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Research Article

A STUDY ON VARIATIONS OF SALIVARY pH WITH INTAKE OF FOOD

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AQ2 **ABSTRACT**

Aim: To study the changes in salivary pH before and after consumption of food in college students.

Objective: This study is done to find the pH changes before and after the intake of food.

Background: Saliva is a watery substance located in the mouths of humans and animals, secreted by the salivary glands. Human saliva is 99.5% water, while the other 0.5% consists of electrolytes, mucus, glycoproteins, enzymes, antibacterial, and bacteria compounds such as secretory immunoglobulin A and lysozyme. The normal pH of saliva is, approximately, 7.4. This can be altered in few people due reasons such as acidity and vomiting. After the consumption of food, people's salivary pH might vary to become more acidic or basic depending on the type of food consumed. The pH of saliva is analyzed using a pocket pH meter and the correlated with dietary habits.

Reason: This study helps to correlate the changes in salivary pH with respect to food habits and the maintenance of the oral cavity.

AQ3 **Keywords:** ???

INTRODUCTION

Saliva is a watery substance located in the mouths of humans and animals, secreted by the salivary glands. Human saliva is 99.5% water, while the other 0.5% consists of electrolytes, mucus, glycoproteins, enzymes, and antimicrobial agents such as secretory immunoglobulin A and lysozyme [1]. There is much debate about the amount of saliva that is produced in a healthy person per day; estimates range from 0.75 to 1.5 L/day while it is generally accepted that during sleep the amount drops to almost zero [2].

Saliva plays an important role in maintaining the integrity of teeth by way of its buffering action and controlling the demineralization and promoting remineralization, occurring continuously at the enamel surface [3]. There is much debate about the amount of saliva that is produced in a healthy person per day; estimates range from 0.75 to 1.5 L/day while it is generally accepted that during sleep the amount drops to almost zero [4]. Saliva is implicated in a wide variety of physiological and biological processes that are crucial to the initial digestion in the upper parts of the gastrointestinal tract including lubrication during chewing so that the food can be swallowed [5]. The salivary flow rate, while chewing food, is elicited by gustatory and mechanical stimulation and the gustatory stimulation of natural food in producing the flow of saliva appeared to be much more important than the mechanical stimulation from chewing [6].

The salivary flow and composition such as mucins, sodium, proteolytic, and lipolytic activities help in the perception of flavor such as fat, sweetness, saltiness, astringency, bitterness, and retronasal aroma inside the mouth. However, few studies have explored the influence of salivary flow and saliva composition on individual taste liking or acceptance [7-10].

Saliva flow rate, buffer capacity, and microorganism content are very important for oral health.

Buffer solutions are solutions that maintain an approximately constant pH when small amounts of either acid or base are added or when the solution is diluted. In other words, buffers are resistant to changes in pH. There are three possible buffer systems in saliva – the protein buffer, phosphate buffer, and carbonic acid/bicarbonate buffer [11]. The protein buffer, however, is not very effective due to its lack of many ionized groups, which means that it does not have enough acidic/basic groups to remove OH^-/H^+ added, respectively. The phosphate buffer is active in unstimulated saliva [12]. The mechanism for the phosphate buffer system is due to the ability of the secondary phosphate ion, $H_2PO_4^-$, to bind a hydrogen ion and form a primary phosphate ion H_2PO_4. Hence, the phosphate buffer has the potential to be an effective buffer in the mouth. However, its effectiveness in buffer action is lowered only due to the low concentrations of phosphate in the oral cavity. But during the resting state, when no food is present in the mouth, the concentration of phosphate would be higher than that of bicarbonate which would be quite efficient in unstimulated saliva. The carbonic acid/bicarbonate buffer is the major buffer in stimulated saliva, which acts mainly on acids produced by bacteria present in the oral cavity given as by-products when they digest sugars in the mouth or acids from the stomach and neutralize them. A normal salivary flow rate is required for a normal concentration of bicarbonate ions to be present. Once the food is present in the mouth, the pH decreases, and the bicarbonate ions concentration increases. The decrease of the pH is caused by increased concentrations of H^+ in the plaque, due to lactic acid being produced by bacteria when they ferment carbohydrates. The buffering capacity of saliva is found to be responsible due to the presence of bicarbonate ions, secreted within the ducts. The concentration of bicarbonate is determined by the stimulation of saliva and by carbonic anhydrase VI (secreted by the serous acinar cells in the parotid and submandibular glands). While eating salivary flow rate increases the fore more bicarbonate is produced as a by-product of cell metabolism which diffuses into dental plaque and helps neutralize the increased amount of acid (H^+) produced by the bacteria. The salivary pH increases with increasing bicarbonate concentrations.

This is convenient because a rise in bicarbonate usually occurs in stimulated saliva (when food is in the mouth), and H^+ is produced by bacteria fermenting sugars in the food. This ensures that saliva pH is maintained well above the critical pH [11]. Salivary flow rate, buffer capacity, and streptococci mutans counts were significantly related to caries occurrence in some studies [13,14] and the evaluation of these factors has been proposed as a tool for caries risk assessment but was found to be less futile for its assessment. It was also found that low buffering capacity is imminent with caries development due to its

impaired neutralization of plaque acids and reduced remineralization of early enamel lesions [14,15].

Table 1: Composition of male and female

Sex				
???	Frequency	Percent	Valid percent	Cumulative percent
Valid				
Male	31	51.7	51.7	51.7
Female	29	48.3	48.3	100.0
Total	60	100.0	100.0	

Table 2: Comparison of means of the fasting and after food pH

???	Paired samples statistics			
	Mean	n	Standard deviation	Standard error mean
Pair 1				
Fasting pH	7.505	60	0.7806	0.1008
After food pH	7.95	60	0.707	0.091

An association between low caries levels and high salivary buffering capacity have been also demonstrated [16,17].

METHODS

This study was done on the students of Saveetha Dental College in Chennai. The sample size taken was 60 consisting of 31 males and 29 females. The students were randomly selected and were between the age of 17 and 20 years. The saliva samples were collected in disposable containers before and after eating food. The saliva's pH was checked using a pocket pH meter, and the readings were noted along with their diet. Their duration of fast, the diet taken for dinner, and whether cold drinks were taken or not were also noted. The data from all 60 students were analyzed with SPSS software which allowed gathering and comparing the various inferences from the data. The permission to conduct the study was obtained from the Institutional Ethics Committee, and the consent was given by the concerned individuals.

RESULTS AND DISCUSSION

The data from all 60 students were analyzed with SPSS software which allowed to gather and to compare the various inferences from the data. The analysis shows a significant change (0.001) in the pH before (mean=7.505) and after food (mean=7.95) (Tables 1-3).

Table 3: Significance in change of pH

Paired samples test								
???	Paired differences					t	df	Sig. (2-tailed)
	Mean	Standard deviation	Standard error mean	95% confidence interval of the difference				
				Lower	Upper			
Pair 1								
Fasting pH-After food pH	−0.4467	0.9948	0.1284	−0.7037	−0.1897	−3.478	59	0.001

Table 4: Food taken after fast

???	Diet			
	Frequency	Percent	Valid percent	Cumulative percent
Valid				
Oil food	30	50.0	50.0	50.0
Confectionary	8	13.3	13.3	63.3
Non-vegetarian	6	10.0	10.0	73.3
Rice	11	18.3	18.3	91.7
Other foods (Wheat/millets, etc.)	5	8.3	8.3	100.0
Total	60	100.0	100.0	

Table 5: Comparison of pH before and after the consumption of food

???	Descriptives							
	n	Mean	Standard deviation	Standard error	95% confidence interval for mean		Minimum	Maximum
Fasting pH								
Oil food	30	7.560	0.7295	0.1332	7.288	7.832	6.5	9.8
Confectionary	8	7.275	0.9438	0.3337	6.486	8.064	6.0	9.0
Non-vegetarian	6	7.383	0.4834	0.1973	6.876	7.891	6.5	7.8
Rice	11	7.664	1.0356	0.3123	6.968	8.359	6.0	9.0
Other foods (Wheat/millets, etc.)	5			0.2619	6.613	8.067	6.5	7.9
Total	60			0.1008	7.703	7.707	6.0	9.8
After food								
Oil food	30	8.12	0.799	0.146	7.82	8.42	7	10
Confectionary	8	8.09	0.491	0.174	7.68	8.50	7	9
Non-vegetarian	6	8.27	0.686	0.280	7.55	8.99	7	9
Rice	11	7.45	0.281	0.085	7.26	7.63	7	8
Other foods (Wheat/millets, etc.)	5	7.46	0.358	0.160	7.02	7.90	7	8
Total	60	7.95	0.707	0.091	7.77	8.13	7	10

Table 6: Comparison of pH with consumption of cold drinks

Any cold drinks taken	Group statistics			
	n	Mean	Standard deviation	Standard error mean
Fasting pH				
Yes	19	7.368	0.5869	0.1347
No	41	7.568	0.8548	0.1355

The food taken by the students were divided into five categories: Oil food, confectionary, non-vegetarian, rice, and other foods (wheat/millets, etc.). The variation in the pH of saliva with respect to the type of food taken was compared to know the effect of diet on salivary pH. Significant changes were found in three cases of diet which include oil food (7.5-8.1 approximately), confectionary (7.2-8.1 approximately), and non-vegetarian (7.3-8.2 approximately). Thus, it can be inferred that the oral cavity becomes more alkaline while consuming oil food, confectionary and non-vegetarian food. The other foods such as wheat and millers (7.3-7.4) and rice (7.6-7.4) does not show a significant change in salivary pH (Tables 4-6).

On comparing, the consumption of intake of cold drinks and fasting pH, no significant decrease or increase in pH is noted. Thereby, one can conclude the effectiveness of buffer system in the oral cavity from the data given above.

CONCLUSION

This survey was conducted to analyze the change in pH in saliva with respect to the nature of diet consumed. From the study, it was observed that the mean pH of saliva during overnight fast was 7.3 while the mean pH post-prandial was found to be 8 (approximate). The survey was also done to check the influence of various foods in altering the salivary pH. The results had shown a noticeable increase in pH in the case of students who took non-vegetarian food. The pH for students who took rice and other foods such as wheat and millets showed no significant change. Therefore, one can conclude the importance of buffer system in the body, which plays a significant role in the maintenance of pH of the body and the importance of proper food selection and intake.

Further, research should be done on the proper buffer action of saliva in the mouth and the proper diet to be taken for the healthy maintenance of the oral cavity.

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