

EFFECTS ON PH VALUE OF SALIVA FOLLOWING INTAKE OF THREE BEVERAGES: A DOUBLE BLIND CROSS-OVER STUDY

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ABSTRACT:

Introduction: The etiology of dental caries as well as dental erosion share a common background that is nature of the saliva. "Good health means good and fresh food" this concept has given way to an alarming increase in the consumption of fruit juices, energy drink and sports drink. Fall in the salivary pH after any dietary intake is a crucial parameter for oral health. With this in mind the following study is proposed to be conducted to determine the difference in pH of saliva, following intake of three types of beverages.

Materials and Methods: Stimulated saliva of the subjects was collected in sterile glass bottles after they chewed one gram of paraffin wax prior to the consumption of beverage as a baseline score. Then the subjects were asked to consume assigned beverage and the salivary sample of each subject was collected in separate sterile glass bottles after 2 minute, 5 minute, 10 minute and 15 minute of beverage consumption.

Results: In the present study the Beverage (B-3) which is a carbonated beverage showed maximum drop in salivary pH when compared to the other two test drinks.

Conclusion: The results suggest that all three available form of beverage caused significant drop in salivary pH.

Key words: Fruit juice, Salivary pH, Oral Health, Dental Caries, Dental Erosion

INTRODUCTION:

Dental Caries is a chronic ubiquitous disease. It is defined as "a microbial disease of the calcified tissue of the teeth, characterized by demineralization of the

inorganic portion and destruction of the organic substance of the tooth" ^[1]. The problem of dental caries is age - old. Dentistry has advanced on a very large scale but the problem of dental caries still persists, with DMFT scores increasing

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every year in the developing world. India is no exception to this problem. About 80% of children and 60% of adults suffer from this disease with almost no dental restorative help available particularly in rural and deprived areas [2].

Dental erosion is defined as “a loss of tooth substance by a chemical process that does not involve a known bacterial action” [3]. Despite differing physiopathology, dental caries and dental erosion have greater impact on the younger generation in comparison with gingival and periodontal pathologies. The aetiology of dental caries as well as dental erosion shares a common background that is the nature of saliva. The reaction of saliva has been the object of study by numerous investigators, either for direct reasons or because of a suspected causal relationship with dental caries. The properties and functions of saliva, as well as role of saliva in oral health, have been discussed extensively in articles, textbooks and various reviews [4].

Beverages are known to produce a tremendous drop in the salivary pH as they contain organic acids and sugars. In dental literature this is reported as critical pH in saliva, the value of which is 5.5 [5]. A further fall in pH disturbs the calcium and phosphate regulation leading to dental caries. Beverage containing inherent acids and sugars has both acidogenic and cariogenic potential. Many studies showed a positive relationship between caries and dental erosion and the consumption of soft drinks. Accordingly, the clinical manifestations and diagnosis

of diseases caused by such beverages should be regarded as a combination of erosion and caries, and clinicians should pay more attention to it. [6]

The individual factor that has been speculated time and again is the genetic predisposition. The salivary flow rate also markedly influences the pH. Low salivary secretion rate accentuates the fall in the pH in dental plaque after gentle rinsing with soft drinks [7]. The presence of dental caries makes the oral cavity more vulnerable to the effects of acidogenicity than its absence [8].

As a result of westernization and cultural changes in the dietary pattern, the beverage industry has grown by 60% in the last two decades. All these can have detrimental effects on oral health; this necessitates the need for further exploration in this field. With a tremendous growth of the advertising industry, children easily fall prey to the luring advertisements provided by the beverage company. Thus fall in salivary pH after any dietary intake is a crucial parameter for oral health. With this in mind the following study was conducted to determine the difference in pH of saliva, following intake of three different beverages.

MATERIAL AND METHODS:

The study was carried out among 30 healthy subjects (between the age of 18-25 years) who were invited to voluntarily participate in the study. Subjects who gave the informed consent to participate in the study and who have DMFT = 0 were

included in the study. Subjects who are suffering from any systemic disorders, who are under medication for any diseases for last two weeks, subjects with any decayed, missing or filled teeth, subjects with any active mucosal lesion, and who wearing any orthodontic appliance were excluded from the study.

Investigator was trained and standardized through a series of training exercises. This procedure included a series of theoretical overview, discussing issues that might be encountered during the study period. Prior to the start of the study, ethical clearance was obtained from the Institutional Ethical Committee. The details of the study procedure were explained to the subjects and informed consent was also obtained from each participant.

Preconditioned procedures done at the beginning of the study (prior to beverage intake) were, clinical examination, estimation of baseline pH value of saliva, estimation of the endogenous pH of test beverages. The subjects were examined by a single examiner using a mouth mirror and explorer (No 5). The teeth were cleaned with cotton, dried with a chip blower and examined for presence of caries. Three types of beverages were selected for the study, fruit juice (nectar) - Code B-1, fruit juice (sugar-free) – Code B-2, Carbonated beverage (Fizzed drink) – Code B-3. For each beverage tested, the saliva was collected in a sterile glass tube five times from each individual at fixed intervals.

The study was conducted over a period of three days. The study participants were instructed to refrain from brushing their teeth or using any oral hygiene aids on the day of study and from consuming any food or drinks for at least 8 hours prior to the procedure. Estimation of the endogenous pH of test beverages was done prior to the saliva collection. Stimulated saliva of the subjects was collected in sterile glass bottles prior to the consumption of juice as a baseline score. The glass bottles were coded with a specific identity number. Then the subjects were asked to consume 100ml of assigned beverage and the salivary sample of each subject was collected in separate sterile glass bottles after 2 minute, 5 minute, 10 minute and 15 minute after consumption. The collected saliva samples were immediately subjected for estimation of the pH changes using a calibrated portable digital pH meter in combination with a glass electrode. The calibration of the instrument was carried out with three standard buffer solutions of pH 4.0, 7.0 and 10.0 respectively.

Statistical Analysis was carried out using “Students paired t test” which was used to compare the effect of one type of beverage with the other, whereas to assess the effect of one type of beverage at different time intervals “One-way ANOVA” was used. All statistical analysis was carried out using SPSS version 18 for Windows.

RESULTS:

Table 1 shows the intrinsic pH of all the three test beverages that were used for this study. It is noted that carbonated apple juice (code B-3) has the most acidic intrinsic pH of 2.31.

Table 2 shows the change in salivary pH after consumption of fruit juice (nectar) (B-1). It was observed that pH recorded the lowest 5 minutes post consumption of the beverage and it was also noted that the drop in pH at 2, 5 and 10 minutes were statistically significant. After 15 minutes the pH slowly started to come back to baseline value.

Table 3 shows the change in salivary pH after consumption of fruit juice (B-2) which is a sugar - free beverage. It was observed that pH recorded the lowest 2 minutes post consumption of the beverage and it was also noted that the drop in pH at 2, 5 and 10 minutes were statistically significant. After 15 minutes the pH slowly started to come back to baseline value.

Table 4 shows the change in salivary pH after consumption of carbonated beverage (B-3). It was observed that pH recorded the lowest 2 minutes post consumption of the beverage and it was also noted that the drop in pH at 2, 5 and 10 minutes were statistically significant. After 15 minutes the pH slowly started to come back to baseline value.

DISCUSSION:

There are many complex factors that contribute to the total cariogenic and

acidogenic potential on enamel. Host, microbial and substrate factors all play a part in the ability or inability of the oral cavity to defend itself against attack [9]. The results of this study indicate that when the oral cavity is subjected to a substrate challenge, salivary pH levels fall. Initially suspecting this observation to be solely substrate driven, one must also consider other variables that could have influenced the data.

The buffering capacity of saliva as well as the flow rate vary amongst individuals and could subsequently create different results in other subject groups [9]. Other host factors such as the pattern of mastication and the frequency of consumption can contribute to the total acidogenic potential [10]. The concentration of acid or base produced by different oral bacteria can lead to either a demineralising or remineralising process [9]. Comparisons between caries-free group and with groups that have multiple carious lesions, the reported that caries-free groups had generally higher plaque pH scores than did the high-caries groups. Had this study utilized a group with multiple caries and active lesions, different data may have been obtained [11, 12].

The increased awareness of the population about health has led to an increased consumption of natural food products, but healthy diet has also been proven to contain substantial acids, which has the potential to cause loss of tooth structure [13]. Foods and beverages, especially fruits and fruit juices, can

contain a variety of acids that have the potential to damage the teeth [14]. The initiation and progression of this dental mortality which is caused by consumption of the acidic drinks may involve a multi factorial process, such as the pH of drink, intra oral pH changes, and the organic acid content of the drink.[15]

In the present study the carbonated beverage (B-3) showed maximum drop in salivary pH when compared to the other two test drinks. This drop could be attributed to the relatively lower intrinsic pH of commercially available fruit juices. Similar results have been shown by Lata Kiran et al [5], Sabysachi Saha et al [16].

It has been shown that carbonated beverages are more efficiently buffered by contact with saliva than fruit juices. The length of time for which this low pH remains at its minimum is important- the longer the stay at critical pH value, the higher the dissolution of enamel. It has been reported that solubility of dental tissue increases by a factor of 7-8 with each drop of pH by 1 unit thereby significantly increasing the potential risk for demineralization.

REFERENCES:

1. William G Shafer, Maynard K. Hine, Barnet M. Levy. Textbook of Oral Pathology. 4th Edition, Saunders;1993. pg 406.
2. Ministry of Health and Family welfare, India. National oral healthcare program in India. Available from <http://www.aiims.edu/aiims/events/de>

Appropriate comparison could not be made due to unavailability of similar study. In present study, the degree of pH drop was – Carbonated beverage (B-3) > Juice nectar (B-1) > Sugar free beverage (B-2).

The above study highlights the detrimental effects caused by the excessive and abusive consumption of the fruit juices and their frozen products. The neutralization of an acidogenic challenge in the oral cavity is a complex phenomenon.

CONCLUSION:

The aforementioned results suggest that all three types of commercially available beverages caused significant drop in salivary pH. There is a dynamic two way relationship between diet and salivary pH. Hence it is incumbent for us Public Health dentists to assist patients eliminate the abusive habits associated with the consumption of these beverages and motivate them for better compliance. It is concluded that dietary counseling and preventive care should be advised to patients who frequently consume beverages.

[ntalworkshop/nohcprog.htm](http://www.oralworkshop/nohcprog.htm) [accessed on 3rd March 2014]

3. William G Shafer, Maynard K. Hine, Barnet M. Levy. Textbook of Oral Pathology. 4th Edition, Saunders;1993. pg 318.
4. Paula Moynihan, Poul Erik Petersen. Diet, nutrition and the prevention of dental diseases. *Public Health Nutrition* 2004; 7(1): 201–226.

5. Latakiran Banan, Anita M.Hegde. Plaque and salivary pH changes after consumption of fresh fruit juices. *J Clin Pediatr Dent* 2005; 30(1): 9-14.
6. Ran Cheng, Hui Yang, Mei-ying Shao, Tao Hu, Xue-dong Zhou. Dental erosion and severe tooth decay related to soft drinks: a case report and literature review. *J Zhejiang Univ Sci B*. May 2009; 10(5): 395–399.
7. Ann-Katrin Johansson, Peter Lingstrom, Downen Birkhed. Effect of soft drinks on proximal plaque pH at normal and low salivary secretion rates. *Acta Odontologica Scandinavia*. 2007; 65: 352-356.
8. Jensdottir T, Bardow A, Holbrook P. Properties and modification of soft drinks in relation to their erosive potential in vitro. *J Dent*. 2005;33(7):569–575
9. Schachtele CF, Jensen ME. Comparison of methods for monitoring changes in the pH of human dental plaque. *J Dent Res*. 1984; 61(2):1117-1125.
10. Owens BM. The potential effects of pH and buffering capacity on dental erosion. *Gen Dent*. 2007;55(6):527–531.
11. Dong YM, Pearce EI, Yue L, Larsen MJ, Gao XJ, Wang JD. Plaque pH and associated parameters in relation to caries. *Caries Res*. 1999; 33(6): 428-436.
12. Abelson DC, Mandel ID. The effect of saliva on plaque pH in vivo. *J Dent Res*. 1981; 60(9): 1634-1638.
13. Johansson AK, Johansson A, Birkhed D, Omar R, Baghdadi S, Carlsson GE. Dental erosion, soft-drink intake, and oral health in young Saudi men, and the development of a system for assessing erosive anterior tooth wear. *Acta Odontol Scand*. 1996;54(6):369–378.
14. Lussi A, Jaeggi T, Zero D. The role of diet in the aetiology of dental erosion. *CariesRes*. 2004;38(Suppl. 1):34–44.
15. Birkhed D. Sugar content, acidity and effect on plaque pH of fruit juices, fruit drinks, carbonated beverages and sport drinks. *Caries Res*. 1984; 18: 120-127.
16. Saha S, Jagannath GV, Shivkumar, Pal SK. Effect of commonly consumed fresh fruit juices and commercially available fruit juices on pH of saliva at various time intervals. *J Int Dent Med Res* 2011; 4(1):7-11.