

# Effect of Fresh Fruit Juices on Salivary pH: A Randomized Controlled Trial

Sp Shetgar<sup>1</sup>, Umesh Kemparaj<sup>2</sup>, Sangeeta Chavan<sup>3</sup>, Rahul Patel<sup>4</sup>

1-Post Graduate, Public Health Dentistry Narsinhbhai Patel Dental College & Hospital, Visnagar, Gujarat. 2,3-Reader, Public Health Dentistry Narsinhbhai Patel Dental College & Hospital, Visnagar, Gujarat. 4- Senior Lecturer, Public Health Dentistry Narsinhbhai Patel Dental College & Hospital, Visnagar, Gujarat.

Correspondence to:  
Dr. Sharanprakash, Post Graduate Public Health Dentistry  
Narsinhbhai Patel Dental College & Hospital, Visnagar, Gujarat.  
Contact Us: www.ijohmr.com

## ABSTRACT

**Introduction:** Fresh fruits consumptions have a tons of benefits documented in literature. On the same side the fresh fruit juices are acidic in nature. Ethology of dental care back ground that is nature of the saliva this concept has given way to an alarming the pH of saliva is one factor for dental caries. To find out the acidogenic potential of the commonly (10 different fruits) consumed freshly prepared fruit juices at room temperature on pH of saliva at various time intervals. **Material and Method:** A cross over study was conducted on 10 subjects. During the study, subjects were asked to collect their unstimulated saliva was collect of 2ml in a 5 ml test tube, before having juice as a baseline score. Subjects were asked to drink the juice, their saliva sample was collected in washed and dried 5 ml test tube after 0 minute (immediate after consuming the last backwash sip of juice), 10 minutes, 30 minutes and 60 minutes of drinking juice and the pH of the samples were measured using digital pH meter. **Results:** Present study shows higher fall in immediate salivary pH after consuming fresh mixed fruit juice. Most of the fresh fruit juices were acidic and reduced the salivary pH to the maximum drop in pH ranges 3.12 to 6.56 was found at after 0 minute (immediate after consuming the last backwash sip of juice). **Conclusion:** Present study suggested that there is a decline in the salivary pH after consumption of fresh fruit juices. There was higher fall in the salivary pH after immediate consuming “zero minute” (back wash sip of fresh fruit juice) and its take almost 60 minutes to attain back to normal saliva Ph. It is advised to rinse the oral cavity after consuming fresh fruit juices.

**KEYWORDS:** Fruits, Saliva pH, Diet, Dental caries

## INTRODUCTION

“Health is wealth” is very old saying. Health is what which keep on changing as the age passes. Health is the multi-dimensional factor. Under multi-dimensional factor, diet is the major part of it. As the diet is an essential part of life, Diet compresses huge contribution and it can maintain the body by having a balanced diet and physical exercise. Among the balance diet regimen, fruits have gained a very important position mainly to the nutrient constitution and benefits. As The word “FRUIT” have accounted before the evolution of the earth. The holy bible mythology documented about Adam and Eve relation with Apple fruit. The concept of health has prevailed for centuries and the dietary habits are apparently changing as well. Urbanization and economic development have resulted in rapid changes in diet and lifestyles. The diet we are consuming has become more refined with increased access to ready-made drink.<sup>1</sup> Also, there has been a substantial increase in consumption of carbonated beverage & fruit juices.<sup>2</sup> Now a day’s “healthy eating” is considered to be important. Though people are aware of the deleterious effect caused by carbonated beverages and fruit juices on the teeth, they do prefer to consume these things.<sup>3</sup> The literature reveals that parent’s influence, peer pressure, diet fallacies,

pleasure, and taste are the reasons that lead children to consume these drinks.<sup>2,4</sup> Saliva plays an important role in maintaining the integrity of teeth by way of its buffering action and controlling the demineralisation and promoting remineralisation, occurring continuously at the enamel surface.<sup>5</sup> The pH value, the calcium and phosphate content of a drink or foodstuff are important factors responsible for the erosive attack and formation of dental caries.<sup>2,6</sup> It also is 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. This is primarily due to the carbonate and phosphate pH buffering agents in the saliva.<sup>5</sup> The production of acid by bacteria in such close proximity to the tooth surface would mean that on consumption, the enamel demineralization could occur, hence their acidogenic and cariogenic potential.<sup>7,8</sup> The erosive effect of fruit juices has been recognized for a long time as evident in the studies of Darby (1892)<sup>9</sup> and W.D. Miller (1907)<sup>10</sup> who reported tooth decalcification due to excessive fruit juice consumption.

The soft drinks are thought to cause damage to the teeth because of two properties – first, the low pH and titrable acidity of some drinks can cause erosion on the enamel surfaces<sup>11,12</sup> and secondly the fermentable carbohydrate in drinks is metabolized by plaque microorganisms to

How to cite this article:

Shetgar SP, Kemparaj U, Sangeeta, Patel R. Effect of Fresh Fruit Juices on Salivary pH: A Randomized Controlled Trial. *Int J Oral Health Med Res* 2017;3(5):28-32.

generate organic acids in the dental plaque and saliva, resulting in demineralization and leading to dental caries.<sup>13</sup> Packaged fruit juices are sweeter having higher sugar content to enhance their taste and carbonated beverages have higher acidic content which causes demineralization of enamel tooth surface.<sup>14</sup>

Hence the present study has been carried out to assess the acidogenic potential of commonly consumed fresh fruit juices at various time intervals.

## MATERIALS AND METHODS

The study was conducted on a total of 10 students of both sexes visiting the department of public health dentistry of Narsinhbhai Patel Dental College and Hospital, Visnagar. Prior to the start of the study, ethical clearance was obtained from the Institutional Ethical Committee of the Narsinhbhai Patel Dental College and Hospital, Visnagar.

The details of the study procedure were explained to the subjects and informed consent was also obtained from each participant. The study was conducted in the Nootan pharmacy college with prior permission of Nootan Pharmacy College principal.

**Test drink:-** Ten test drink used here were:

- Mango
- Sapota
- Apple
- Banana
- Pineapple
- Grapes
- Orange
- Guava
- Watermelon
- Muskmelon

All the above fruits were selected which were commonly available in visnagar fruit market

**Subject Selection:** Following were the inclusion & exclusion criteria.

**Inclusion criteria:** Inclusion criteria will comprise of

- Healthy individuals
- Participants willing to give informed consent
- Whose DMFT score is ZERO

**Exclusion criteria:** Exclusion criteria will comprise of any:-

- Subject having any history of systemic diseases & Infection diseases.
- A subject suffering from any congenital diseases.
- Subject with the history of any antibiotic 2 months prior to the study.
- Participants of xerostomia condition.
- Participants undergoing and undergone radiation therapy.
- Participants allergic to fruits.

**Study Design:** It is a Cross Over - Double-Blinded Experimental Study. 10 students of Narsinhbhai Patel dental college, with the above-mentioned inclusion criteria, were enrolled to participate in the study. The study was conducted for a period of 20 days (10 alternative days). The study subjects were informed to gather in the Nootan pharmacy college chemistry laboratory at 10 am on every fixed date by principal investigator an alternative day gap is maintained for the wash out period of fruit juice.

**Juice Preparation:**

- The fruits were procured and juiced by co-investigator randomly, the principle investigator is oblivious about the sequencing of the fruits.
- The sequence in which fruit juice administered was decided randomly by chit method for to minimize the selection bias prior the starting day of study.
- All the fruits were purchased from one local fruit store in visnagar on the same day of the study of particular fruit which has drawn from chit. The non-damaged, consumable ripened fresh fruit was selected and washed under the running tap water to make dirt free.
- Fruits were peeled off (with help of peeling knife or by manually). The pulp portion is exposed and fruits pulp were chopped into the desirable size. (The seeds were removed (for seed fruits).
- 750 ml of fresh fruit juice was prepared without addition of water and sugar to which 250 ml of water is added to standardize the consistency and quantity of fruit juice. Juice was prepared in closed cabin. Which was given to consume to study participants 100 ml of each fruit juice was consumed on an alternative day in a paper (non transparent) disposable glass for the blinding purpose to the study participants.
- The intrinsic pH of fruit juice is noted by the digital electronic pH meter (- bench type pH meter TASHCON) by dipping the electrode into the large container of fruit juice before it is distributed to study participants for assessing salivary pH as it is a sensitive and accurate (Figure 1).
- Study participants were instructed not to drink or eat before and after 20 minutes till the pH recording is completed.
- One minute time interval gap is maintained between each participant for uniformity (1st, 2nd, and 3rd and so on till 10th participant) in a distribution of the juices, followed by the collection of saliva for pH analysis.

Saliva pH was analyzed at the following interval of time:

- Baseline – before the consumption of fruit juice.
- 0 minute – immediately after last backwash sip of fruit juice consumed.
- 10 minute – after the backwash sip consumed.
- 30 minute – after the backwash sip consumed.



Figure: 1 : Estimation of Fruit pH

- 60 minute – after the backwash sip consumed.

All the examinations were carried out by a single trained and calibrated investigator.

**Estimation of Salivary pH:**

- Unstimulated 2ml of saliva was collected in the sterile glass saliva collecting jar by saliva drooling method. The participants were made to sit on the chair in upright position and instructed to tilt their head to one side so that saliva drools into the sterile glass easily followed by this the digital pH electrode tip was dipped into the collected sterile glass saliva collecting jar (Figure 2).



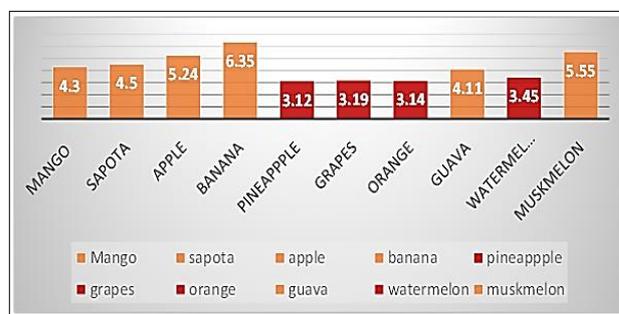
Figure: 2 Estimation of The Salivary pH

- The pH meter was calibrated each day prior to pH analysis for the accurate reading. The accuracy of the pH meter was checked at regular intervals to ensure that readings were correct. This complete procedure repeated at 0 min, 10 min, 20 min and 30 min time interval.
- The pH-sensitive electrode was dipped in a sample for the reading. The digital reading was allowed to stabilize for a few seconds and the pH reading was taken. In between readings, the electrode was cleaned with distilled water and placed in a standard solution of pH 7.0. This ensured stable readings and provided a constant check on the drift.

- The pH of saliva was scored by digital pH meter LCD indicator. Manufacturer instruction was followed throughout the procedure.

**RESULTS**

Graph 1 is showing the fruits included in the study. Among the ten fruits in the study, 4 fruits showed pH less than 4 (more acidic). Viz Orange (3.14) Pineapple (3.12) Watermelon (3.45) and Grape (3.19). Table 1 is showing the saliva pH at different interval of time pre and post consumption of fruits. The salivary pH drastically dropped at zero minutes (backwash sip) and it took almost 30 -60 minute to attain to baseline pH. Graph 2 represents the Stephan Curve with comparing study 10 fruits juices. Buffering capacity of the saliva reaching to a normal oral saliva pH after 60 minutes. With comparing 10, 30, 60 minutes respectively fall from zero minutes to 60



Graph:1. Fruit Juices pH Value

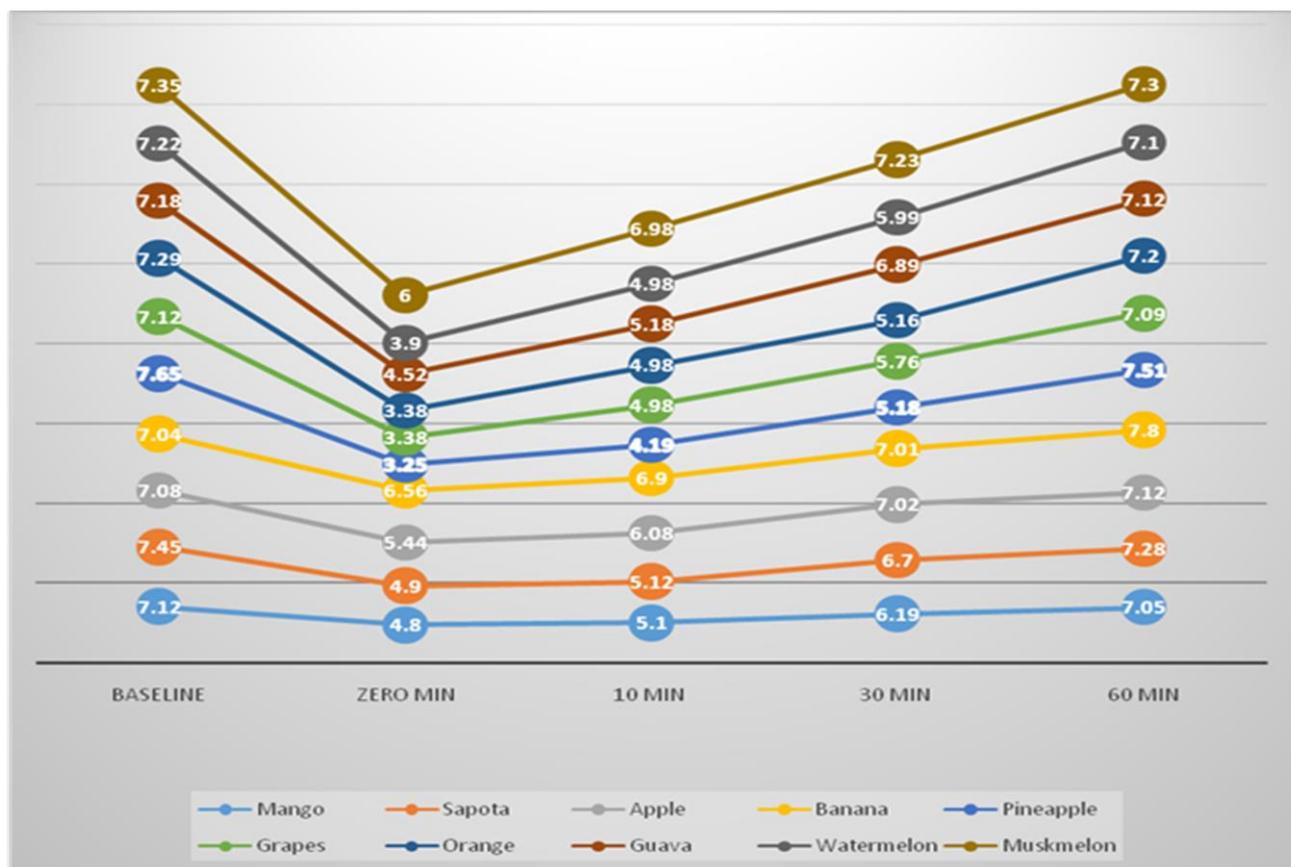
	Before con <sup>a</sup>	Zero min	10 min	30 min	60 min
Mango	7.12	4.80	5.10	6.19	7.05
Sapota	7.45	4.90	5.12	6.70	7.28
Apple	7.08	5.44	6.08	7.02	7.12
Banana	7.04	6.56	6.90	7.01	7.08
Pineapple	7.65	3.25	4.19	5.18	7.51
Grapes	7.12	3.38	4.98	5.76	7.09
Orange	7.29	3.35	4.74	5.16	7.20
Guava	7.18	4.52	5.18	6.89	7.12
Watermelon	7.22	3.90	4.98	5.99	7.10
Muskmelon	7.35	6.00	6.98	7.23	7.35

Table:1. Saliva pH Before And After Consumption Of Different Fruit Juices

**DISCUSSION**

A vast amount of laboratory research has been carried out on the effects of carbonated beverages in relation to dental caries and erosion,<sup>15</sup> but very much less has been done on humans and there is a paucity of data. Hence, a cross sectional double blinded study was done to know the salivary pH changes and buffering capacity of saliva after consumption different fresh fruit juice in study participants at different interval time.

In the present study glass combination electrode was used for assessing salivary pH as it is an established, sensitive and accurate methodology. Usually various colorimetric methods have been employed to determine the pH of



Graph 2: Stephan Curve Representing Potential in Salivary Buffering Capacity of Different Fruits

saliva. The electronic method with the glass electrode is preferable because of its accuracy.<sup>16</sup> In the present study there were 10 participants who drank the fresh fruit juices on alternative day with different fruit juice, In the present study has shown that four fruits like pineapple, grapes, orange & watermelon has shown drastic fall in salivary pH.

This results were in concurrence with the study results of Sabyasachi Saha et al (2001), where in Apple and guava packed juices were used for the study and showed pH changes from baseline to 30 min ranging from 7.17 to 6.58, 7.08, 7.31, 7.31.<sup>22</sup> Birgül Azrak et al (2003) in Germany among children with mean age of 4.4 years showed results similar to our study by detecting the pH difference from baseline to 30 minutes ( $\Delta$  PH = -0.20 at baseline, -0.50 at 5 minutes, -0.24 at 10 minutes, -0.16 after 15 minutes, and -0.01 after 30 minutes bringing back the pH to baseline value) after consuming packaged apple juice.<sup>23</sup> Similarly, Lata Kiran Banan and Amitha M Hegde in 2005 conducted a study on 10-12 year old children in Mangalore using fresh fruit juices (Grape, Orange and Pineapple) which showed a maximum percentage reduction in salivary pH within 5 minutes of consumption of these fruit juices and a multivariate analysis of various fresh fruit juices, at different time intervals showed significant difference ( $p < 0.05$ ).<sup>2</sup> It was also reported that fruit juices were 10 times more destructive than the whole fruit.<sup>24</sup>

Maximum pH decrease after intake of different beverages is an important consideration in dental erosion, as apatite dissolution increases in the lower pH range.<sup>25</sup> The probable reason for the immediate drop in salivary pH in our study could be that the intrinsic acidity of fruit juices rendered it more able to combat salivary buffers. The greater the pH fall can also be attributed to prolonged period of consumption of these fruit juices (approximately 5 minutes), which could expose the teeth to dangerously low levels of pH as the acid and sugar is held for a prolonged period in contact with the teeth.<sup>1</sup> There may be a prolonged fall in the oral cavity pH due to the increased buffering capacity of fruit juices & the fluidness consistency of the pulp of the fruit. Though the amounts of a fruit juices normally consumed by population may be insignificant, the presence of immature enamel, inadequate neuromuscular coordination and inability to clear the retentive substrate, along with the deleterious methods of consumption, makes them susceptible to dental erosion.<sup>26</sup>

Acidified sugar containing fruit juices has shown to be cariogenic and erosive in rats.<sup>27</sup> Juices for example contain several sugars and non-volatile organic acids.<sup>28</sup> Fructose and glucose are considered to be less cariogenic than sucrose, but the dental plaque, formed in the presence of a mixture of these two sugars also leads to a decrease in the micro hardness of the enamel. Packaged juices contain high amount of added sugar i.e., sucrose, which is highly cariogenic.<sup>29</sup>

Theoretically, the erosive potential of a fruit juices must be dependent upon the immediate effect of the drink & time taken for its clearance on the tooth, the drinking method, the protective effect of saliva, the amount of residual drink after swallowing, the actual amount of fruit juices consumed and the frequency of consumption (that is, if small sips are taken at frequent intervals or the entire quantity is consumed quickly). A single acidic attack is of minor importance but if repeated, the ability of saliva to deal with the acid attack may decrease. Hence, the main concern is about the frequent use of acidic fruit juices over time. If the challenge is frequent enough and there are few or no protective factors this may be aggressive as in caries susceptible people.

Consumption of Fruits or Fruit juices after meal as a desert part of food is most commonly practised in our day to day life. But as pH of few fruits are acidic in nature, the acidity of fruit juices and the demineralization of tooth are directly proportional. After consuming dinner the saliva pH drops drastically below critical pH. This condition in turn lead a favour to demineralization of enamel takes place upon.

## CONCLUSION

The present study has shown that consuming fruit juices will reduces the pH of the saliva and it takes nearly 30 – 60 minutes to attain for the baseline pH. If the challenge is frequent enough will favour the dental caries process rapidly. Although the erosion and caries process have contrasting histological appearance, these conditions occurring simultaneous can have undesirable effects on dental hard tissue.

## REFERENCES

- Lata Kiran Banan, Amitha M Hegde. Plaque and salivary pH changes after consumption of fresh fruit juices. *Journal of ClinPed Dent.* 2005; 30(1): 9-13.
- Lussi A, Jaeggi T, Jaeggi-Schärer S. Prediction of the erosive potential of some beverages. *Caries Res.* 1995; 29(5):349-54.
- Mainwaring PJ. A relationship between plaque pH and caries increment in 11-12 year old boys. *Caries Res* 1981; 30:9-13
- May J, Waterhouse PJ. Dental erosion and soft drinks. A quantitative assessment of knowledge, attitude, and behaviour using focus groups of school children. A preliminary study. *Int J Paediatr Dent.* 2003 Nov; 13(6):425-33.
- George K. Stookey. The effect of saliva on dental caries. *J Am Dent Assoc.* 2008 May; 139Suppl: 11S-17S.
- Lussi A, Jäggi T, Schärer S, The influence of different factors on in vitro enamel erosion. *Caries Res.* 1993; 27 (5):387-93.
- Duggal M S. Curzon M E J. An evaluation of cariogenic potential of baby and infant fruit drinks. *Br Dent J.* 1989 May 6; 166 (9):327, 329-30.
- Grenby T H. Lessening dental erosive potential by product modification. *Eur J Oral Sci.* 1996 Apr; 104:2 (Pt 2):221-8.
- Darby ET. Dental erosion and the gouty diathesis: Are they usually associated? *Dent Cosmos* 1892; 34: 629-640
- Miller W.D. Experiments and Observations on the Wasting of Tooth Tissue variously designated as erosion, abrasion, chemical abrasion, and denudation. *Dent Cosmos* 1907; 49:225-247
- Smith AJ, Shaw L. Baby fruit juices and tooth erosion. *Br Dent J.* 1987 Jan 24; 162(2):657.
- Grenby TH, Mistry M, Desai T. Potential dental effects of infants' fruit drinks studied in vitro. *Br J Nutr.* 1990 Jul; 64(1):273-83.
- Grobler SR, Jenkins GN, Kotz D. The effect of consumption and method of drinking. *Br Dent J.* 1985 Apr 20; 158(8):293-6.
- Birkhed D. Sugar Content, Acidity and effect on plaque pH of fruit juices, fruit drinks, carbonated beverages and sports drinks. *Caries Res* 1984(18):120-27.
- Edwards M, Creanor SL, Foye RH, Gilmour WH. Buffering capacities of soft drinks: the potential influence on dental erosion. *J Oral Rehabil.* 1999 Dec; 26(12):923-7.
- Hofman LF. Human saliva as a diagnostic specimen. *J Nutr.* 2001 May; 131(5):1621S-5S.
- Lingström P, Ruyven FOG, Houte JV and Kent R. The pH of Dental Plaque in its Relation to Early Enamel Caries and Dental Plaque Flora in Humans. *J Dent Res* 2000; 79(2):770-777.
- Kashket S, Zhang J, and Houte JV. Accumulation of Fermentable Sugars and Metabolic Acids in Food Particles that Become Entrapped on the Dentition. *J Dent Res* 1996; 75(11):1885-1891
- Teresa AM, Julie ME, Michelle AL, Warren JJ, Steven ML. Comparison of the intakes of sugars by young patients with and without dental caries experience. *JADA* 2007; 138:39-46.
- Sabyasachi Saha, Gudamarlahally Venkatarayappa Jagannath, SahanaShivkumar, Sumit Kumar Pal. Effect of commonly consumed fresh fruit juices and commercially available fruit juices on ph of saliva at various time intervals. *Journal of International Dental and Medical Research.* Volume · 4 · Number · 1 · 2011
- BirgulAzrak, Angelika Callaway, Suzanne Knozinger, Brita Willershausen. Reduction of the pH- values of whole saliva after the intake of apple juice containing beverages in children & adults. *Oral health preventive dentistry* 2003; 1:229-236.
- Miller CD. Erosion of molar teeth by acid beverages. *J Nutr* 1950; 401: 63–67.
- Larsen MJ, Nyvad B. Enamel erosion by some soft drinks and orange juices relative to their pH, buffering effect and contents of calcium phosphate. *Caries Res.* 1999; 33(1):817.
- Landt H. Oral stereognosis and oral muscular co-ordination ability. *Front Oral Physiol.* 1983;14: 55–79.,
- IshaGoel, S. Navit , Sandeep Singh Mayall, MandeepRallan, PragatiNavit, Sneha Chandra.Effects of Carbonated Drink & Fruit Juice on Salivary pH of Children: An in Vivo Study. *International Journal of Scientific Study.* Oct - Dec2013|Volume01|Issue03
- Lee HS, Wroistad RE, Appiejuice composition: sugar, noh-volatile acid, and phenoic profiles, *J AssocAnaiChem* 1988: 71:789-794.
- CuryJA, Rebeio MAB, Dei Bel CuryAA, Derbyshire MTVC, Tabchoury CPM, Biochemica composition and cariogenicity of dental plaque formed in the presence of sucrose orgiucose and fructose. *Caries Res* 2000:34:491-497.

Source of Support: Nil  
Conflict of Interest: Nil