



## Tip Of an Iceberg- The Untold Story of Smoking

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### Abstract

Saliva secreted by three pairs of major salivary glands and about 600-1000 minor salivary glands differs from one another in composition. The parotid gland secretes a watery saliva rich in enzymes like amylase and glycoprotein. The submandibular gland, on the other hand contains higher proportion of glycosylated substances such as mucin. The whole saliva collected from mouth is complex mixture and its composition reflects the cellular makeup of the particular gland. However, both the physical and chemical characteristics of saliva is altered during different disease conditions. Presence of carcinogenic agents like those associated with cigarettes and bidy also alters both the physical and chemical characteristics of saliva. This study focuses on the alteration of the physical characteristics of saliva in presence of carcinogenic agents that ultimately creates a suitable platform for the development of carcinoma.

### Introduction

A critical component of oral environment is saliva, a dilute aqueous solution containing both organic and inorganic constituents. Any disease process or change in the body constituent is reflected as both quantitative and qualitative changes in saliva.

Among the different functions of saliva are;

1. Protection.
2. Buffering.
3. Tissue repair.
4. Antimicrobial activities.
5. Maintaining tooth integrity.
6. Digestion and taste.

Saliva which provides a favorable environment in the oral cavity has certain physical and chemical characteristics. These physical and chemical characteristics are altered in diseased conditions like inflammatory or neoplastic diseases. A number of studies have been carried out that focus on the changes in the chemical characteristics of saliva in carcinoma. But a very few studies have been carried out to document the alteration in physical characteristics in presence of carcinogenic agents like either beedis or cigarette that cause neoplasia

### **Material and Methods**

This study was carried out at Sharad Pawar Dental College, Sawangi (Meghe), Wardha, Maharashtra.

### **Number of samples -60**

Alteration in temperature was recorded with digital thermometer

1. Five minutes prior to smoking.
2. In the process of smoking.
3. Five minutes after smoking.

Alteration in pH was recorded by pH strips

1. Five minutes prior to smoking
2. In the process of smoking
3. Five minutes after smoking.

Alteration in the rate of flow of saliva was recorded in terms of milliliter per minute. By collecting saliva in a saliva container from 30 chronic smokers and 30 control.

**Observation**

<b>NO.of Chronic smokers</b>	<b>Temperature and pH recorded 5 minutes before smoking</b>	<b>Temperature and pH recorded in between smoking</b>	<b>Temperature and pH recorded 5 minutes after smoking</b>
1	97.5°F 7.0 pH	100.1°F 5.0 pH-	99.3°F pH -6.0
2	97.4°F 7.0 pH	100.0°F 5.5 pH-	99.4°F pH -6.0
3	97.6°F 7.0 pH	100.2°F -5.0 pH	99.3°F pH -6.0
4	97.3°F 7.0 pH	100.5°F -5.0 pH	99.5°F pH -6.0
5	97.5°F 7.0 pH	100.1°F -5.0 pH	99.6°F pH- 6.0
6	97.4°F 7.0 pH	100.0°F -5.5 pH	99.5°F pH -6.0
7	97.3°F 7.0 pH	100.0°F 5.0 pH-	99.1°F pH -6.0
8	97.5°F 7.0 pH	100.5°F 5.0 pH-	99.3°F pH -6.0
9	97.2°F 7.0 pH	100.0°F 5.0 pH-	99.5°F pH -6.0
10	97.4°F 7.0 pH	100.9°F pH-5.5	99.2°F pH- 6.0
11	97.5°F pH7.0	100.1°F pH-5.5	99.5°F pH-6.0
12	97.4°F pH-7.0	100.0°F pH-5.0	99.4°F pH-6.0

13	97.6°F 7.0	pH-	100.1°F 5.5	pH-	99.3°F	pH-6.0
14	97.3°F 7.0	pH-	100.2°F 5.0	pH-	99.6°F	pH-6.0
15	97.4°F 7.0	pH-	100.1°F 5.0	pH-	99.5°F	pH-6.0
16	97.5°F 7.0	pH-	100.0°F 5.0	pH-	99.2°F	pH-6.0
17	97.3°F 7.0	pH-	100.0°F 5.0	pH-	99.4°F	pH-6.0
18	97.4°F 7.0	pH-	100.0°F 5.5	pH-	99.3°F	pH-6.0
19	97.2°F 7.0	pH-	100.0°F 5.5	pH-	99.6°F	pH-6.0
20	97.3°F 7.0	pH-	100.0°F 5.0	pH-	99.5°F	pH-6.0
21	97.5°F 7.0	pH -	100.1°F 5.0	pH-	99.3°F	pH -6.0
22	97.4°F 7.0	pH -	100.0°F 5.5	pH-	99.4°F	pH -6.0
23	97.6°F 7.0	pH -	100.2°F 5.0	pH -	99.3°F	pH -6.0
24	97.3°F 7.0	pH -	100.5°F 5.0	pH -	99.5°F	pH -6.0
25	97.5°F 7.0	pH -	100.1°F 5.0	pH -	99.6°F	pH- 6.0
26	97.4°F 7.0	pH -	100.0°F -5.5	pH	99.5°F	pH -6.0
27	97.3°F -7.0	pH	100.0°F 5.0	pH-	99.1°F	pH -6.0
28	97.5°F 7.0	pH -	100.5°F 5.0	pH-	99.3°F	pH -6.0

29	97.2°F 7.0	pH -	100.0°F 5.0	pH-	99.5°F	pH -6.0
30	97.4°F 7.0	pH -	100.9°F 5.5	pH-	99.2°F	pH- 6.0
31	97.5°F 7.0	pH-	100.1°F 5.5	pH-	99.5°F	pH-6.0
32	97.4°F 7.0	pH-	100.0°F 5.0	pH-	99.4°F	pH- 6.0
33	97.6°F 7.0	pH-	100.1°F 5.5	pH-	99.3°F	PH -6.0
34	97.3°F 7.0	pH-	100.2°F 5.0	pH-	99.6°F	pH- 6.0
35	97.4°F 7.0	pH-	100.1°F 5.0	pH-	99.5°F	pH-6.0
36	97.5°F 7.0	pH-	100.0°F 5.0	pH-	99.2°F	pH-6.0
37	97.3°F 7.0	pH-	100.0°F 5.0	pH-	99.4°F	pH-6.0
38	97.4°F 7.0	pH-	100.0°F 5.5	pH-	99.3°F	pH-6.0
39	97.2°F 7.0	pH-	100.0°F 5.5	pH-	99.6°F	pH-6.0
40	97.3°F 7.0	pH-	100.0°F 5.0	pH-	99.5°F	pH-6.0
41	97.5°F 7.0	pH -	100.1°F 5.0	pH-	99.3°F	pH -6.0
42	97.4°F 7.0	pH -	100.0°F 5.5	pH-	99.4°F	pH -6.0
43	97.6°F 7.0	pH -	100.2°F 5.0	pH -	99.3°F	pH -6.0
44	97.3°F - 7.0	pH	100.5°F 5.0	pH -	99.5°F	pH -6.0

45	97.5°F 7.0	pH	100.1°F -5.0	pH	99.6°F	pH- 6.0
46	97.4°F 7.0	pH	100.0°F -5.5	pH	99.5°F	pH -6.0
47	97.3°F 7.0	pH	100.0°F 5.0	pH-	99.1°F	pH -6.0
48	97.5°F 7.0	pH	100.5°F 5.0	pH-	99.3°F	pH -6.0
49	97.2°F pH-7.0		100.0°F 5.0	pH-	99.5°F	pH -6.0
50	97.4°F 7.0	pH	100.9°F pH-5.5		99.2°F	pH- 6.0
51	97.5°F 7.0	pH	100.1°F 5.0	pH-	99.3°F	pH -6.0
52	97.4°F 7.0	pH	100.0°F 5.5	pH-	99.4°F	pH -6.0
53	97.6°F 7.0	pH	100.2°F -5.0	pH	99.3°F	pH -6.0
54	97.3°F 7.0	pH	100.5°F -5.0	pH	99.5°F	pH -6.0
55	97.5°F 7.0	pH	100.1°F -5.0	pH	99.6°F	pH- 6.0
56	97.4°F 7.0	pH	100.0°F -5.5	pH	99.5°F	pH -6.0
57	97.3°F 7.0	pH	100.0°F 5.0	pH-	99.1°F	pH -6.0
58	97.5°F 7.0	pH	100.5°F 5.0	pH-	99.3°F	pH -6.0
59	97.2°F 7.0	pH	100.0°F 5.0	pH-	99.5°F	pH -6.0
60	97.4°F 7.0	pH	100.9°F pH-5.5		99.2°F	pH- 6.0

Saliva Flow in milliliter per minute in chronic smokers	Saliva Flow in milliliter per minute in Non smokers
0.5ml	0.9ml
0.5ml	0.8ml
0.2ml	0.9ml
0.3ml	0.8ml
0.2ml	1.0ml
0.5ml	0.9ml
0.4ml	0.8ml
0.6ml	0.9ml
0.3ml	1.0ml
0.2ml	0.9ml
0.3ml	0.9ml
0.4ml	0.8ml
0.2ml	0.9ml
0.3ml	0.8ml
0.2ml	1.0ml
0.4ml	0.9ml

0.4ml	0.8ml
0.5ml	0.9ml
0.3ml	1.0ml
0.3ml	0.9ml
0.2ml	0.8ml
0.3ml	0.9ml
0.4ml	0.9ml
0.2ml	0.9ml
0.3ml	0.8ml
0.3ml	0.9ml
0.4ml	0.8ml
0.2ml	0.9ml
0.3ml	0.8ml
0.2ml	1.0ml

## Result

Observations reflect significant statistical differences with regard to-

### 1. Temperature

a) An intraoral rise of temperature of 3°F from 97.5°F to 100.5°F during smoking was noted.



b) The intraoral rise of temperature was 2°F 5 minutes after smoking.

c) Return to the base line temperature of 97.5°F is seen half an hour after smoking.

## 2. pH

a) The pH of saliva dropped to 5.0 from 7.0 during smoking.

b) Five minutes after smoking pH remained at 6.0

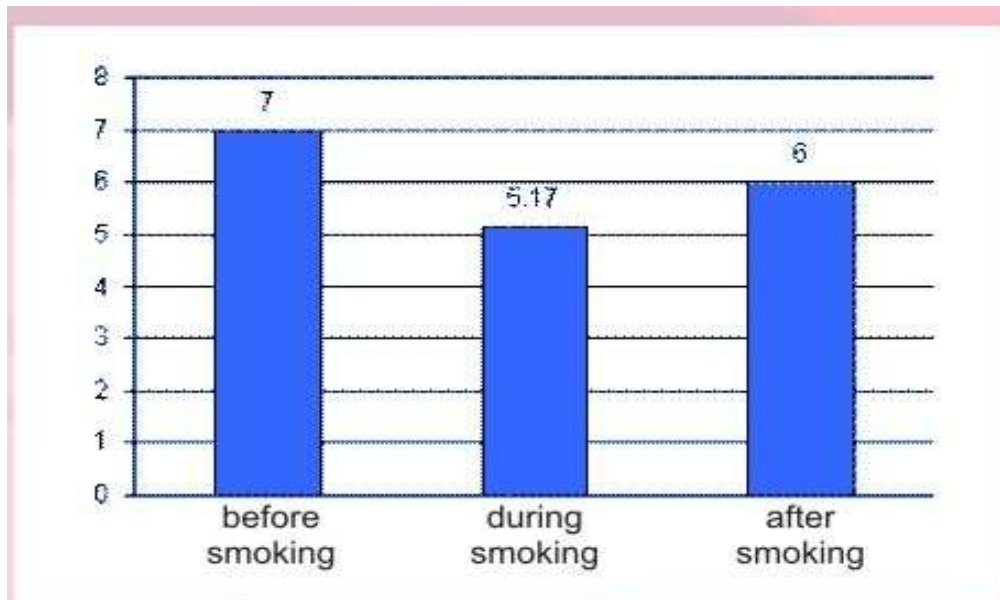
c) PH returns to 7.0 half an hour after smoking.

## 3. Salivary flow

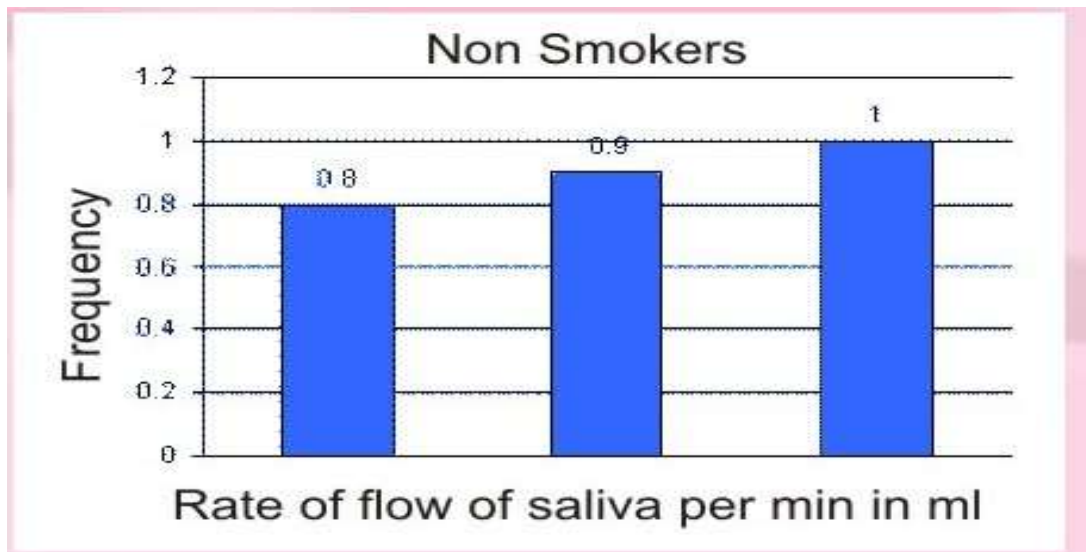
Reduction of saliva flow to the tune of 30% was seen on comparing smokers with non-smoker (the average flow of saliva in chronic smokers being 0.34 ml per minute, while for nonsmokers is 0.66)

### Graphical Representation of the Result

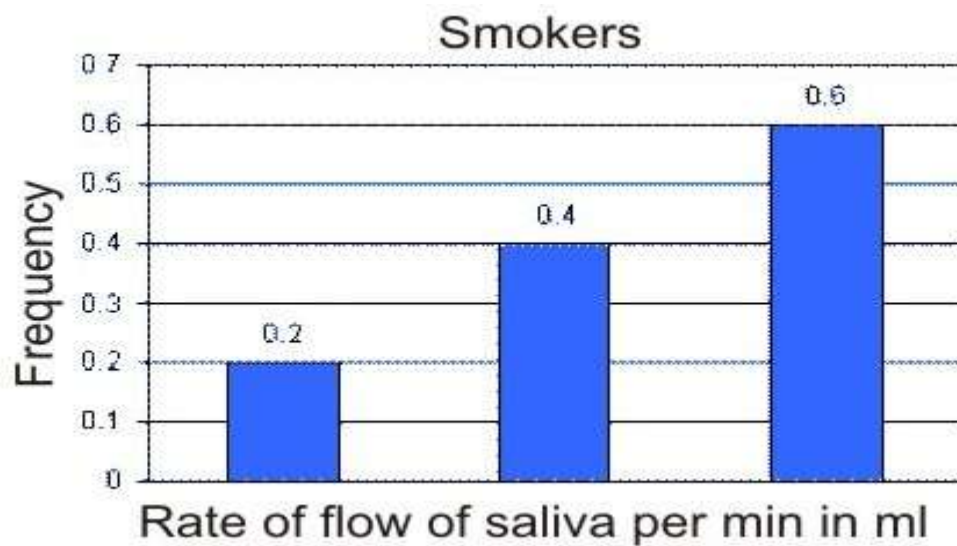
Fig. 1: Alteration In pH (before smoking-7, during smoking-5.17 and after smoking 6)



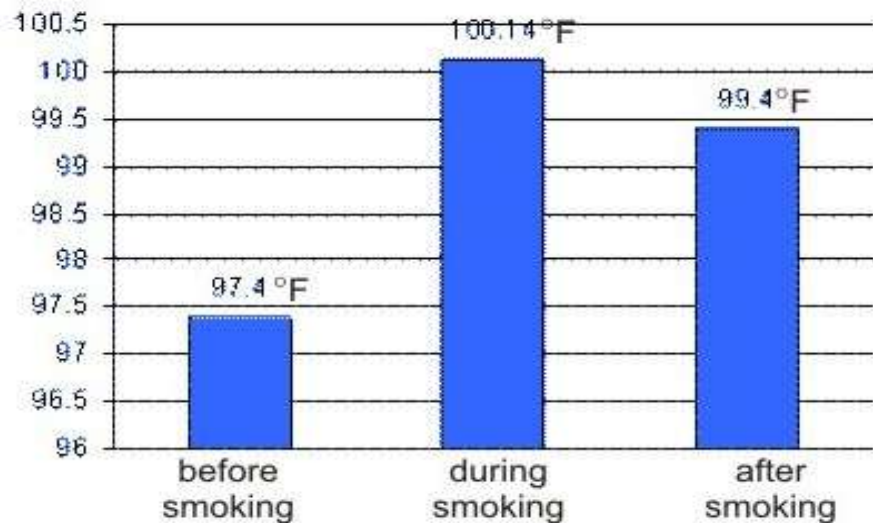
**Fig. 2: Rate of Flow of Saliva per Minute in Milliliter in Non-Smokers**



**Fig. 3: Rate of Flow of Saliva per Minute in Milliliter in Smokers**



**Fig. 4: Alteration in Temperature in Oral Cavity (Before Smoking 97.4°F, During Smoking 100.14°F and After Smoking-99.4°F)**



## Discussion

The study demonstrates the following changes in chronic smokers-

1. Increase in temperature of 2°F which persists for a period of half an hour after smoking
2. A fall in pH of 1 which persists for a period of half an hour after smoking.
3. Decrease in salivary flow in chronic smokers irrespective of time of smoking.

### Effect of Temperature Rise

It has been documented that the rise in temperature associated with smoking in chronic smokers causes cell damage and increases the permeability of the alveolar cells of lungs which contribute to the entry of carcinogenic agents into the cells. Similar changes could be anticipated in the oral cavity also.

### Effect of Drop in pH Due to Cigarette Smoking

An acid pH causes;

1. Inhibition of efficient cellular metabolism and causes chemical ionic disturbances interfering with cellular communications and functions.
2. Deactivation of the enzymes required for DNA repair.
3. Decrease in energy production in the cell.
4. Decrease in the ability to repair damaged cell.
5. Decrease in the ability to detoxify heavy metals and
6. Inhibition of proper cellular regeneration and accelerates the possibility of cellular mutation

There are two factors always present with cancer-Acidic pH and lack of oxygen. A small difference in pH translates to a big difference in the number of oxygen or hydroxyl ions. Drop in pH from 7.0 to 5.0 reduces the oxygen level by 100 fold. Reduction in oxygen level by 100 fold, create a favorable

environment for replication of cancer cells along with metastases.

Dr. Warburg in 1931 won his first novel prize for proving cancer is caused by lack of oxygen respiration in cells. He stated in an article –'THE PRIME CAUSE AND PREVENTION OF CANCER' –the cause of cancer is no longer a mystery, we know it occurs whenever any cell is denied 60% of its oxygen requirement for a prolonged period.

Thus smoking provides both an acidic pH as well as lack of oxygen and thus contributes significantly to the development of carcinogenesis.

### **Effect of Reduced Saliva Flow**

Reduction in saliva flow in the oral cavity of the chronic smokers is associated with increased colonization of a number of organism's like- *Streptococcus α hemolyticus*, *Streptococcus mutan*, *Streptococcus aureus*, *Streptococcus Mitis*, *Candida albican*. Relationship between carcinoma and

bacteria, fungal, viral and protozoa infection has been well documented. Several mechanisms by which microorganisms play a role in cancer development include-

1. through induction of chronic inflammation.
2. Interference with cell cycle either directly or indirectly.
3. By the metabolism of potentially carcinogenic substances, which can induce DNA damage, mutagenesis and hyper proliferation of the epithelium.

The acidic pH of saliva and the associated decrease in oxygen level further helps in the growth of these microorganisms in the oral cavity of the chronic smokers. Thus, the reduced salivary flow associated with increased colonization of microorganisms could serve as an important parameter in the development of oral cancer.

### **Conclusion**

The qualitative and quantitative alteration in the physical characteristics of saliva in

chronic smokers is not an isolated event but an uninterrupted cycle as smoking is a habitual cyclic process. This continuous cyclic alteration provides a favorable environment for the carcinogens to act on the oral mucosa. This physical alteration is a sadly neglected field in oral cancer research. It is our understanding that this alteration could act as a predisposing environment for the development of malignancy in the oral cavity in chronic smokers. Any factor which could control this physical alterations could find a role in cancer prevention.

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