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ASSESSMENT OF SALIVARY FLOW RATE AND pH IN TOBACCO AND NON-TOBACCO USING INDIVIDUALS

[1]Debasis Biswas, [2]Sandip Dandapat, [3]Mousumi Biswas and [4]Prof. Malina Jain

[1] Research Scholar, Index Medical College, Hospital & Research Centre, Malwanchal University, Indore (M.P.), India.
[2] Postgraduate student, Department of Anatomy, NIMS University, Rajasthan, India.
[3] Triveni Institute of Dental Science, Hospital & Research Centre, Bilaspur (CG), India.
[4] Professor & HOD, Department of Physiology, Index Medical College, Hospital & Research Centre, Malwanchal University, Indore (M.P.), India.

ABSTRACT :

Saliva, a thick, colourless fluid that is constantly secreted in the oral cavity of human and other vertebrates by some group of glands known as salivary glands. Salivary secretion is a complex physiological process. Under different circumstances its composition and flow vary greatly. On an average 0.75 to 1.5 L saliva is secreted daily. Unstimulated whole salivary flow rate (SFR) is about 0.3-0.5 ml/min, whereas, this flow rate increases up to 4.0-5.0 ml/min during eating, chewing and other stimulatory activities. The normal pH of saliva ranges from 6.8 to 7.1. Amongst Indian people, the habit of smoking and tobacco chewing appears to be wide spread and is cutting through all cross-sections of the society. About 50% of the total tobacco use in India is in smokeless form, i.e., zarda, gutkha, khaini, pan-masala etc. Whether usage of smoked or smokeless tobacco forms have systemic as well as locoregional effects. In oral cavity, saliva is the first biological fluid that gets exposed to the toxic chemicals present in tobacco or areca nut. The present study showed the effect of long-term use of tobacco on the salivary flow rate and salivary pH. Both unstimulated and stimulated salivary flow reduced significantly. It was also observed that long-term tobacco use also lowers salivary pH, making it more acidic.

Key words : saliva, tobacco, unstimulated and stimulated salivary flow rate, salivary pH.

1.0 INTRODUCTION :

Saliva is a thick, colourless fluid constantly secreted by the salivary glands of human and other vertebrates into the oral cavity. Saliva is essential for oral hygiene and helps in protection, lubrication, solubilizing food, remineralization of teeth and many more. There are three major salivary glands, the parotid, submandibular, and sublingual, along with many smaller ones **(Tortora, 2009)**. Saliva is composed of 99.5% water and 0.5% solutes, containing ions, dissolved gases, various organic substances, and salivary amylase, a digestive enzyme that acts on starch. The saliva acts as a dissolving medium for foods so that they can be tasted by gustatory receptors, and digestion can begin.

Salivary secretion is a complex physiological process under the control of salivary centres and is dependent on afferent stimulation. The rate of salivary flow may be affected by several factors, including age, stress, depression, alcohol consumption, exercise, cancer, and radiation treatment. On an average, 0.75 to 1.5 L saliva is secreted daily. Unstimulated whole salivary flow rate is about 0.3-0.5 ml/min, whereas this flow rate increases up to 4.0-5.0 ml/min during eating, chewing, and other stimulatory activities **(Iorgulescu, 2009)**. The normal pH of saliva ranges from 6.8 to 7.1, and different buffers maintain the acid-base equilibrium of saliva.

Habits are behaviour associations in memory that grow as people repeatedly experience pleasure or reward for a specific action. Habitual "psychosocial stress" is defined as a pattern of behaviour or thought that has developed through repetition and that is known to be associated with stress **(Rooban et al., 2011)**. Psychosocial stress can reduce salivary flow rate and affect the levels of salivary pH. Tobacco, alcohol, and areca nut are some readily available PS **(Bhat et al., 2010)**. In India, smoking and tobacco chewing are widespread across all sections of society, with about 50% of total tobacco use in smokeless form **(Boyle et al., 2006; Gupta & Johnson, 2014)**. As of 2014, over 1 billion people or 20% of the world's population smoked tobacco, with more than 80% of smokers living in countries with low or middle incomes, and 60% in just 10 countries, led by China **(https://en.wikipedia.org; Wild et al., 2020)**. Tobacco consumption is increasing by 2.1% per annum on a global scale, with a decrease of 0.2% per annum in developed countries like the US and Europe but an increase of about 3.4% per annum in developing countries like India **(https://en.wikipedia.org)**, especially among youth who are getting hooked to smoking and chewing under peer influence. The availability of consistent tobacco, areca nut, lime, and catechu preparations in attractive polythene pouches and their heavy promotion through mass media and sporting events have led to an increase in the use of smokeless tobacco preparations among youth, fostering nicotine addiction and dependence stronger than cigarette smoking **(Gupta & Johnson, 2014)**.

Thus, it was considered of interest to study whether tobacco has any effect on the composition of saliva which may be caused due to the effects of the harmful constituents.

The present study dealt with the role of tobacco on different salivary parameters, i.e., salivary flow rate and salivary pH and to find out the possible reason behind that.

Therefore, the main objectives of the present study were :

- To compare salivary flow rate in subjects with and without tobacco consumption.
- Comparison of salivary pH in subjects with or without tobacco consumption.

2.0 REVIEW OF LITERATURE :

Early Americans started using tobacco long ago. In Europe it was introduced by the arrival of Spain. The people got the habit of smoking and it became a lucrative business **(Rachel, 2021)**. After the industrial revolution, tobacco became highly popular worldwide. But in the mid-20th century, it was first shown through medical research that tobacco has very high negative on all the body organs including lung and throat cancer.

As the Europeans arrived America, tobacco was the main products helping in colonization, and also an important factor in introducing of African slave labour. In about 1528, Tobacco was introduced in Europe by the Spanish and Diego Columbus mentioned of a tobacco merchant of Lisbon in his will in 1533. This shows how quickly tobacco use had sprung up. Initially it was referred as the "sacred herb" by the French, Spanish, and Portuguese because of its valuable medicinal properties **(Handbook of American Indians North of Mexico)**.

Germany was the first country to see first anti-smoking campaign **(Carroll, 2018)**. The National Socialist government of Germany condemned tobacco use and funded research against it **(Robert, 1996)**. Germany also banned tobacco use public places in 1941 keeping its health hazards **(Robert, 1996)**.

In 1948, the British physiologist **Richard Doll** gave the first breakthrough by publishing the first major studies proving that smoking could cause serious health damage **(Sander et al., 2004; Appel, 2009)**. In 1950, Richard Doll showed a close link between smoking and lung cancer in his research publication in the British Medical Journal **(Doll and Hill, 1950)**. In 1954, about 40 thousand doctors (British Doctors Study) in their research over 20 years, confirmed the suggestion of Richard Doll and based on that the government issued advice that smoking and lung cancer rates were related **(Doll and Hill, 1954)**.

Reddy et al. (1980) measured salivary flow rates by mechanical stimulation (with 10% citric acid stimulation) among normal healthy adults and people with a history of chronic tobacco-use. The tobacco users secreted less saliva as compared to non-tobacco users. The salivary flow rates had significant positive correlation with the duration of chewing, but not with the amount of tobacco chewed. **Reddy et al.** concluded that chronic tobacco use stimulates secretion of more watery saliva leading to a decrease in enzyme and electrolyte content.

Normal salivary flow rate is an important factor for the maintenance of oral hygiene. A change in the unstimulated salivary flow rate plays an important role in pathogenesis of various oral conditions. A study by **Rad et al. (2010)** on 100 smokers and 100 non-tobacco users (as control group) showed that the mean

salivary flow rate was significantly lower in smokers than that in non-smokers. **Rad et al.** used a set of questionnaires to collect the demographic data and smoking habits. Also, smoker subjects experienced more xerostomia symptoms than non-tobacco users. Oral lesions including gingivitis, cervical caries, calculus, tooth mobility and halitosis were significantly higher in smokers **(Khan et al., 2005)**. This study of **Rad et al.** was in match to other studies of **Weinstein et al. (1996), Friedman and Isfeld (2008) and Shah et al. (2003).**

In 2013, **Kanwar et al. (2013)** conducted a study on 60 subjects to analyze and compare the long-term effects of tobacco on salivary flow rate and salivary pH between tobacco users and normal people (control group). The results showed a significant and appreciable decrease in salivary flow among tobacco using individuals. As per **Kunwar**, this decrease in salivary flow may be due to the effect of nicotine on the taste nerve apparatus. However, other studies also have shown that long-term consumption of tobacco in any form is one of the risk factors for reducing saliva **(Rooban et al., 2006)**. The salivary pH was observed to be lower in tobacco users as compared with control. Authors found that when there is a decrease in salivary flow, the pH became more acidic and vice versa.

Effects of tobacco on salivation was also shown on 60 smokers by **Petrusic et al. (2015)**. Saliva was collected by spitting method in a graduated tube. They studied the effect of tobacco on both unstimulated and stimulated saliva. The study showed that long-term smoking causes saliva to significantly decrease and this was similar to the result of **Rad et al. (2010)**. **Petrusic et al. (2015)** showed a decrease in the amount of saliva in smokers and it was associated with the duration of smoking. The results have shown that the quality of saliva of the smokers had been a modified greatly in compared to non-smokers. The smokers had thick saliva while in non-smokers has watery saliva. The harmful components of cigarettes firstly affect parotid gland which secrete watery saliva. This loss of salivation from parotid gland is compensated by submandibular and sublingual glands which secrete mucous saliva. This explains the reason behind thicker saliva in smokers. Some other researches also confirmed the fact that smoking negatively affects the quality of saliva **(Sariri et al., 2008)**. Substances from cigarette smoke destroy protective macromolecules of saliva, enzymes and proteins, and thus saliva loses its protective role and becomes an agent in carcinogenesis and development of oral and oropharyngeal cancer **(Nagler and Dayan, 2006)**.

With these above considerations, it is seen there are still some scopes of research on the effect of long-term use of tobacco (smoke or non-smoke chewable form) on the saliva parameters. So, this work of the "assessment of salivary flow rate and pH in tobacco and non-tobacco using individuals" were undertaken.

3.0 MATERIALS AND METHODS

A pilot study was conducted to evaluate the possible correlation of smoking and use of tobacco on unstimulated whole saliva, considering variable history of habitual usage of smoking/tobacco chewing.

3.1 Selection of Subjects

The subjects of this study were selected randomly from the outpatients attending the Index Medical College, Indore, Madhya Pradesh. Subjects were in an age range of 20-50 years and had a habit of using tobacco (smoking & smokeless) for more than three years. The selection of the subjects was based on their past deleterious habit and medical history. All the subjects were clinically examined to assess the oral hygiene and to exclude the possibility of any other oral disease or systemic disease with oral manifestation. All potential participants (control & study group) were explained about the study in a simple yet detailed manner. If the patient desired to be a part of the study, then his/her consent (signature/thumb impression) was recorded in the informed consent form (as in Annexure).

The sample size of study consisted of 200 individuals and were divided equally in two groups such as tobacco users and non-tobacco users.

Group A consisted of 100 subjects without any habit of tobacco consumption (control).

Group B consisted of 100 individuals with the habit of tobacco use (smoking, smokeless tobacco, or combined habits of smoking and smokeless tobacco) (case).

Inclusion criteria:

- Apparently fit and healthy individuals were chosen for the study after having consent.
- This study was done in individuals in the age group of 20-50 years.
- The subjects comprised individuals who were using tobacco daily for more than 3 years.
- The subjects who smoked more than 4 cigarettes or 10 bidis **(Bjartveit and Tverdal, 2005)** or consumed 2 pouches of chewable tobacco daily were considered tobacco-user group and those who did not smoke or used chewable tobacco were considered in non-tobacco-user group.

Exclusion criteria

- Individuals below 20 or above 50 years of age were not accepted.
- Cases with any evidence of oral pathology or oral lesions were excluded.
- Individuals who had the history of any systemic disease, causing alterations in salivary flow rate like diabetes mellitus, diabetes insipidus etc. were excluded **(Shah, 1996)**.
  - Subjects who were under medications for a systemic disease were excluded.
  - Individuals who had the habit of taking drug were not considered.
  - Persons who had the history of alcohol consumption were also excluded **(Shah, 1996)**.
  - Subjects who had undergone surgery of the salivary glands were excluded.
  - Those who had salivary gland dysfunction, were also excluded.
  - People who were taking medicines which may modify salivary flow.
- Individuals who had been exposed to radiation of the head and neck region were excluded **(Shah, 1996)**.

3.2 Materials Used

- Dental chair for oral examination.
- Gloves.
- Face mask.
- Mouth mirror for oral examination.
- 2% citric acid solution.
- Saliva measuring tube with funnel.
- Sample collecting jar.
- pH meter.
- Spectrophotometer.
- Normal saline
- Sodium chloride

3.3 Saliva Collection and Storage

Unstimulated Method

Saliva collection was done between 10:00 am and 11:00 am to avoid diurnal variation. The subjects were instructed to refrain from eating, drinking, smoking, exercising or chewing 1 hour before and during the entire procedure (**Kanwar et al., 2013)**. Additionally, they were instructed to swallow any saliva in their mouth, immediately before the collection started. Unstimulated whole salivary samples were collected by spitting method. Subjects were comfortably seated in the chair and a few minutes of relaxation, saliva samples were collected for the procedure in a graduated tube through a glass funnel, every 1min for 5min. The specimens were immediately centrifuged (1,000 g for 10min) at 4°C and the supernatant was isolated and immediately frozen at -20°C until the biochemical analysis **(Ahmadi-Motamayel et al., 2016)**. After the collection, the salivary flow rate was measured and expressed in ml/min.

Stimulated method

After the unstimulated saliva collection process was over, stimulated saliva was collected by placing few drops of 2% of citric acid on the subject's tip of the tongue at regular intervals ranging from 15 to 60 sec. After 60 sec patient was asked to spit into another sterile container. During saliva collection subjects were instructed not to speak or swallow.

3.4 Analysis of Salivary Flow Rate

Flow rate (ml/min) of saliva was determined by allowing the saliva to flow into the graduated plastic container having graduated marks from 1ml to 20ml. Graduated container was cylindrical in shape. For differentiating, the containers were labelled as stimulated and unstimulated saliva. Collected saliva was measured by seeing the graduated container and expressed in ml/min.

3.5 Analysis of Salivary pH by pH Meter

The pH values for all salivary characteristics were assessed with the help of IONIX pH Meter. The pH meter was standardized using a standard protocol, using pH calibration solutions ranging from pH 4, 7 and 10. Following the manufacturer guidelines the head of the pH bulb was immersed in the calibration solution (pH 4, 7, 10), until the pH of the solution was determined correctly in all the three ranges. The pH meter is dipped into the container containing saliva and placed for 10 seconds, then the reading was noted for both stimulated and unstimulated saliva. Tip of the PH meter should rest on the bottom of the container and should be immersed completely in saliva. Readings are comparatively reliable.

3.6 Recording of Data

For systematic and methodical recording of the data without errors, a special Proforma was designed, and all the subjects were interviewed by the investigator himself and the details were recorded carefully.

3.7 Statistical Analysis

The descriptive data were expressed as the mean and standard deviation. All statistical analyses were performed using the statistical software [SPSS 15.0 (Statistical Package for Social Science Inc., Chicago, IL, USA). The statistical significance of difference between mean values was estimated by Student T-test and P-value<0.05 was considered significant and P-value<0.01 was considered a high significant. Comparison of clinical parameters of the groups were analyzed using the analysis of variance (ANOVA) test.

3.8 Ethical Clearance

The investigations were performed in human samples to identify the difference in salivary amylase, pH and flow rate between tobacco users and non-tobacco using individuals to establish a relationship between the usage of tobacco and change in the salivary parameters. So, the ethical clearance was obtained from the Institution.

4.0 RESULTS

This study was conducted on 200 individuals in the age group of 20-50 years. 100 subjects formed the control group, who had never smoked/chewed tobacco. Another 100 individuals who had the habit of using tobacco (in any form) were selected (randomly) as case/test group. All participants were healthy and did not have any health issue that interferes with saliva secretion and composition and also were similar in terms of economic and social status. The results were based on self-report, intra-oral examination, and wherever necessary biochemical validation of self-reported tobacco usage was carried out. The quantitative and qualitative amounts of saliva categorized by normal and tobacco-user group are tabulated in the following section. Statistical analysis showed that this difference is statistically significant (P<0.001).

4.1 Effect of Tobacco Use on Salivary Flow

On comparison of unstimulated salivary flow rate, it was found that long-time use of tobacco had detrimental effect on salivary flow. Tobacco significantly reduced salivary flow (unstimulated and stimulated both) in those who were using tobacco for more than three years.
Analysing the results, it was observed that mean unstimulated salivary flow rate was less in the tobacco-user group (0.290 ± 0.019 ml/min) as compared to the control group (0.409 ± 0.029 ml/min) (**Table 1**). The difference observed was statistically highly significant (p-value<0.0001).

Table 1 : Mean unstimulated salivary low rate (ml/min) in control and tobacco-user group.

Group	Unstimulated Salivary Flow Rate (mean ± SD)
Control	**0.409 ± 0.029**
Tobacco User	**0.290 ± 0.019**

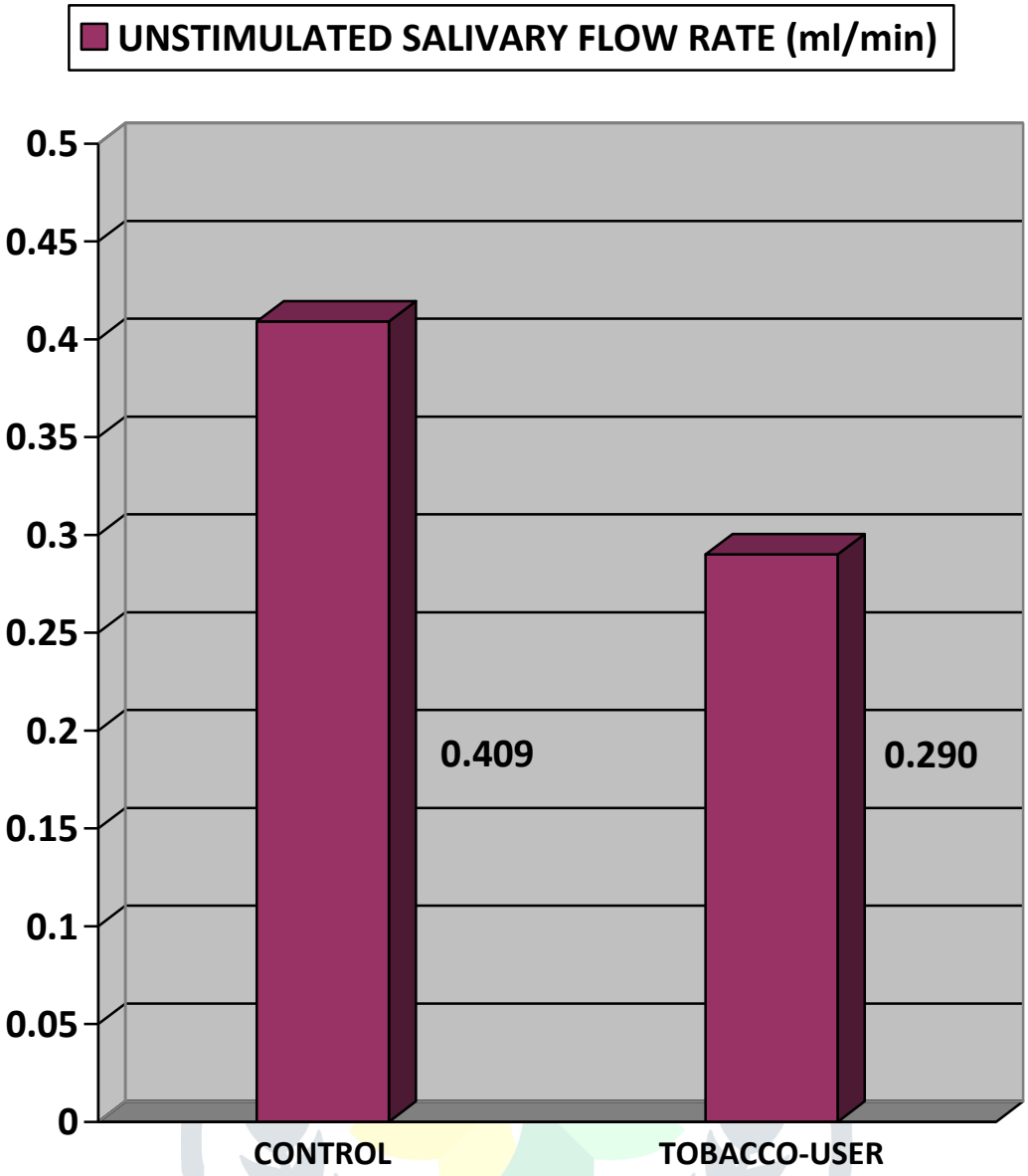

Fig. 1 : Mean unstimulated salivary flow rate in control (tobacco non-users) and tobacco-users

Stimulated salivary flow rate was measured after placing 2% citric acid in the oral cavity. This gave an enhancement to the salivary secretion and secretion rose manifolds. The results showed a significant ($p<0.0001$) reduction in stimulated salivary flow rate in tobacco-user group. The mean (± SD) stimulated salivary flow rate in the control group (those who didn't use tobacco) was 4.139 (± 0.438), whereas those who used tobacco (in any form) had a lower salivary flow rate of 3.036 (± 0.391) (**Table 2**).

Table 2 : Mean stimulated salivary low rate (ml/min) in control and tobacco-user group.

Group	Stimulated Salivary Flow Rate (mean ± SD)
Control	**4.139 ± 0.438**
Tobacco User	**3.036 ± 0.391**

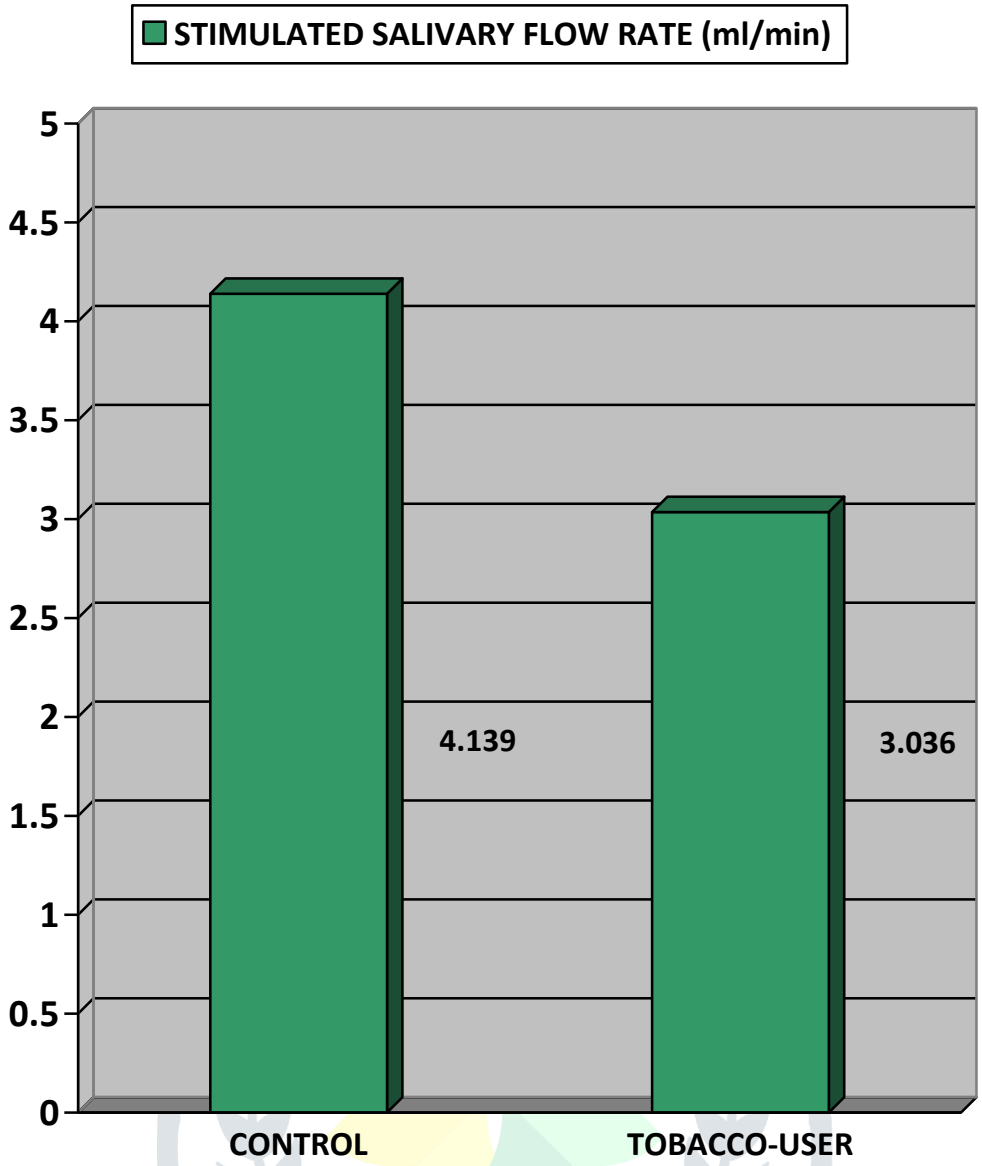

Fig. 2 : Mean stimulated salivary flow rate in control (tobacco non-users) and tobacco-users.

4.2 Effect of Tobacco Use on Salivary pH

On comparing the salivary pH, it was found that long-time use of tobacco had detrimental effect on salivary pH. In the present study, it was observed that tobacco significantly lowered salivary pH to about 6.387 (± 0.144) as compared to the control group (6.896 ± 0.127).

Analysing the results, a high significant ($p<0.0001$) relation was obtained when the mean salivary pH of both the groups (control and test/tobacco-user) were compared [**Table 3**].

Table 3 : Mean salivary pH in control and tobacco-user group.

Group	Salivary pH
Control	**6.896 ± 0.127**
Tobacco User	**6.387 ± 0.144**

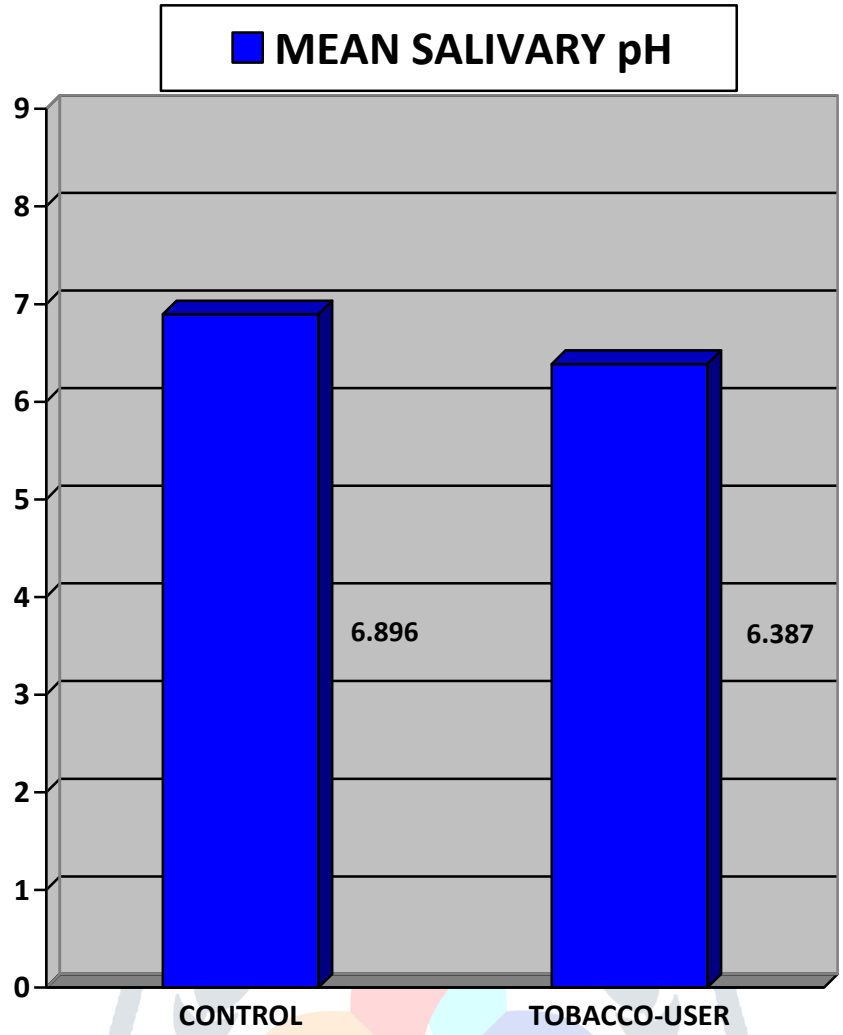

Fig. 3 : Mean salivary pH level in control (tobacco non-users) and tobacco-users.

5.0 DISCUSSION

Tobacco use is a well-known risk factor for many adverse health outcomes, including oral health problems. One of the ways in which tobacco use affects oral health is by lowering the levels of salivary amylase, pH, and salivary flow. This discussion will explore the relationship between tobacco use and these three salivary parameters and the implications for oral health.

Studies have found that individuals who smoke or use other forms of tobacco have reduced salivary secretion compared to tobacco non-users. Nicotine, a key component of tobacco, can cause decreased saliva production and a dry mouth. Additionally, the chemicals in tobacco can damage the salivary glands, further contributing to decreased saliva production. Tobacco-use reduced unstimulated salivary flow rate to 0.29ml/min in comparison to about 0.41ml/min in normal person. This is called unstimulated salivary secretion. A normal flow of unstimulated and stimulated saliva is important to ensure sufficient and continuous lubrication of the teeth and oral mucous membranes, and also helps to prevent retrograde infection of the salivary glands with oral microorganisms via the salivary ducts **(Amerongen and Veerman, 2002; McQuone, 1999)**. It also decreased stimulated salivary flow rate to about 3.04ml/min (4.14ml/min in control).

Over the long term, the reduction of salivary secretion caused by tobacco use can have even more severe consequences. It has been linked to an increased risk of oral cancer, as well as other types of cancer. Nicotine is a highly addictive substance, and the longer a person uses tobacco, the more difficult it can be to quit. This means that the longer a person continues to use tobacco, the greater the risk of developing serious health problems.

Salivary pH refers to the measure of acidity or alkalinity of the saliva. It is another critical parameter that plays a significant role in oral health. A neutral pH of 6.8-7.3 is optimal for maintaining oral health, and deviations from this range can have adverse effects. Tobacco-use also lowers salivary pH in several ways. In our study, the results showed that tobacco-use reduced salivary pH to an acidic level of about 6.38.

A low salivary pH level can lead to the demineralization of tooth enamel, which can result in the development of dental caries or tooth decay **(Cunha-Cruz et al., 2013)**. Acidic environments also promote the growth of harmful bacteria in the mouth, which can lead to the development of gum disease and other oral health problems.

On the other hand, a high salivary pH level can also be detrimental to oral health. An alkaline environment can lead to the formation of calculus or tartar, which can cause gum irritation and inflammation.

Maintaining an optimal salivary pH level is essential for good oral health. This can be achieved through various methods, including a healthy diet, regular brushing and flossing, drinking plenty of water, and avoiding foods and beverages that are highly acidic or sugary. Additionally, using oral hygiene products that contain fluoride can also help in maintaining an optimal salivary pH level and protecting the teeth from decay.

5.1 Effects of tobacco use on salivary pH levels

Tobacco use has been shown to have a significant impact on salivary pH levels. The chemicals found in tobacco products lead to a decrease in salivary pH, creating an acidic environment in the mouth. The salivary pH was reduced to 6.38 (in test group) from 6.89 in non-tobacco user people.

One study found that individuals who smoke or use smokeless tobacco products had lower salivary pH levels compared to non-tobacco users. The researchers also noted that the longer an individual had been using tobacco products, the lower their salivary pH levels were likely to be **(Kanwar et al., 2013)**.

The effects of tobacco use on salivary pH levels can be seen in both smokers and users of smokeless tobacco products. Smokeless tobacco products, such as chewing tobacco and snuff, are often highly acidic, and the act of chewing or holding the tobacco in the mouth can lead to a decrease in salivary pH levels.

Overall, tobacco use can have a significant impact on salivary pH levels, leading to an acidic environment in the mouth that can cause damage to the teeth and gums. It is important for individuals who use tobacco products to be aware of these risks and to take steps to quit using tobacco to protect their oral health.

5.2 Causes of the decrease in salivary pH caused by tobacco use

Tobacco use can cause a decrease in salivary pH levels through several mechanisms. One of the main ways is through the production of acids from tobacco products. For example, smokeless tobacco products such as chewing tobacco and snuff are often highly acidic, with pH levels ranging from 3.5 to 5.5. When these products are used, they can cause an immediate decrease in salivary pH levels due to the introduction of acidic substances into the mouth.

In addition, smoking cigarettes can also cause a decrease in salivary pH levels. The smoke from cigarettes contains several chemicals, including carbon monoxide and nicotine, which can decrease salivary flow rates and alter the composition of saliva. This can lead to a decrease in the buffering capacity of saliva, which is essential for maintaining a healthy pH level in the mouth.

Furthermore, tobacco use can also cause a decrease in the production of bicarbonate ions in the saliva. Bicarbonate ions are essential for neutralizing acids in the mouth, and a decrease in their production can result in a decrease in the pH level of the saliva.

Overall, the decrease in salivary pH caused by tobacco use is a multifactorial process involving the introduction of acidic substances into the mouth, alterations in the composition of saliva, and a decrease in the production of bicarbonate ions. These changes can have serious implications for oral health, as they can lead to tooth decay, gum disease, and other oral health problems.

5.3 Effects of tobacco use on salivary flow rates

Salivary flow refers to the amount of saliva produced by the salivary glands in the mouth. Tobacco use can have a significant impact on salivary flow rates. Both smoking and smokeless tobacco use have been shown to decrease salivary flow rates, which can have negative implications for oral health.

Studies have shown that smoking tobacco can cause a decrease in salivary flow rates by as much as 50% **(Khemiss et al., 2017)**. This decrease is due to the toxic chemicals in tobacco smoke, which can damage the salivary glands and reduce their ability to produce saliva. Smoking can also cause a decrease in the quality of saliva, leading to an increased risk of tooth decay and gum disease.

Smokeless tobacco use, such as chewing tobacco and snuff, can also cause a decrease in salivary flow rates. This is because the tobacco products contain chemicals that can damage the salivary glands and reduce their ability to produce saliva. In addition, the physical act of chewing tobacco can cause damage to the oral tissues and further reduce salivary flow rates.

Overall, tobacco use can have significant negative effects on salivary flow rates and oral health. It is important for individuals to take steps to quit smoking or using other tobacco products to protect their oral health and maintain a healthy flow of saliva.

5.4 Causes of the decrease in salivary flow caused by tobacco use

Tobacco use can cause a decrease in salivary flow due to several factors. Firstly, nicotine, which is present in tobacco, has been found to have an inhibitory effect on salivary gland function. It can reduce the production of saliva by decreasing the activity of the cholinergic receptors in the salivary glands. This can lead to a decrease in the amount of saliva produced and released into the oral cavity.

Secondly, tobacco use has been found to cause damage to the salivary gland tissues. The toxic chemicals present in tobacco can cause inflammation and damage to the glandular tissues, leading to a decrease in salivary flow. This damage can be irreversible in some cases, and can lead to chronic dry mouth or xerostomia.

Lastly, tobacco use can also cause psychological stress, which has been found to be a significant factor in decreasing salivary flow rates. Stress can lead to a decrease in the secretion of saliva, and tobacco use has been found to be associated with increased stress levels in some individuals.

Overall, the decrease in salivary flow caused by tobacco use can be attributed to the inhibitory effects of nicotine, damage to salivary gland tissues, and psychological stress. This decrease in salivary flow can have serious implications for oral health, as saliva plays an important role in maintaining oral hygiene and protecting against dental caries and gum disease.

5.5 Clinical Implications of the clinical implications of the changes in salivary parameters caused by tobacco use

The changes in salivary parameters caused by tobacco use have significant clinical implications for oral health. A decrease in salivary pH can create an acidic environment that promotes the growth of acidogenic bacteria and demineralization of tooth enamel, leading to tooth decay and erosion. Reduced salivary flow rates can also contribute to these problems by decreasing the buffering capacity of saliva and limiting the flushing of food particles and bacteria from the mouth.

Furthermore, the changes in salivary parameters caused by tobacco use can increase the risk of oral cancer. Studies have shown that tobacco use can lead to alterations in the composition of salivary gland secretions, including changes in the levels of various proteins and enzymes. These changes can affect the ability of the salivary glands to function properly and may contribute to the development of oral cancer.

In addition to the direct effects on oral health, the changes in salivary parameters caused by tobacco use can also have broader implications for systemic health. For example, reduced salivary flow rates can lead to dry mouth, which can cause discomfort, difficulty speaking and swallowing, and an increased risk of oral infections. Additionally, the decreased buffering capacity of saliva can contribute to gastrointestinal problems and other systemic health issues.

Tobacco use has been linked to a variety of oral health problems, including:

Tooth decay: Tobacco use can lead to the build-up of plaque and bacteria on the teeth, which can contribute to tooth decay.

Gum disease: Tobacco use can cause inflammation and infection of the gums, leading to gum disease. This can cause the gums to recede, teeth to become loose, and can even result in tooth loss.

Oral cancer: Tobacco use is a major risk factor for oral cancer, which can affect the lips, tongue, cheeks, and other parts of the mouth.

Dry mouth: Tobacco use can decrease salivary flow, leading to dry mouth. This can contribute to tooth decay and gum disease, as saliva helps to wash away food particles and bacteria from the mouth.

Halitosis: Tobacco use can cause bad breath, or halitosis, due to the build-up of bacteria in the mouth.

Stained teeth: Tobacco use can cause teeth to become yellow or brown due to the build-up of tar and other chemicals in cigarette smoke.

5.6 Prevention and Treatment options for oral health problems associated with tobacco use

Prevention:

1. *Quitting tobacco use*: The most effective way to prevent oral health problems associated with tobacco use is to quit using tobacco. This can reduce the risk of developing oral cancer, gum disease, tooth decay, and other health problems.
2. *Regular dental check-ups*: Regular dental check-ups are essential for detecting early signs of oral health problems. A dentist can identify any issues and provide early intervention and treatment.
3. *Healthy oral hygiene habits*: Good oral hygiene habits, such as brushing twice a day, flossing daily, and using an antiseptic mouthwash, can help prevent dental problems.

Treatment:

1. *Medications*: Depending on the condition, medications can be used to manage oral health problems associated with tobacco use. For example, gum disease may be treated with antibiotics, while oral cancer may require chemotherapy or radiation therapy.
2. *Surgery*: In some cases, surgery may be necessary to treat oral health problems associated with tobacco use, such as removing a tumour or repairing damage to the teeth or gums.
3. *Dental procedures*: Dental procedures such as fillings, root canals, and extractions may be necessary to treat dental problems caused by tobacco use.
4. *Oral rehabilitation*: Oral rehabilitation is a treatment that involves restoring the structure, function, and aesthetics of the mouth. This may involve dental implants, bridges, or dentures.

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