

EFFECTS OF LONG-TERM USE OF TOBACCO ON TASTE RECEPTORS AND SALIVARY SECRETION

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Background: Most of the methods of tobacco use are linked to the mouth, where the taste receptors, a primary site for stimulation of salivary secretion, are constantly exposed to tobacco. The main purpose of this study was to observe the effects of long-term use of tobacco on taste receptors and salivary flow rates. **Methods:** Subjects of the study were divided into smokers, pan, (tobacco-betel-lime quid) chewers, niswar (moist oral snuff) dippers and non-tobacco users as controls. Each group was comprised of 20 healthy male adults. The saliva of each subject was collected under resting condition and following application of crude nicotine and citric acid solutions to the tip of his tongue. **Results:** The appreciation of taste sensations perceived by each subject of each group was different for nicotine (bitter unpleasant burning sensations) than citric acid (sour burning sensations) but no subjective difference was observed among the corresponding groups. After stimulation with both nicotine and citric acid, all subjects of each group showed a significant rise ($p < 0.05$) in their salivary flow rates but the increase was highly significant ($p < 0.005$) in pan chewers only. **Conclusion:** We found that the taste receptors response and salivary flow rates of tobacco users were not much different from that of non-tobacco users. Therefore, we conclude that long-term use of tobacco does not adversely affect the taste receptors response and hence salivary secretion.

Keywords: Tobacco, taste receptors, Saliva

INTRODUCTION

Use of tobacco is a world wide problem and the traditional methods of tobacco use are smoking, snuffing, chewing and dipping. Chronic use of tobacco is causally linked to a variety of serious diseases, ranging from coronary artery disease to lung cancer.¹ However it was in 18th century when it was discovered that smoking increases the activity of salivary glands. Indeed, this observation has been made by every one who begins smoking. It has also been observed that some tolerance develops to the salivary effects of smoking because habitual smokers do not salivate as do novice smokers in response to smoking.² However, it has also been seen that there is no difference in the secretion rate of saliva between smokers and non-smokers.³ It was observed that regular, but not immediate, smoking did not cause any significant change in the salivary flow rate.⁴

Mostly it is believed that long term use of tobacco depresses or inactivates the taste receptors and salivary reflex. Presumably, this might lead to altered taste receptors response and hence to changes in salivary secretion. The present study was designed to document these changes, if any.

MATERIAL AND METHODS

The subjects were selected from the students of Basic Medical Sciences Institute (BMSI), Jinnah Post Graduate Medical Centre (JPMC) and the general population of Karachi.

The subjects were divided into smokers, pan (tobacco-betel-lime quid) chewers, niswar (moist oral snuff) dippers and non-tobacco users as controls. Each group comprised of 20 apparently healthy male adults. All the subjects were well matched with respect to age (25-30 years) and the duration of beginning tobacco use (5-7 years). Subjects in the habit of more than one type of tobacco use or bad oral hygiene or with too little salivary secretion were not included in the study.

Before sampling, each subject was briefed about the procedure and instructed to wash his mouth and gargle with plain water. The saliva of each subject was collected (for 10 minutes) under resting condition and following application of crude nicotine solution (50 μ l of 1% v/v) and citric acid solution (50 μ l of 1% w/v) to the tip of his tongue. Crude nicotine was extracted from tobacco⁵ and citric acid was obtained from the Physiology Department of BMSI, JPMC, Karachi. Flow rate (ml/min) of saliva was determined by allowing the saliva to flow into a graduated tube. Taste is a subjective phenomenon and was determined by the individual himself. The data was statistically analyzed by Student's T test.^{6,7}

RESULTS

Taste sensations

The appreciation of taste sensation was different in case of nicotine stimulation from that in case of citric stimulation. Each of the subjects of all groups perceived a bitter burning taste when nicotine solution was applied to the tip of his tongue. However, the application of citric acid caused a sour burning taste in all the subjects of all groups.

Salivary flow rate

The mean salivary flow rate of controls (0.44 ± 0.04 ml/min) smokers (0.49 ± 0.05 ml/min) pan chewers (0.47 ± 0.04 ml/min) and niswar dippers (0.47 ± 0.04 ml/min) did not show great variation from one another and no statistically significant difference ($P > 0.05$) was observed when the chronic tobacco user groups were compared with controls under resting condition (Figure 1).

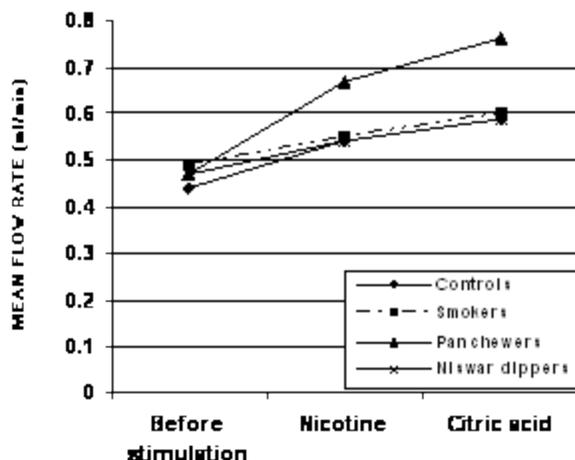


Figure-1: Change in mean salivary flow rate of controls, smokers, pan chewers & niswar dippers, following stimulation with 50µl of 1%(v/v) crude nicotine & 50µl of 1%(w.v) citric acid

Following stimulation with nicotine, there was a gradual increase in the flow of saliva of all groups which then gradually declined to the resting level. The mean flow rates were 0.54 ± 0.04 ml/min in control, 0.55 ± 0.05 ml/min in smokers, 0.67 ± 0.04 ml/min in pan chewers and 0.54 ± 0.04 ml/min in niswar dippers. The increase in the mean flow rate of controls (22.73%) smokers (12.25%) pan chewers

(42.55%) and niswar dippers (14.89%) was statistically significant ($P < 0.05$) in controls, highly significant ($P < 0.005$) in pan chewers but not significant ($P > 0.05$) in the other two groups. When the mean salivary flow rates of the chronic tobacco users were compared with the corresponding mean salivary flow rates of controls, a statistically significant difference ($P < 0.05$) was observed in case of pan chewers only (Table 1).

After stimulation with citric acid, an abrupt rise was seen in the flow of saliva of all groups and then gradually declined to the basal level. The mean flow rates were 0.59 ± 0.05 ml/min in controls, 0.60 ± 0.05 ml/min in smokers, 0.76 ± 0.04 ml/min in pan chewers and 0.59 ± 0.04 in niswar dippers. The increase in the mean flow rates of controls (34.09%), smokers (22.45%), pan chewers (61.70%) and niswar dippers (25.53%) was not statistically significant ($P > 0.05$) in controls and niswar dippers and highly significant ($P < 0.005$) in pan chewers. On comparison the mean salivary flow rates of chronic tobacco user groups with that of controls, the only statistically significant difference ($P < 0.5$) was observed in case of pan chewers (Table 1).

Table-1. Comparison of mean salivary flow rate (ml/min) of controls, smokers, pan chewers and niswar dippers, before and after stimulation with 50µL of 1% (v/v) Crude Nicotine and 50µL of 1% (w/v) Citric acid

Group	Mean salivary flow rate (ml/min) ±S.E.		
	Before stimulation	Following stimulation with	
		Nicotine	Citric acid
Controls	0.44 ± 0.04	0.45 ± 0.04 (22.73%)#	0.59 ± 0.05 (34.09%)#
Smokers	0.49 ± 0.05	0.55 ± 0.05 (12.25%)	0.60 ± 0.05 (22.45%)
Pan chewers	0.47 ± 0.04	0.67 ± 0.04* (42.55%)##	0.76 ± 0.04* (61.70%)##
Niswar dippers	0.47 ± 0.04	0.45 ± 0.04 (14.89%)	0.59 ± 0.05 (25.53%)#

Percent (%) increase is given in parenthesis

* $p < 0.05$ as compared with corresponding mean value in controls.

$p < 0.05$ and ## $p < 0.005$ as compared with its mean value before stimulation

DISCUSSION

The salivary secretion is a complex process and its flow and composition vary greatly under different conditions. On the basis of some experiment it was thought that saliva collected routinely in the laboratory as “resting” saliva is in fact stimulated or activated secretion and gross variation in the rate of its secretion are due to fluctuation in intensity and frequency of internal stimulation.⁸ It is said that the secretion of saliva from the salivary glands is generally elicited only in response to stimulation of the automatic innervation to the glands or in response to drugs that mimic the actions of automatic innervation.⁹ It was also found that different chemicals stimulate the salivary secretion differently.¹⁰ It has been observed that the pattern of taste sensations and salivary secretion in man following application of compounds, like nicotine and citric acid, to the tongue, which activate lingual sensory neurons, differ not only between the agents used but also between different sites of application.¹¹ It is suggested that oral mucosal wetness and minor salivary gland secretion could be influenced by various factor differently according to mucosal sites.¹² Moreover, temperature of stimulating substances also affects salivary secretion because the stimuli in the form of ice were the most effective and liquids at 37°C were least effective in stimulating salivary flow.¹³

The present work revealed that the appreciation of taste sensations evoked by the application of nicotine and citric acid to the tongue were different in the same individual but no subjective difference was observed between tobacco users and non-tobacco users. In this regard the taste receptors response to either of the compound was similar in all groups.

It was noted that buffering response in smokers in response to drinking acidic carbonated beverages is 20% lower than in non-smokers. On this basis an in activation of the taste receptors by nicotine was suggested as an explanation for this depression of the salivary reflex.¹⁴ Although we have not studied the buffering response of saliva in our study, yet we were unable to find any significant difference in the salivary response to stimulating substances between tobacco users and non-tobacco users. It seems, therefore, somewhat unreasonable to suggest an inactivation of the taste receptors merely on the basis of lowered buffering response of saliva in smokers. Moreover it was also found that the pH of stimulated whole saliva, in both sexes, was lower in smokers than non-smokers⁴. In our opinion, this lowered buffering response to acidic carbonated beverages might be due to this acidic pH in these individuals. Similarly no statistically significant different was observed for either over all taste sensitivity or for the specific taste primaries between smokers and non-smokers.¹⁵

We found that lingual apex application of nicotine and citric acid was associated with a rise in salivary secretion rate but the salivation response to citric acid was abrupt and more pronounced as compared to nicotine proving that citric acid is more potent and quicker in its action. However, the flow rates in pan chewers were comparatively higher and significant. The authors of one study, who also found similar higher flow rates in pan chewers, were of the view that this might actually be due to increased salivary gland mass induced as a result of chronic chewing or due to chronic exposure to one or all of the constituents of tobacco-betel-lime quid.¹⁶ However, it seems reasonable to us that tobacco on its part,

might not be responsible for the increased gland mass induction in pan chewers, for it would also bring similar changes in smokers and niswar dippers.

The effect of nicotine on the taste nerve apparatus appears to be initial stimulation followed by depression². In the study under consideration the initial increase in the flow of saliva following stimulation by both nicotine and citric acid and then gradual decline also gives similar impression but before establishing such an opinion it must be bore in mind that increased flow of saliva also gradually washes the stimulating substances.

We have seen, that the behavior of taste sensations and salivary secretion in chronic tobacco users are not much different from that in non-tobacco users. In view of the previous studies and our own experimental work, it is therefore concluded that long term use of tobacco does not adversely affect the taste receptors, salivary reflex and salivary secretion.

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