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# EFFECT OF VARIOUS SUGARY BEVERAGES ON SALIVARY pH AND FLOW RATE AMONG ADULTS - A CLINICAL TRIAL

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## ABSTRACT

**Introduction:** Diet is a major aetiological factor for dental caries and enamel erosion. Dietary habits are apparently changing with modernization. Fresh fruits consumption has tons of benefits but on the other side fresh fruit juices and beverages are acidic in nature and saliva is one of the factors for dental caries.

**Objectives:** To assess effect of various sugary beverages on salivary pH and flow rate among adults.

**Materials and Method:** This clinical trial comprised of 120 subjects. Test beverages undertaken were pepsi, fruit drink, coffee, and sweetened milk. Statistical analysis was carried out using SPSS 23.0 version , one-way ANOVA were applied in the statistical tests.

**Results:** It was found that salivary pH decreased for all the beverages immediately after consumption and the salivary flow rate increased after their consumption. The oral clearance rate of sweetened milk was found to be the least at 6.5 minutes and that of pepsi was found to be 13 minutes. However, the oral clearance rates of fruit drink and coffee were found to be equal at 15 minutes.

**Conclusion:** Although it was found out that liquids cleared rapidly from the oral cavity, they had a significant cariogenic and erosive potential. Hence, it is always advised to minimise the consumption of beverages, especially amongst children and young adults to maintain a good oral health.

**Keywords: Sugary Beverages, Salivary Ph, Flow Rate, Clinical Trial**

## INTRODUCTION

Saliva is a complex secretion consisting of 99% of water and remaining 1% of organic and inorganic molecules. The diverse functions of the oral tissues such as mastication, deglutition, taste sensation, speech and initial digestion of the carbohydrates would be impossible without the salivary secretions. The interface between the saliva and oral tissue is the site of many dynamic reactions which affect both the soft tissues and hard tissues of the mouth. Saliva provides the physiologic environment in oral cavity where the complex interactions between the agent, host and the environment factor occur, to bring about demineralization of the tooth and subsequent development of caries. The salivary parameters which affect the enamel stability in the oral environment are pH of saliva, salivary flow rate, oral clearance, concentrations of calcium, phosphate and fluoride ions and salivary levels of the oral microorganisms [1].

Diet is a major aetiological factor for dental caries and enamel erosion. Nutritional status impacts the development of the teeth and the host's resistance to many oral conditions, including periodontal diseases and oral cancer. The normal pH of saliva is 6.7 to 7.4 but as bacteria break down the carbohydrates, they release lactic acid, butyric acid, and aspartic acid which bring down the pH of saliva. When the pH level in mouth goes below 5.5 (i.e., the critical pH value), the acids begin to break down the enamel on teeth. The longer the teeth are exposed to a low salivary pH, it is more likely that the development of dental caries occurs [2].

In recent decades, an increase in the consumption of soft drinks, including fruit juices and carbonates beverages, has been observed in developed countries. This tendency is reflected in the parents' behaviour in that they offer fruit juices and soft drinks in the feeding bottles and cups more and more often. Almost the quarter of the daily energy intake in young children stems from the carbohydrate content of soft drinks [3].

Saliva plays an important role in oral homeostasis, as it modulates the ecosystem in the oral cavity. Alteration in salivary flow rate (SFR) and pH have a significant impact on oral and dental health and can be used for the diagnosis of a wide range of disease such as dental caries.

Hence, the following study was undertaken with the aim of assessing the effect of selected locally available beverages on salivary pH and to assess salivary flow rate amongst dental students [1].

## MATERIAL AND METHODS

The present study was clinical trial carried out for period of 2 month in dental college and hospital. In total 120 randomly selected

undergraduate students from the same college were examined. Before scheduling the study, the ethical clearance was obtained from the institutional ethical committee of dental college. Informed consent was also obtained from each participants before beginning of the study.

**Sample Size Estimations**:

The sample size has been estimated using the GPower software v. 3.1.9.2. Considering the effect size to be measured (f) and the margin of the error at 9%, the sample size obtained is 114, which will be rounded off to 120. Each group will consist of 30 samples. [30 x 4 groups =120 samples]

**Inclusion Criteria:**

(1) Subjects who were above 18 years of age.

(2) Subjects who were caries-free, that is, with DMFT score = 0.

(3) Subjects who were not suffering from any systemic disease or illness.

**Exclusion Criteria:**

(1) Subjects who did not give informed consent.

(2) Subjects who were using alcohol or tobacco in any form.

(3) Subjects who were using any medication at the time of study or in the period of the last 15 days prior to the study.

(4) Subjects who were suffering from any systemic illness.

(5) Participants allergic to fruits drink.

Study tools

- Diagnostic Instruments
- pH strips
- Graduated saliva collecting cups.
- Fruit drink ,Cold drink ,Milk (with table sugar),Coffee (with table sugar)

**Procedure**

Unstimulated salivary sample was collected for each study subject at least one hour after their breakfast. After the collection of baseline salivary samples (before the consumption of test beverage), the subjects were given one beverage to drink and then stimulated saliva samples were collected at the following fixed time intervals:

1) 1st follow-up, immediately after test food consumption.

2) 2nd follow-up, 5 minutes after the test food consumption.

3) 3rd follow-up, 10 minutes after the test food consumption.

4) 4th follow-up, 15 minutes after the test food consumption.

The study subjects were given 4 different beverages to drink for subsequent days and subsequent salivary samples were collected. Carbonated beverage (pepsi), fruit drink (mango drink), and coffee and milk (containing table sugar) were taken under liquids category. Before starting, the intrinsic pH of each beverage was measured. The amount of sugar added in

coffee and milk was 1 tablespoon each in 50 ml. The beverages were consumed as an amount of 50 ml for liquid items.

For the collection of unstimulated saliva, subjects were seated comfortably on a normal chair. The subjects were sitting with their head bent forward and spat into a sterile saliva collecting cups. Unstimulated saliva was collected at baseline and at each time interval after test beverage for up to one minute. The salivary pH was directly estimated using the pH strips buffers of pH 4 and 7. The pH of saliva was measured as soon as possible and not later than 10 minutes after the collection of the sample. The flow rate was measured directly from the calibrated saliva collecting cups after each sample collection.



COLLECTION OF SALIVA

**Statistical analysis**

The data obtained were tabulated and analysed using statistical package for social sciences version 23.0 (SPSS). Mean salivary pH of different beverages was compared using ANOVA test. p value $\leq$ 0.05 was considered to be statistically significant.

**RESULTS**

The intrinsic pH of pepsi was found to be the least at 3.01, followed by that of fruit drink (3.99), coffee (5.87), and sweetened milk (6.83). It also shows mean salivary pH at different intervals of time after consumption of different liquid food items. The mean salivary pH of pepsi at base line level was 5.93±0.63, at 5 minutes 6.33±0.44, at 10 minutes 7.07±0.36 and there was maximum rise in pH at 15 minutes i.e. 7.50±0.57. The mean salivary pH of fruit drink at base line level was 5.61±0.51, at 5 minutes 6.47±0.48, at 10 minutes 6.97±0.37 and there was maximum rise in pH at 15 minutes i.e. 7.54±0.45. The mean salivary pH of coffee at base line level was 5.64±0.55, at 5 minutes 6.41±0.41, at 10 minutes 7.05±0.41 and there was maximum rise in pH at 15 minutes i.e., 7.43±0.40. The mean salivary pH of sweet milk at base line level was 6.29±0.49, at 5 minutes 6.93±0.42, at 10 minutes there was maximum rise in pH

i.e.7.79±0.54 and at 15 minutes salivary pH was 6.45±0.40 **(Table 1)**.

It was found that the difference in the mean salivary pH at baseline and at different intervals of time after the consumption of pepsi, fruit drink, coffee, and sweet milk was found to be statistically significant ($p = 0.000$) **(Table 2)**.

In case of carbonated beverage (pepsi), the mean salivary flow rate of the subjects at baseline level was $0.93 \pm 0.13$. It was observed that the mean salivary flow rate for pepsi was maximum at 5 minutes ($1.33 \pm 0.14$) which came back to baseline level at 15 minutes ($1 \pm 0.07$). In case of fruit drink, the mean salivary flow rate of the subjects at baseline level was $0.61 \pm 0.15$. It was observed that the mean salivary flow

rate for fruit drink was maximum at 5 minutes ($1.47 \pm 0.48$). In case of coffee, the mean salivary flow rate of the subjects at baseline level was $0.67 \pm 0.15$. It was observed that the mean salivary flow rate for coffee was maximum at 5 minutes ($1.41 \pm 0.41$). In case of sweet milk, the mean salivary flow rate of the subjects at baseline level was $1.09 \pm 0.19$. It was observed that the mean salivary flow rate was maximum sweet milk at 5 minutes ($1.93 \pm 0.42$) **(Table 3)**.

It was found that the difference in the mean salivary flow rate at baseline and at different intervals of time after the consumption of pepsi, fruit drink, coffee, and sweet milk was found to be statistically significant ($p = 0.000$) **(Table 4)**.

**Table 1: Mean Salivary pH at Different Intervals of Time After Consumption of Different Liquid Food Item**

| GROUP | INTRINSIC Ph | BASELINE | 5 MIN | 10 MIN | 15 MIN |
|---|---|---|---|---|---|
| PEPSI | 3.01 | 5.93±0.63 | 6.33±0.44 | 7.07±0.36 | 7.50±0.57 |
| FRUIT DRINK | 3.99 | 5.61±0.51 | 6.47±0.48 | 6.97±0.37 | 7.54±0.45 |
| COFFEE | 5.87 | 5.64±0.55 | 6.41±0.41 | 7.05±0.41 | 7.43±0.40 |
| SWEET MILK | 6.83 | 6.29±0.49 | 6.93±0.42 | 7.79±0.54 | 6.45±0.40 |

**Table 2: Comparison of Mean Salivary pH After Beverage Consumption at Different Intervals of Time (one- way ANOVA)**

| GROUP | F-VALUE | P VALUE | SIGNIFICANT/ NON SIGNFICANT |
|---|---|---|---|
| PEPSI | 15.051 | 0.000 | |
| FRUIT DRINK | 53.654 | 0.000 | SIGNIFICANT |
| COFFEE | 67.543 | 0.000 | |
| SWEET MILK | 53.086 | 0.000 | |

**Table 3: Mean Salivary Flow Rate After Beverage Consumption at Different Intervals of Time (one- way ANOVA)**

| GROUP | BASELINE | 5 MIN | 10 MIN | 15 MIN |
|---|---|---|---|---|
| PEPSI | 0.93±0.13 | 1.33±0.14 | 1.07±0.16 | 1±0.07 |
| FRUIT DRINK | 0.61±0.15 | 1.47±0.48 | 0.97±0.37 | 0.88±0.35 |
| COFFEE | 0.67±0.15 | 1.41±0.41 | 1.05±0.31 | 0.93±0.20 |
| SWEET MILK | 1.09±0.19 | 1.93±0.42 | 1.19±0.34 | 0.90±0.10 |

**Table 4: Comparison of Mean Salivary Flow Rate After Beverage Consumption at Different Intervals of Time (One-Way Anova)**

| GROUP | F-VALUE | P VALUE | SIGNIFICANT/ NON SIGNFICANT |
|---|---|---|---|
| PEPSI | 16.041 | 0.000 | |
| FRUIT DRINK | 13.154 | 0.000 | SIGNIFICANT |
| COFFEE | 17.143 | 0.000 | |
| SWEET MILK | 33.186 | 0.000 | |

## DISCUSSION

In modern society, it has been perceived that prevalence of tooth loss by dental caries or dental erosion is rapidly increasing. The dietary components have been contemplated to be the contributing factor for development of enamel defects. Relation allying diet and nutrition, the oral health and nutrition is a synergistic [4].

The beverage market has in recent years seen drastically increased consumption of aerated drinks [5]. Teenagers and children, whom many fizzy drinks are marketed towards, are among the largest consumers and account for 65% of total sales. Literature reveals that parents' influence, peer pressure, diet fallacies, pleasure, and taste are reasons that lead children to consume these drinks [6].

The changes in drinking patterns also have implications for dental health. A common trend has been observed in the drinking habit of children and adults worldwide. A large number of studies have reported that the quantity of soft drinks consumed was directly proportional to the time spent watching television [7]. The number of sugar-containing snacks and beverages consumed between meals and a late onset of oral hygiene measures correlate positively with plaque accumulation and caries incidence in the primary dentition [8]. Soft drinks contain not only sugars but also different organic acids, and they are implicated as an extrinsic cause in the development of dental erosion [9, 10].

The consumption of fruit juices vary greatly among populations. On consumption, they tend to alter pH of oral cavity and shift the equilibrium toward demineralization but data correlating the effect of salivary pH on cariogenicity is scarce in literature. Packaged fruit juices are sweeter having higher sugar content to enhance their taste. It is also known that the plaque pH goes from acidic to normal (or the resting level) within a few minutes and depends on the presence of saliva [4].

In this study, comparison of mean salivary pH after beverage consumption at different intervals of time showed that the difference in the mean salivary pH at baseline and at different intervals of time after the consumption of pepsi, fruit drink, coffee, and sweet milk was found to be statistically significant ($p = 0.000$). Similar result was

found in the study conducted by Susan Thomas *et al* **[2]** in which the difference in the mean salivary pH at baseline and at different intervals of time after the consumption of pepsi, fruit drink, coffee, and sweet milk was found to be statistically significant ($p = 0.000$).

It was found that the difference in the mean salivary flow rate at baseline and at different intervals of time after the consumption of pepsi, fruit drink, coffee, and sweet milk was found to be statistically significant ($p = 0.000$). Similarly in the study conducted by Susan Thomas *et al* **[2]** the flow rate at baseline and at different intervals of time after the consumption of pepsi, fruit drink, coffee, and sweet milk was found to be statistically significant ($p = 0.000$).

This finding of the study was in agreement with that of the study carried out by Azrak *et al* **[12]** in which the oral clearance rate of milk was found to be 5 to 10 minutes. This result of the present study was in contradiction to the study carried out by Khodadadi *et al* **[13]** in which the oral clearance rate of milk was found to be 30 minutes.

Carbohydrates consumed in liquid form usually do not stay in mouth very long, but if they are consumed often throughout the day, chances for developing dental caries increase. If teeth are constantly exposed to sugary drinks, the acids produced by bacteria remain in oral cavity for a longer time thus causing dental caries and erosion. Drinking sugary beverages with meals will reduce chances for developing dental caries and erosion **[14]**.

As dental professionals, we need to educate our patients about the repercussions of soft drink consumption and furnish solutions to minimize the risk. Future endeavour also needs to be directed toward modifying drinking habits as well as limiting frequency of intake of acidic drinks to avoid erosion.

**CONCLUSION**

Although it was found out that liquids cleared rapidly from the oral cavity, they had a significant cariogenic and erosive potential. Hence, it is always advised to minimise the consumption of beverages, especially amongst children and young adults, to maintain a good oral health.

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