Original Article

Effect of using tobacco on taste perception

Yugandhara S. Kale[1], Nupura Vibhute[1], Uzma Belgaumi[1], Vidya Kadashetti[1], Sushma Bommanavar[1], Wasim Kamate[1]

[1]Department of Oral Pathology and Microbiology, School of Dental Sciences, Krishna Institute of Medical Sciences "Deemed to be University", Malakapur, Karad, Satara, Maharashtra, India

Abstract

Background: Impaired taste perception has impact on quality of life. Tobacco is a perilous factor that contributes to an impaired taste. **Objective:** To evaluate and compare taste perception among tobacco chewers and nonchewers. **Materials and Methods:** Sixty subjects (30 tobacco chewers + 30 nonchewers as controls) were enrolled in the study for evaluating taste perception. Taste identification time using four aqueous solutions of basic tastes – sweet, salty, sour, and bitter – was recorded (in seconds) and compared between tobacco chewers and controls. The data were analyzed using Student's *t*-test and analysis of variance using SPSS 20 version software. **Results:** A statistically significant increase in taste identification time for salty taste in tobacco chewers (12.32 s) was noted compared with nonchewers (10.21 s) ($P = 0.03$). The average taste identification time was higher for tobacco chewers than nonchewers for sweet and salty taste. However, the average taste identification time was lower for tobacco chewers than nonchewers for sour and bitter taste. In nonchewers, the average taste identification time was 13.01, 10.21, 8.43, and 7.56 s for sweet, salty, bitter, and sour taste, respectively. In tobacco chewers, the average taste identification time was 15.16, 12.32, 7.75, and 7.04 s for sweet, salty, bitter, and sour taste, respectively. **Conclusion:** The results of the study demonstrated noticeable decrease in taste perception to salty taste among tobacco chewers when compared with tobacco nonchewers. There is a remarkable difference in taste perception to basic tastes among tobacco chewers and controls.

Keywords: Basic tastes, taste identification time, taste perception, tobacco

Introduction

When a substance in the mouth reacts chemically with the taste receptor cells located on taste buds in the oral cavity, predominantly over the dorsum of tongue, they produce "taste" sensation.[1] The sense organs for taste or gustatory sensation are the taste buds, which are ovoid bodies with a diameter of 50–70 μm. Apart from tongue, taste buds are also found on the pharynx, palate, uvula, epiglottis, and at the beginning of esophagus.[2] The common causes of taste disturbances include oral and perioral infections, oral appliances, aging, gastric reflux, systemic conditions such as diabetes mellitus, pernicious anemia, Sjogren's syndrome, and so on.[2] Various medications, trauma, metal exposure, surgical procedures, and radiation may also contribute to an impaired taste perception. In the recent data provided by the Government of India's National Sample Survey, there are 184 million tobacco consumers in India. About 40% of these tobacco consumers take smokeless tobacco, 20% population consume cigarettes, and another 40% smoke beedis.[3] Tobacco is composed of several components such as nicotine, carbon monoxide, nitrogen oxides, and metals, and many of them act as chemical carcinogens and irritants. Tobacco in any form (smoke/smokeless) when used intraorally, the chemicals from it get leached out in oral mucosa and may alter taste parameters.[4] The taste perception has been studied and evaluated in cases of aging,[1] denture wearers,[2] oral submucous fibrosis,[4] radiation,[5] chemotherapy,[6] and use of specific medications.[7]

Address for correspondence: Dr. Yugandhara S. Kale, Department of Oral Pathology and Microbiology, School of Dental Sciences, Krishna Institute of Medical Sciences "Deemed to be University," Malakapur, Karad, Satara - 415 539, Maharashtra, India.
E-mail: dharapawar90@gmail.com

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Yet, corroboration correlating the use of tobacco and taste perception is sparse. This contemplated the intention of the study. Thus, the this study was aimed to evaluate these taste perception parameters among tobacco chewers and to compare it with nonchewers.

Materials and Methods

A comparative study was conducted to assess and compare taste identification time among 60 patients (30 tobacco chewers + 30 non-chewers) visiting the Department of Oral Pathology and Microbiology, School of Dental Sciences, KIMS "Deemed to be University," Karad, the ethical clearance was obtained from the institutional ethical committee on 11-12-2018. The subjects were clarified regarding the objectives and protocol of the study, and a signed informed consent, agreeing to their participation, was taken from all the participants.

The study group comprised patients presenting with a history of chewing tobacco for more than 6 months,[4] and the age group of 25–50 years of either sex was taken. The individuals with the same age group of either sex with no deleterious tobacco habits were taken as the control group. Subjects with history of any systemic disease, smoking, head trauma, upper respiratory tract infections, chemotherapy, radiation therapy, and use of any medications known to influence taste perception were excluded from the study.

Four taste variables were prepared using aqueous solutions containing 50% sucrose for sweet taste, 0.9% saline solution for the salty taste, 4.2% solution of vinegar for sour taste, and 20% of coffee solution (without sugar) for bitter taste.[8] The study was performed in the morning hours (09:00 am–11:00 am) for eliminating the bias in results caused due to circadian variation, and subjects were abstained from eating and drinking 1 h prior to the appointment.[4] Subjects were asked to rinse the mouth with distilled water and a stopwatch was given in their right hand to record the time duration of taste identification. The aqueous solutions with four basic tastes, that is, sweet, salty, sour, and bitter were presented to the subjects with the help of paper strips of equal size and shapes. The taste strips were placed on the anterior two-third of the dorsum of tongue. After placing the strips, the taste recognition time (in seconds), recorded by the subjects, was documented for every taste. Between testing of each of the samples, the subjects were asked to rinse their mouth thoroughly with distilled water.

Statistical analysis

All the findings were entered in Microsoft Excel using SPSS 20.0 software and were expressed as mean and standard deviation and calculated using one-way analysis of variance (ANOVA). Unpaired *t*-test was done to compare taste identification time in study and control groups. A $P < 0.05$ indicated significant association at 5% level of significance.

Results

A total of 30 control subjects were matched with 30 study subjects. Unpaired *t*-test was done to compare taste identification time in study and control groups [Table 1].

It was found that the average taste identification time was higher for tobacco chewers than nonchewers for sweet and salty taste. Hence, the taste perception was lower for tobacco chewers than nonchewers for sweet and salty taste.

Taste identification time was significantly higher for salty in tobacco chewers (12.32) than nonchewers (10.21) ($P = 0.03$). Hence, the taste perception was lower for tobacco chewers than nonchewers for salty taste.

It was also found that the average taste identification time was lower for tobacco chewers than nonchewers for sour and bitter taste. Hence, the taste perception was higher for tobacco chewers than nonchewers for sour and bitter taste.

One-way ANOVA was done to compare between different tastes' identification times of tobacco nonchewers. It was found that there was a significant difference between different tastes for group of tobacco nonchewers ($P < 0.05$). The average taste identification time for sweet (13.01) was significantly higher than salty (10.21) which was higher than bitter (8.43) followed by sour taste (7.56) [Table 2].

One-way ANOVA was done to compare between different tastes' identification times of tobacco chewers. It was found that there was a significant difference between different tastes for group of tobacco chewers ($P < 0.05$).The average taste identification time for sweet (15.16) was significantly higher than salty (12.32) which was higher than bitter (7.75) followed by sour taste (7.04) [Table 3].

Discussion

The gustatory cortex is amenable for taste perception.[1] In adults, about 1000 taste buds are present.[2] Taste buds are capable to differentiate among different tastes through detecting interaction with different molecules or ions.[1] The taste sensation comprises four established basic tastes: sweetness, saltiness, sourness, and

Table 1: Comparison of taste identification time (in seconds) in tobacco chewers and nonchewers

Taste	Groups	*n*	Mean	Std. deviation	*t* statistic	*P*
Sweet	Control group	30	13.01	4.69	1.60	0.12
	Study group	30	15.16	5.69		
Salty	Control group	30	10.21	3.91	2.22	0.03*
	Study group	30	12.32	3.47		
Sour	Control group	30	7.56	2.74	0.83	0.41
	Study group	30	7.04	2.15		
Bitter	Control group	30	8.43	3.51	0.97	0.34
	Study group	30	7.75	1.68		

*Statistically significant

Table 2: Taste identification time (in seconds) in tobacco nonchewers

Tobacco nonchewers	Minimum	Maximum	Mean	Std. deviation	*F* statistic	*P*
Sweet	5.8	22	13.01	4.69	12.14	<0.001
Salty	3.3	19.3	10.21	3.91		
Sour	2.8	16	7.56	2.74		
Bitter	4.3	20.8	8.43	3.51		

Table 3: Taste identification time (in seconds) in tobacco chewers

Tobacco chewers	Minimum	Maximum	Mean	Std. deviation	*F* statistic	*P*
Sweet	7.8	28.5	15.16	5.69	34.47	<0.001
Salty	6.1	20.8	12.32	3.47		
Sour	3.2	12.4	7.04	2.15		
Bitter	4.5	12.1	7.75	1.68		

bitterness.[9] Data based on counting the papillae on a series of cadaver tongues suggested an average of approximately 200 fungiform papillae per tongue contributing to taste perception. However, taste sensations rely not only on the count of papillae but also on the integrity of taste bud distribution within papillae and nerve fibers carrying information from papillae to brain.[10] The classic taste map of the tongue shows that sweet taste is perceived on the tip of the tongue, salty at the lateral border of the tongue, and bitter and sour on the posterior part and lateral areas of tongue. It is now known that all four basic taste quantities can be perceived in all areas of the tongue and palate where taste buds are located.[11] Taste cannot be broken down onto these four primaries, sweet, sour, salty, and bitter, but that it consists of a range of stimuli that form a spectrum of sensations making up all taste senses.[12]

Among human beings, taste perception begins to wane around 50 years and above because of loss of tongue papillae and a gradual decline in salivary flow rate.[13] Saliva serves a vital role in taste sensation as it dissolves the taste stimulus to taste buds.[4] Alteration in salivary flow due to any possible reason can in turn have effect on its pH which is essential in buffering activity and ultimately the taste perception.[14] Various studies propose that the sensory-specific satiety reduces with age.[15] The decrease in taste intensities is because of the reduced number of taste buds and the shrinkage of some of the taste buds.[1]

Tobacco exposes the chewer to ~4720 toxic substances; 60 of them have cancer-causing potential, proven to be hazardous to the general health of the individual. When these substances are explored to the gustatory systems, it causes injuries that might be reversible or irreversible.[16] The exposure time, concentration, and toxicity of tobacco determine the degree of the injury induced.[17] An impaired gustatory function is an outcome of the change in form, quantity, and vascularization of the taste buds induced by tobacco consumption.[18] Tobacco also causes noteworthy changes in size, shape, and vascularization of the papillae,[19,20] decreasing the number of taste receptor cells,[10,21] and also influencing salivary glands.[22,23] One other explanation concerning the mechanism of reduced taste sensitivity is that nicotine from the tobacco acts at a central level and regulates the taste signal. An experimental study on rats revealed that when nicotine is applied over the tongue surface, it showed modified response of the neurons in the nucleus of the solitary tract and relay in the gustatory pathway of taste buds of the tongue.[24]

Tobacco on consumption releases various byproducts such as nitrosamine and nitrosonornicotine which on close contact with mucosa facilitates infiltration of these products into mucosa and can influence cellular morphometry causing pronounced cellular changes.[25] These irritants are also responsible for thickening of the epithelium, that is, hyperkeratosis of the papillae and this thereby alters taste identification time.[26] Tobacco causes peripheral vasoconstrictions. Carbon monoxide and other chemicals generated during combustion of tobacco can hamper capillary blood flow within mouth.[27]

A general trend was observed that sweet taste was perceived in a better degree in comparison to the other tastes.[1] In this study, the salty taste is mainly affected followed by sweet, bitter, and sour taste, which is in agreement with a study conducted by Deeplaxmi *et al.*[28] Khan *et. al.* in their case–control study concluded that smokers have elevated taste threshold because of reduced number of fungiform papillae over the dorsum of tongue.[10] Dyasanoor and Khader also demonstrated marked decrease in taste perception to salty and sour taste among oral submucous fibrosis subjects.[4] Da Ré *et al.* in their review mentioned a study regarding pleasantness of taste; sucrose registered higher ratings in comparison to salt solutions. They also found that the withdrawal factor was also statistically significant, reflecting higher pleasantness ratings in nonabstinent. The data collected showed the relationship between smoking and flavor, which may contribute to the known effects of smoking on appetite and feeding behavior.[29] Tobacco consumption not only affects taste perception but also declines inhibitory control and executive functions (including emotions, cognition, and affective decision-making) in chronic chewers. They have been found to be exhibited brain alterations associated with severity and duration of tobacco use.[30] Such findings could provide a motivational help to motivate tobacco chewers to quit the habit and can be strengthened by the observation of taste perception.

Conclusion

From this study, it is clear that tobacco has an impact on taste perception. This would help in motivating tobacco chewers to give up the habit, as it has negative effects on taste perception. The primary care physicians can include history regarding the possible alterations in taste perception experienced by the patient and can rule out the effect of using tobacco. They can also guide patients to quit the habit with the help of counseling. However, considering the small number of samples in each group and sparse existence of literature correlating the relationship between

tobacco use and the taste sensation, further investigations with high quantity of samples are obligatory to establish the subject.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity.

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Conflicts of interest

There are no conflicts of interest.

References

1. Krishnaa PK, Jayaraj G. Effect of age on taste perception: A survey. Int J Orofac Biol 2017;1:35.
2. Srinath HP, Akula R, Maroli S, Reddy AV, Yarlagadda S, Prasad KS. Altered taste perception among complete denture patients. Indian J Oral Sci 2014;5:78-82.
3. Chadda RK, Sengupta SN. Tobacco use by Indian adolescents. Tob Induc Dis 2002;1:111-9.
4. Dyasanoor S, Khader NF. Alteration in salivary properties and taste perception in OSMF. Contemp Clin Dent 2016;7:146-52.
5. Baharvand M, Shoaleh Saadi N, Barakian R, Moghaddam EJ. Taste alteration and impact on quality of life after head and neck radiotherapy. J Oral Pathol Med2013;42:106-12.
6. Comeau TB, Epstein JB, Migas C. Taste and smell dysfunction in patients receiving chemotherapy: A review of current knowledge. Support Care Cancer 2001;9:575-80.
7. Doty RL, Bromley SM. Effects of drugs on olfaction and taste. Otolaryngol Clin North Am 2004;37:1229-54.
8. Caputo JB, Campos SS, Pereira SM, Castelo PM, Gavião MB, Marques LS, *et al.* Masticatory performance and taste perception in patients submitted to cancer treatment. J Oral Rehabil 2012;39:905-13.
9. Boron WF, Boulpaep EL. Medical Physiology, 2e Updated ed. E-Book: With STUDENT CONSULT Online Access. Elsevier Health Sciences; 2012.
10. Khan AM, Narayanan VS, Puttabuddi JH, Chengappa R, Ambaldhage VK, Naik P, *et al.* Comparison of taste threshold in smokers and non-smokers using electrogustometry and fungiform papillae count: A case control study. J Clin Diagn Res 2016;10:101-5.
11. Zhang Y, Hoon MA, Chandrashekar J, Mueller KL, Cook B, Wu D, *et al.* Coding of sweet, bitter, and umami tastes: Different receptor cells sharing similar signaling pathways. Cell 2003;112:293-301.
12. Bhaskar SN. Orban's Oral Histology and Embryology. 11th. ed. St. Louis: CV Mosby; 1991. p. 178.
13. Spence C. Just how much of what we taste derives from the sense of smell? Flavour 2015;4:30.
14. Ganapathy KS, Gurudath S, Balikai B, Ballal S, Sujatha D. Role of iron deficiency in oral submucous fibrosis: An initiating or accelerating factor. Indian J Oral Med Radiol 2011;23:25-8.
15. Rolls BJ, McDermott TM. Effects of age on sensory-specific satiety. Am J Clin Nutr 1991;54:988-96.
16. Reveles CC, Segri NJ, Botelho C. Factors associated with hookworm experimentation among adolescents. J Pediatr2013;89:583-7.
17. Palheta Neto FX, Targino MN, Peixoto VS, Alcântara FB, Jesus CC, Araújo DC, *et al.* Sensorial abnormalities: Smell and taste. Int Arch Otorhinolaryngol 2011;15:350-8.
18. Deems DA, Doty RL, Settle RG, Moore-Gillon V, Shaman P, Mester AF, *et al.* Smell and taste disorders: A study of 750 patients from the University of Pennsylvania Smell and Taste Center. Arch Otolaryngol Head Neck Surg 1991;117:519-28.
19. Pavlos P, Vasilios N, Antonia A, Dimitrios K, Georgios K, Georgios A. Evaluation of young smokers and non-smokers with electrogustometry and contact endoscopy.BMC Ear Nose Throat Disord 2009;9:9-16.
20. Pavlidis P, Gouveris H, Anogeianaki A, Koutsonikolas D, Anogianakis G, Kekes G. Age-related changes in electrogustometry thresholds, tongue tip vascularization, density, and form of the fungiform papillae in humans. Chem Senses 2013;38:35-43.
21. Tomassini S, Cuoghi V, Catalani E, Casini G, Bigiani A. Long-term effects of nicotine on rat fungiform taste buds. Neuroscience 2007;147:803-10.
22. Klein I, Nagler RM, Tofler R, Van Der Vliet A, Reznick AZ. Effect of cigarette smoke on oral peroxidase activity in human saliva: Role of hydrogen cyanide. Free Radic Biol Med 2003;35:1448-52.
23. Avşar A, Darka Ö, Bodrumlu EH, Bek Y. Evaluation of the relationship between passive smoking and salivary electrolytes, protein, secretory IgA, sialic acid and amylase in young children. Arch Oral Biol 2009;54:457-63.
24. Simons CT, Boucher Y, Carstens MI, Carstens E. Nicotine suppression of gustatory responses of neurons in the nucleus of the solitary tract. J Neurophysiol 2006;96:1877-86.
25. Khot K, Deshmane S, Bagri-Manjarekar K, Warke D, Kotak K. A cytomorphometric analysis of oral mucosal changes in tobacco users. J Nat Sci Biol Med 2015;6:22-4.
26. Al Shammari AF, Ibrahim IK, Alaauldeen AI, Merza RF, Ahmed HG. Effects of tobacco smoking on the dorsum of the tongue and buccal epithelium. Asian Pac J Cancer *P* 2016;17:4713-8.
27. Balaji SM. Tobacco smoking and surgical healing of oral tissues: A review. Indian J Dent Res2008;19:344-8.
28. Deeplaxmi R, Sakarde SK, Sur J, Singh AP, Jain S, Mujoo S. Altered taste perception in oral submucous fibrosis: A research. J Indian Acad Oral Med Radiol 2012;24:288-91.
29. Da Ré AF, Gurgel LG, Buffon G, Moura WER, Marques Vidor DCG, Maahs MAP. Tobacco influence on taste and smell: Systematic review of the literature. Int Arch Otorhinolaryngol 2018;22:81-7.
30. Sariah A, Zhening L, Pu W, Liu H, Xue Z, Huang X. Structural and functional alterations in betel-quid chewers: A systematic review of neuroimaging findings. Front Psychiatry 2019;10:16.