ORIGINAL RESEARCH

Effects of Habitual Arecanut and Tobacco Chewing on Resting Salivary Flow Rate and pH

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ABSTRACT

Introduction: Chewing of areca nut is the most widely used psychoactive substance with several 100 million users world-wide. Tobacco remains one of the most preventable causes of addiction and mortality globally. Salivary parameters are altered by drugs like anticholinergic, antihypertensive agents and psychoactive substances. Tobacco and areca nut are commonly used habitual psychoactive substances with deleterious effect on oral mucosa. Hence assessment of salivary parameters in individuals who use tobacco and areca nut thereby early recognition of changes in oral mucosa can prevent serious diseases. **Aim:** 1. To assess the salivary flow rate and pH among different forms of Areca nut chewer (raw/betel leaf), tobacco users (smoking/smokeless) form and control group. 2. To observe the alteration in salivary flow rate and Ph among the same. **Result:** Alterations in salivary parameters are observed in different forms of areca nut chewers. Among tobacco users the change depends on the effect of nicotine which is linked with duration of use. **Conclusion**: Salivary flow rates and pH measurements can be used as a chair side, non-invasive method for assessing pathological changes in oral mucosa linked to the vulnerable effects among people addicted to these adverse habits thereby early recognition can prevent morbidity and mortality caused by oral precancerous and cancer state.

KEYWORDS: Salivary Flow Rate(SFR),Ph(Power Of Hydrogen),Areca Nut(AN), Tobacco

INTRODUCTION

Saliva is a complex and important body fluid which is very essential for oral health.[1] Saliva is necessary for protection, lubrication of oral mucosal tissues, remineralisation of teeth, digestion, taste sensation, stimulation, washed out effect, pH balance and phonation. It is being used for the diagnosis of a wide range of diseases.[2] It is the most easily accessible fluid in the human body and in the future it is probable that it will provide as an easy tool for non-invasive measurements of various body parameters.[3] Thus saliva plays a critical role in oral homeostasis, as it modulates the ecosystem within the oral cavity.[4]

Salivary parameters are supposed to be altered by drugs like anticholinergics, diuretics, antihistaminics, anti-hypertensive agents and psychoactive substances [2] and conditions like post-surgery, metabolic, nutritional, neurological abnormalities and hydration status.[2]

The three major salivary glands (parotid, submandibular and sublingual) contribute to 90 percent of the mixed fluid in the mouth that is known as whole saliva; minor salivary glands that are scattered throughout the mouth contribute to the remaining 10 percent of the mixed fluid. The normal daily production of saliva is between 0.5 and 1.5 litres. The submandibular glands are the major contributors to resting (unstimulated) saliva, and the parotid glands are the major contributors to stimulated saliva. The contribution of sublingual glands to unstimulated and stimulated whole saliva is low.[5]

Secretion of saliva is a reflex function emanating from salivary centres that is dependent on afferent stimulation and involves complex integration from higher centres. Salivary gland responds to both parasympathetic and sympathetic stimulus but in different ways. The parasympathetic impulses are more common, often isolated, causing a fluid secretion with a varying degree of expulsion from the acinar cells.[5,6] Parasympathetic stimulus also promotes contraction of myoepithelial cells leading to vasodilatation causing a more serous salivary secretion.[5,6] Sympathetic stimulus alters the fluid component only producing thick concentrated saliva.[7] The blood vessels in salivary gland on parasympathetic impulses cause vasodilatation supplying more blood thereby more fluid. Mobilization of water into salivary secretion in mammals is predominantly a function of parasympathetic nerves.[6]

Alteration in SFR has a significant impact on orodental health. Altered salivary gland function could be associated with oral, pharyngeal, oesophageal, neoplastic, metabolic nutritional, inflammatory, genetic, auto-immune and nervous system disorders and require early diagnosis and intervention.[6,8] It is well known that SFR

How to cite this article:
Barman I, Umesh CPG. Effects of Habitual Arecanut and Tobacco Chewing on Resting Salivary Flow Rate and pH. Int J Oral Health Med Res 2015;2(1):13-18.

may greatly vary in an individual, and if repeated samples are taken at different time points, varying results will be obtained.[9] Variation in SFR can be as high as 50% over a 24-hour period due to circadian rhythms. Further, normal variations have been shown to be age and gender independent.[9,10] Several studies of resting salivary pH estimate a range of 5.5 to 7.9, with the higher pH exhibited upon increased SFR. The pH of saliva is maintained by the carbonic acid/ bicarbonate system, phosphate system, and protein system.[5]

Areca nut is one of the most widely used psychoactive substances with several hundred million users worldwide.[11] Areca nut contains several alkaloids and tannins. Among the alkaloids, arecoline is most abundant, whereas arecaidine, guvacine and guvacoline occur in smaller quantities.[12] The common oral lesions associated with AN chewing include dental attrition, staining, dental caries, periodontal diseases, lichenoid lesions, betel chewer's mucosa (reddish crusted oral mucosa with burning sensation in AN chewers), oral leukoplakia, oral submucous fibrosis (OSF) and oral squamous cell carcinoma.[13]

In the presence of lime (calcium oxide, turns to alkali calcium hydroxide in an aqueous form) arecoline and guvacoline are largely hydrolyzed into arecaidine and guvacine respectively. Arecoline is a parasympathomimetic while arecaidine lacks it.[10] An AN can be chewed as such in raw form (RAN), or wrapped in betel leaves.[10] The Betel Quid (refered as pan) is a mixture of areca nut (Areca catechu) and slaked lime (calcium oxide and calcium hydroxide) wrapped in a betel leaf (Piper betel). Condiments, sweetening agents and spices may be added according to individual preferences.[14] Processed Areca nut forms (PAN) contains chemically or naturally cured Areca nut mixed with saffron, catechu, artificial flavouring and sweetening agents (supari) and lime (pan masala) along with tobacco (gutka). [15]

Tobacco remains one of the most important preventable causes of addiction, sickness and mortality in the world. The smoking and chewing of tobacco products has a number of well- documented side-effects on the oral cavity. These cover a range of implications from those that alter a person's appearance to others that are potentially fatal.[16] Smoking of tobacco as factory-made cigarettes, cigars and loose tobacco in pipes or hand-made cigarettes is familiar to all. Tar, nicotine, and nitrosamine content vary greatly, depending on species, curing additives, and method of combustion.[17] Tobacco, which is often chewed along with AN (PAN,BQT (betel quid mixture) and nicotine of tobacco acts on certain cholinergic receptors in the brain and other organs causing a neural activation.[18]

Tobacco usage immediately stimulates salivary flow, but there is no long-term effect on saliva flow rates. The pH of saliva rises during smoking, but over longer time periods most studies indicate that smokers have slightly reduced pH.

Few studies have been done on the influence of Areca nut and tobacco use on the salivary parameters. Given the paucity of literature on the influence of [3] areca nut chewing and tobacco use [19] on SFR and pH, the present study was undertaken to observe the alteration in SFR and pH between Areca nut, tobacco and control groups.

MATERIALS AND METHODS

The study was conducted to assess the salivary flow rate and pH among habitual Areca nut chewers and tobacco users and compared with the control group

Selection of Subjects: A total of 60 subjects were included in the study of which 20 were Areca nut chewers(10-raw and 10 with betel leaf), 20 tobacco users (10 –smoking and 10- smokeless form) and 20 non-chewers which was taken as a control group.

Volunteers suffering from any systemic illness, drug therapy or radiotherapy, occasional Areca nut/tobacco users, and pregnant women were not included in the study.

Saliva collection method: Salivary collection was done between 9.00am to 12:00 pm to avoid diurnal variation. Each subject was requested not to eat, drink or perform oral hygiene or chew or smoke 60 minutes before and during the entire study. Subjects were then seated in the dental chair and asked to spit on a graduated container for 10 minutes.During saliva collection, subjects were instructed not to speak or swallow. After collection, the SFR was measured and expressed in mL/ minutes on the graduated tube (Fig 1).

Salivary pH was measured immediately after measuring SFR using the pH meter(HICOM, India). Manufacturer's instructions were followed while measuring salivary pH. The corresponding value recorded in the pH meter was recorded and taken as the salivary pH (Fig 2).

Statistical Analysis: Data were entered and analyzed. Student t-test was employed to find the statistical significance of the difference in mean SFR and mean pH between areca nut chewers, tobacco users, and non-chewers. Student t-test was utilized to find the mean difference in SFR and pH in duration, intensity and frequency among various types of areca nut and tobacco users. A p value of less than 0.05 was considered as statistically significant.

RESULTS

The study group comprised of 20 areca nut chewers, 20 tobacco users, and 20 non-chewers as control. The salivary flow rate and pH of all the subjects are listed in

TABLES

- Table 1,2 : Areca nut chewers (raw Areca nut and Areca nut with betel leaf)
- Table 3,4 : Tobacco users (smoking and smokeless forms) and

- Table 5 : Non-chewers (control)
- Table 6: Mean value of salivary flow rate between raw Areca nut chewers & non-chewers
- Table 7: Mean value of salivary flow rate between Areca nut (pan) & non-chewers
- Table 8: Mean value of salivary flow rate between smoking form of tobacco & non-chewers
- Table 9: Mean value of salivary pH rate between smokeless form & non-chewers
- Table 10: Mean value of salivary pH rate between raw Areca nut & non-chewers
- Table 11: Mean value of salivary pH rate between Areca nut (pan) & non-chewers
- Table 12: Mean value of salivary pH rate between smoking form of tobacco & non-chewers
- Table 13: Mean value of salivary pH rate between smokeless form of tobacco & non-chewers

The mean salivary flow rate for raw areca nut chewers is 3.46±1.18, and non-chewers is 1.85 ±0.56.The difference was statistically significant whereas the flow rate between areca nut chewer (pan) is 2.21±0.50, and non-chewer is 1.85± 0.56 which is statistically non-significant.

Among tobacco users, the mean salivary flow rate between smoker is1.97±0.40 and non-chewers is 1.93± 0.61. The difference was statistically non -significant whereas the flow rate of smokeless form is 2.12±0.40 and 1.93±0.61 for non-chewers which are also statistically non-significat (Fig 3).

In reference to pH, the mean pH among raw Areca nut is7.60±0.68, and non-chewer is 6.95±0.17 which is statistically non-significant. Among Areca nut (pan) the mean pH is 6.45±0.25, and non-chewer is 6.95±0.17 which is also non-significant.

The mean pH of smoking form of tobacco and non-cheweres are 7.0±029, and 6.89±0.15 which is statistically non- significant. For smokeless form it is 6.96±0.13 and non-chewer 6.89±0.15 and is non-significant (Fig 4).

S.No	S.F.R.	pH
01	4.2ml/min	7.62
02	3.8ml/min	7.56
03	1.6ml/min	8.7
04	1ml/min	8.76
05	3.8ml/min	7.47
06	4ml/min	7.20
07	3.9ml/min	7.40
08	4.3ml/min	6.86
09	4.5ml/min	7.78
10	3.5ml/min	6.68

Table 1: SFR & pH among raw Areca nut

S.No	S.F.R.	pH
01	2ml/min	6.4
02	1ml/min	6.2
03	2.2ml/min	6.27
04	2.6ml/min	6.66
05	1.9ml/min	6.11
06	2.5ml/min	6.82
07	2.8ml/min	6.80
08	2.4ml/min	6.45
09	2.2ml/min	6.22
10	2.5ml/min	6.62

Table 2:SFR & pH among arecanut & betel leaf

S.No	S.F.R.	pH
01	2ml/min	7.3
02	2.3ml/min	6.9
03	1.8ml/min	7
04	1.5ml/min	6.8
05	2.5ml/min	7.23
06	2ml/min	7.32
07	2.1ml/min	6.69
08	1.9ml/min	7.4
09	2.4ml/min	6.66
10	1.2ml/min	6.7

Table 3: SFR & pH among smokers

S.No	S.F.R.	pH
01	2.4ml/min	7.1
02	2.5ml/min	6.9
03	1.5ml/min	6.8
04	2.4ml/min	6.7
05	2ml/min	7.2
06	1.6ml/min	6.9
07	1.9ml/min	7
08	2.5ml/min	6.86
09	1.8ml/min	7
10	2.6ml/min	7

Table 4: SFR & pH among smokeless form

S.No	S.F.R.	pH
01	1.5ml/min	6.8
02	1.7ml/min	6.8
03	2ml/min	6.7
04	1.3ml/min	6.9
05	2.5ml/min	6.7
06	2.8ml/min	7.2
07	2.5ml/min	6.8
08	1ml/min	6.9
09	1.5ml/min	6.8
10	2.5ml/min	7.1
11	1ml/min	6.9
12	2ml/min	7.2
13	1.5ml/min	7.2
14	2.5ml/min	6.7
15	2ml/min	7.1
16	1.5ml/min	7
17	2.5ml/min	6.9
18	2ml/min	7.3
19	1ml/min	6.8
20	1.6ml/min	6.9

Table 5: SFR & pH among non chewers (control group)

FORMS	MEAN± SD	t- value	p - Value	Significance
Raw Arecanut	3.46± 1.18			
Non Chewers	1.85 ± 0.56	5.07	0.000	Significant

Table 6: Mean value of salivary flow rate between raw arecanut chewers & non chewers

FORMS	MEAN± SD	t- value	p - Value	Significance
Chewers	2.21± 0.50			
Non- Chewers	1.85± 0.56	1.7	0.105	Non-Significant

Table 7: Mean value of salivary flow rate between arecanut (pan) chewers & non chewers

FORMS	MEAN±SD	t-value	p - Value	Significance
Smoking form	1.97± 0.40 –			
Non-Chewers	1.93± 0.61	0.173	0.86	**Non significant**

Table 8: Mean value of salivary flow rate between smoking form of tobacco & non-chewers

FORMS	MEAN± SD	t- value	p - Value	Significance
Smokelessform	6.96± 0.13 –			
Non- Chewers	6.89± 0.15	1.11	0.29	**Non -Significant**

Table 9: Mean value of salivary pH rate between smokeless form & non-chewers

FORMS	MEAN± SD	t- value	p - Value	Significance
Raw Arecanut	7.60± 0.68 –			
Non -Chewers	6.95± 0.17	4.06	0.000	**Significant**

Table 10: Mean value of salivary pH rate between raw arecanut & non-chewers

FORMS	MEAN± SD	t-value	p - Value	Significance
Arecanut Chewers (pan)	6.45± 0.25 –			
Non- Chewers	6.95± 0.17	6.25	0.000	**Significant**

Table 11: Mean value of salivary pH rate between arecanut (pan) & non-chewers

FORMS	MEAN± SD	t- value	p - Value	Significance
Smoking form	7.0± 029 –			**Non-**
Non-Chewers	6.89± 0.15	1.08	0.30	**Significant**

Table 12: Mean value of salivary pH rate between smoking form of tobacco & non-chewers

FORMS	MEAN± SD	t- value	p - Value	Significance
Smokeless form	6.96± 0.13 –			**Non -**
Non- Chewers	6.89± 0.15	1.11	0.29	**Significant**

Table 13: Mean value of salivary pH rate between smokeless form of tobacco & non-chewers

DISCUSSION

The effects of arecanut chewing are habit related and dose dependent. The report of effects being more pronounced in fresh or occasional chewers and less in habitual chewers suggests that tolerance or habituation occurs in areca nut use.[10] Hence, habituation to the stimulus occurs in the receptors.

Fig 1: Saliva recorded and expressed in ml/min on a graduated tube.

Fig2: Salivary pH recorded in a pH meter

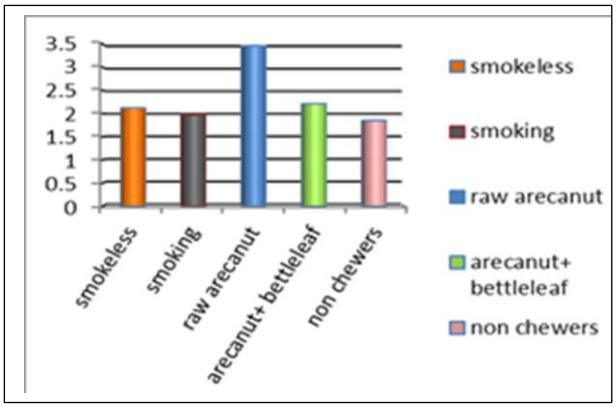

Fig 3: Graph showing relation between salivary flow rate among different form of areca nut chewers, tobacco users and non-chewers (control)

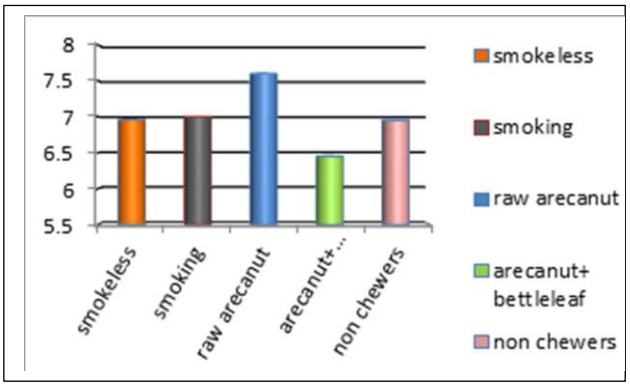

Fig4: Graph showing relation between pH among different form of areca nut chewers, tobacco users and non-chewers (control)

Raw arecanut chewers have the highest mean salivary flow rate as compared to the non- chewers and another chewer. This is due to the parasympathmimetic activity of arecoline. In arecanut(pan) the mean salivary flow rate drops probably due to lime that converts arecoline to arecaidine

The pH of raw arecanut increases with increase in salivary flow rate as an increase in saliva bicarbonate increases the pH. In arecanut, (pan) with lime as a constituent reacts with bicarbonate buffering system by the loss of bicarbonate, turning saliva more acidic. In case of chewers using coarser RAN, there is increased SFR as it requires more masticatory force. The statistical significant correlation between SFR and pH in chewers shows an increasing pattern may reflect an alteration in the electrolyte constituent of saliva in chewers. [20] The alteration in electrolytes and ions alters the pH as they interact with the buffering systems of saliva.

It is especially important to understand that harmful effects of tobacco products are dose-dependent, that they depend more on abuse than on simple use.[21]

It is generally believed that repeated exposure of a receptor to a stimulus results in inactivation (suppression or adaptation) of the receptor. Most of the methods of tobacco use are linked to the oral cavity where the taste receptors, a primary site for stimulation of salivary secretion, are constantly exposed to tobacco for long time.[22] It has been discovered that smoking increases the activity of salivary glands and, indeed, this observation has been made by everyone who begins smoking.[23] Tobacco usage immediately stimulates salivary flow, but there is no long-term effect on saliva flow rates. The pH of saliva rises during smoking, but over longer time periods most studies indicate that smokers have slightly reduced pH and buffering power compared to non-smokers. A consistent finding is an increased concentration of thiocyanate in saliva. A component in normal saliva, thiocyanate is also present in tobacco smoke, and its concentration in saliva can be used to monitor tobacco exposure.[24] It has also been observed that some tolerance develops to the salivatory effects. The effect of nicotine on the taste nerve apparatus appears to be initial stimulation followed by depression.[23] Thus, it can be concluded that salivary reflex is not adversely affected by long-term use of tobacco.

In this study, the mean salivary flow rate and pH among the different form of tobacco users and non-chewers are non-significant in nature.

Our observations are based on this preliminary study, in which the sample size was small.Very few studies have been made to site the SFR and pH in areca nut chewers and tobacco users and one to point the difference in SFR and pH between different forms. We consider further analyses like: amount of active compounds released [10] from arecanut and tobacco during chewing/using and also those that are absorbed into the circulation and the brain, possible complex interactions between various absorbed active compounds in the brain and the autonomic nervous system, the biological in-equivalence of [10] all components of arecanut and tobacco products and the sensitization of receptors and habituation with chronic chewing in a larger sample will reveal processes involved in arecanut chewing/tobacco use and their effect on SFR and pH.

CONCLUSION

Alterations in salivary flow rate and salivary pH are observed in habitual areca nut chewers. The alteration is dependent on the type of areca nut chewed. The alteration in SFR and pH are vital in causation of various oral diseases. Moreover, the complex action of areca nut chewing is also reflected as variation in SFR and pH. The salivary flow rate and pH remains unaffected with the long term use of tobacco hence among tobacco users the changes depends on the effect of nicotine which is linked with duration of use.

Hence salivary flow rate and salivary pH measurements can be used as a chair side, non-invasive measures for assessing the pathological changes in oral mucosa linked to the vulnerable effects among people addicted to these adverse habits thereby early recognisation can prevent morbidity and mortality caused by oral precancerous and cancer state.

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Source of Support: Nil
Conflict of Interest: Nil