo and Shi15 recently found that saliva contains various microbes and hosts biological components that could be used for caries risk assessment. In addition, the viscosity and capability of saliva to lubricate the oral cavity, wash away microorganisms and food debris, and balance the demineralization and remineralization process on the oral cavity aid in maintaining oral health.3,10,11

The khat chewing habit may affect the properties of saliva and consequently contribute to the formation of dental caries. However, no information is available on the possible effects of this habit on salivary parameters. In this study, a comparison of salivary parameters between khat chewers and nonchewers was conducted to provide dental practitioners with knowledge on salivary caries parameters that may affect dental caries management among khat chewers.

Materials and methods

The study was approved by the research ethics committee of the University of Malaya number DFRD 1001/0009 (P). This comparative study involved 60 healthy Yemeni male khat chewers and nonchewers, aged 18–22 years, selected from private dental clinics in Sana’a City. The participants were selected based on their khat chewing habit. The participants were then divided into two groups, one with 30 khat chewers and the other with 30 nonchewers. An individual was excluded from the study if he had any special health care needs, was suffering from any systemic or metabolic diseases, had taken any medication within the last two weeks, or was undergoing orthodontic treatment.

The participants were given written instructions regarding the collection of saliva. They were asked not to eat, drink, or smoke on the day of saliva collection. They were also instructed to swallow several times to clear their mouth and stimulate new saliva. Whole saliva was obtained under basal conditions between 8:00 AM and 9:00 AM to minimize changes attributed to circadian rhythm variations. Before saliva collection, the participants were asked to rinse their mouth twice with tap water to remove food debris and other nonsalivary elements that could interfere with the measurements. All participants were subjected to trial before the collection. Saliva was then collected in a plastic cup for 5 minutes.

Saliva pH, flow rate, and viscosity measurements

All participants were instructed to sit still before saliva collection. They were also instructed to lean their head forward over the funnel, chew gum without swallowing any saliva, and spit every minute into the tube. All saliva samples were processed within a 5-minute collection process. The volume of saliva was measured using a 5 mL syringe, and the flow rate was calculated in mL/minute.

All saliva samples were collected and prepared. The samples were allowed to reach the same temperature, given that pH readings are temperature dependent. The advance pH meter 850056 (Sper Scientific Ltd, Scottsdale, Arizona, USA) was used to measure saliva pH. The pH meter was calibrated, and the manufacturers’ instructions were followed. Viscosity was assessed visually.16 A frothy and bubbly appearance indicates increased viscosity, whereas a watery and clear appearance indicates normal and healthy salivary viscosity.

Conclusion: The findings suggest that khat-chewing habits may reduce salivary flow rate, lower salivary pH, and lead to unhealthy viscosity.
Results

Salivary flow rate

Normal flow rate of stimulated saliva was found in 70% of the nonchewing group, and the difference was highly statistically significant. Low salivary flow rate was found in 100% of the khat chewers group. The mean saliva flow rate/minute for the khat chewer group and nonchewer group were 0.71 ± 0.07 mL/minute and 0.99 ± 0.09 mL/minute, respectively. The independent t test showed a significant difference in the salivary flow rate/minute between both groups at (P < 0.05). Results show that khat chewers exhibited a significantly lower salivary flow rate/minute.

Saliva pH

The mean saliva pH values for the khat chewer group and nonchewer group were 6.32 ± 0.44 and 6.78 ± 0.35, respectively. Furthermore, pH < 6.30 was found in 50% of the khat chewers. The Mann-Whitney test showed a significant difference in saliva pH between khat chewers and nonchewers at (P < 0.05). This result indicates that khat chewers exhibited significantly lower pH than the nonchewers.

Saliva viscosity

A bubbly appearance of saliva was found in 87% of the khat chewers and in 43% of the nonchewers, as shown in Table 1. A clear appearance of saliva was found in 57% of the nonchewers and 13% of the khat chewers. The Chi-square test showed a significant difference at (P = 0.001) as shown in Table 1.

Discussion

This study is the first to attempt to compare salivary parameters, such as flow rate, pH, and viscosity, between Yemeni khat chewers and nonchewers. Normal salivary flow rate imparts a strong protection against dental caries. This study found that 80% of khat chewers exhibited a stimulated salivary flow rate at almost 0.70 mL/min. A flow rate of <1.0 mL/minute is regarded as low.17,18 A significantly lower salivary flow rate among khat chewers may be associated with some predisposing factors, such as salivary gland fatigue attributed to chewing for several hours daily, lack of stimulus to the salivary gland, or a problem with the salivary gland itself. Al-Sharabi3 added that a positive association exists between khat chewing and salivary gland enlargement and inflammation. A patient with a stimulated salivary flow rate of less than 1.0 mL/minute is at risk of developing dental caries.19

In this study, khat chewers exhibited an inadequate or low salivary flow rate. The clinical findings can be attributed to the amphetamine-like effect of khat. Amphetamine users are known to have rampant caries due to reduced salivary flow.20 As a result, the lack or inadequacy of salivary flow increases the rate of caries progression.21 Al-Sharabi2 also indicated an increase in cervical caries, attrition, and staining, which may be associated with low salivary flow rate among khat chewers. Similar to the findings of this study, Yarom et al.5 reported that oral dryness occurs 30 minutes upon initiation of a khat-chewing session. Stimulating the flow of saliva alters its composition. Dawes22 noted that increasing the rate of salivary flow increases the concentration of protein, sodium, chloride, and bicarbonate while decreasing the concentration of magnesium and phosphorus. Perhaps of the greatest importance is the increase in the concentration of bicarbonate, which increases progressively with the duration of stimulation. The increased concentration of bicarbonate diffuses plaque, neutralizes plaque acids, increases pH of the plaque and favors the remineralization of damaged enamel and dentin.

In this study, the pH was significantly lower among khat chewers than nonchewers. Saliva serves an important function in optimal oral health, and new research suggests that salivary pH is more critical to the development and progression of dental caries than once thought.23 Science suggests that pH, rather than sugar, is the selective factor for cariogenic plaque biofilms. Low saliva pH is associated with reduced salivary flow and increased risk for caries.23 This study indicates that salivary viscosity of khat chewers is bubbly, which is unhealthy. Almost 90% of khat chewers have bubbly and thick saliva, whereas only 40% of the nonchewers exhibited this characteristic. Bubbly and thick saliva is unhealthy and is not watery owing to inadequate salivary flow rate. Salivary viscosity affects the aggregation of oral streptococci with Actinomyces. An increase in salivary viscosity is disadvantageous to oral health in terms of bacterial clearance from the oral cavity.24 Increased salivary viscosity may also be associated with an increase in dental caries.25 In addition, salivary viscosity is significantly influenced by pH and calcium.

The time of saliva collection was between 8:00 AM and 9:00 AM to prevent circadian rhythm variation. The participants fasted for 1 hour before saliva collection to avoid the effect of immediate food consumption and food contamination. The limitation of this study is that unstimulated saliva and buffering capacity were not measured. The flow rate may vary between stimulated and unstimulated saliva. However, no significant difference in salivary flow rate for stimulated and unstimulated saliva was reported by Heft and Baum.26 Moreover, in this study, salivary parameters were measured only on one occasion. It has been found that salivary flow rate varied from time to time.27 Within the limitations of this study, we can thus conclude that khat chewing may affect salivary parameters or properties such as flow rate, pH, and viscosity. Further consideration and studies are needed to investigate the relation between khat chewing and such findings. Further consideration recommended investigating which active components

Table 1. Saliva viscosity among khat chewers and nonchewers.

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Viscosity appearance</th>
<th>P (Chi-square test)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Bubbly</td>
<td>Clear</td>
</tr>
<tr>
<td>Khat chewers</td>
<td>30</td>
<td>26 (87%)</td>
<td>4 (13%)</td>
</tr>
<tr>
<td>Nonchewers</td>
<td>30</td>
<td>13 (43%)</td>
<td>17 (57%)</td>
</tr>
</tbody>
</table>
in khat may affect the saliva among khat chewers. Additional research is recommended to study the correlation among salivary pH, stimulated and unstimulated salivary flow rate, buffering capacity, consistency, and the presence of S. mutans presence relative to khat chewing.

Conflicts of interest

All authors declare no conflicts of interest.

References