EFFECT OF COMMONLY CONSUMED FRESH FRUIT JUICES AND COMMERCIALLY AVAILABLE FRUIT JUICES ON pH OF SALIVA AT VARIOUS TIME INTERVALS

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Abstract

To find out the acidogenic potential of the commonly consumed freshly prepared fruit juices (Pomegranate, Lime) and commonly consumed commercially available fruit juices (Guava and Apple) at room temperature on pH of saliva at various time intervals.

The double-blind study was done on 40 subjects. During the study, subjects were asked to collect their stimulated saliva in a glass bottle before having juice as a baseline score. Subjects were asked to drink the juice, their saliva sample was collected after 1minute, 5minutes, 15minutes and 30 minutes of drinking juice and the pH of the samples were measured using digital pH meter.

All fruit juices were acidic and reduced the salivary pH. The maximum drop in pH was found at after min of consuming fruit juices. Drop in salivary pH was greater after consumption of commercially available fruit juices than that after consumption of fresh fruit juices. Commercially available fruit juices are more acidogenic than the fresh fruit juices.

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Introduction

As the mankind is evolving there has been drastic changes occurring in the dietary pattern as well.[1] The diet we are consuming has become more refined with increased access to readymade fruit juices and high frequency of snacking. Also there has been substantial increase in consumption of carbonated beverages and fruit drinks.[1] Since recently there has been considerable emphasis on “healthy food and healthy eating”. Fruit juices have been widely marketed and promoted as ‘healthy drinks’.

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Fruit juices are widely popular among people of all ages as they are perceived to be good for health and are sometimes preferred over carbonated beverages which are inherently highly acidic. However claims of safety of fruit juices for teeth are unsubstantiated due to inadequate report in the literature.[2] The erosive effect of fruit juices have been recognized for a long time as evident in the studies of Darby (1892)[3] and W. D. Miller (1907)[4] who reported tooth decalcification due to excessive fruit juice consumption.

Saliva plays a very 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.[5] There will be a drop in salivary pH whenever one consumes sugary foods or beverages. The sweeter a food or a drink is the more will be the magnitude of the drop in salivary pH. Packaged fruit juices are sweeter having higher sugar

content to enhance their taste.[6]

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

Material & Methods

Sample selection

Around one hundred first year under graduate students of Sardar Patel Post Graduate Institute of Dental Sciences, Lucknow, were invited to voluntarily participate in the study. They were screened using following inclusion and exclusion criteria.

Inclusion Criteria

The inclusion criteria comprised of subjects voluntarily participating in the study with Decayed Missing Filling Tooth Index (DMFT)[7] score < 3 & Oral Hygiene Index-Simplified (OHI-S)[8] score < 1.2, depicting good oral hygiene.

Exclusion criteria

Exclusion criteria comprised presence of any relevant past medical history, history of any antibiotic and medication therapy two months prior to the study and any known history of allergy to any fruit / fruit juice.

Procedure of this institutionally approved study was explained to all the subjects and written consent from each subject was obtained.

A total of 40 volunteers with an age range of 18 to 20 years consisting of 17 males and 23 females fulfilling the above mentioned criteria were selected and randomly allocated to the groups consuming different fruit juices.

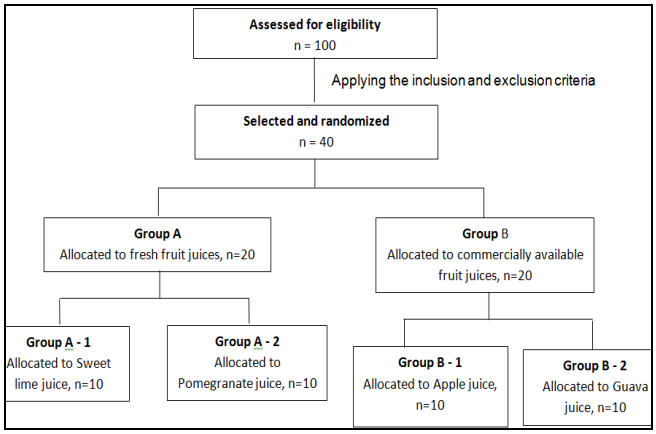
A pilot survey was conducted to know which fruit juice is most commonly consumed among the general population, which showed that among commercially available fruit juices the most commonly consumed were Apple and Guava, among the freshly prepared fruit juices the most commonly consumed were Lime and Pomegranate. Therefore only these four fruit juices were considered in the study.

Experimental Design

Procedure of the study was explained to all the subjects and written consent from each subject was obtained. Ethical clearance was obtained from the Institutional Ethical Committee. All the 40 subjects were randomly allocated to the groups of fresh fruit juice (Group - A) and commercially available fruit juice (Group - B) each with 20 subjects. Both groups were again subdivided into two groups each having 10 subjects for consuming the assigned fruit juices: A-1 for Sweet lime, A-2 for pomegranate, B-1 for Apple, B-2 for Guava.

Procedure

The intrinsic pH of all four fruit juices were measured prior to the consumption. These were as follows- Fresh fruit juices: Sweet lime (A-1) pH 4.59, Pomegranate (A-2) pH 4.47; Commercially available fruit juices: Apple (B-1) pH 3.33, Guava (B-2) pH 3.10. Stimulated saliva of the subjects were collected in sterile glass bottles after they chewed one gram of paraffin wax prior to the consumption of juice as a baseline score. Then the subjects were asked to consume assigned fruit juice and the salivary sample of each subject was collected in separate sterile glass bottles after 1 minute, 5 minute, 15 minute and 30 minute of fruit juice consumption. Salivary samples were collected of only 10 subjects in a single day.



Summary of experimental design.

The glass bottles were coded with a specific identity number given to each subject. The pH of the samples were measured in the institutional laboratory using calibrated digital pH meter. The same procedure was repeated with the other three groups after consumption of assigned fruit juice. Whole process was supervised and carried out by a single investigator.

Tools used: Glass bottles, Digital pH meter, Paraffin wax, Fruit juices.

Statistical Analysis

'Student t-test' was used to compare the effect of one type of fruit juices with other type, where as to assess the effect of one type of fruit juice at different time intervals 'paired t-test' was used.

Results

Mean resting salivary pH of all the subjects was 7.28 ± 0.30 and this was compared with drop in pH at 1 min, 5 minute, 15 minute and 30 minute following fruit juice consumption.

Table 1 shows that on the whole the drop in pH in relation to resting pH at 1 minute was 6.11 ± 0.95, at 5 minute 6.80 ± 0.66, at 15 minute 7.18 ± 0.31 and at 30 minute it was 7.24 ± 0.26 and the difference was statistically significant ($p < 0.001$) except for 30 minute time interval. It was found that the magnitude of overall fall in salivary pH was more (7.28 v/s 6.11) in Group B.

	N	Mean	Std. Deviation	paired t	P-value
pH at base line	40	7.28	0.30	8.529	**<0.001***
pH after 1 minute	**40**	**6.11**	**0.95**		
pH at base line	40	7.28	0.30	5.018	**<0.001***
pH after 5 minute	**40**	**6.80**	**0.66**		
pH at base line	40	7.28	0.30	2.641	0.012
pH after 15 minute	**40**	**7.18**	**0.31**		
pH at base line	40	7.28	0.30	1.610	0.116
pH after 30 minute	**40**	**7.24**	**0.26**		

Table 1. Overall change in salivary pH after consumption of juices. (*Statistically significant)

Table 2 shows that in group A, the mean resting pH was 7.39 ± 0.27 which after consuming sweet lime and pomegranate juices, dropped to 6.58 ± 0.47 after 1 minute and the difference (0.81) was statistically highly significant, ($p < 0.001$), similarly at 5 minute the pH observed was 7.08 ± 0.33 and the difference (0.31) was statistically highly significant ($p < 0.001$).

Table 3 shows that in group B, the mean resting pH was 7.17 ± 0.29 which after consuming Apple and Guava juices, dropped to 5.65 ± 1.09 after 1 minute, and the difference (1.52) was statistically highly significant ($p = 0.001$), similarly at 5 minute the pH observed was 6.52 ± 0.79 and the difference (0.65) was statistically highly significant ($p < 0.001$).

	N	Mean	Std. Deviation	paired t	P-value
pH at base line	20	7.39	0.27	7.130	**<0.001***
pH after 1 minute	**20**	**6.58**	**0.47**		
pH at base line	20	7.39	0.27	3.719	**0.001***
pH after 5 minute	**20**	**7.08**	**0.33**		
pH at base line	20	7.39	0.27	1.781	0.091
pH after 15 minute	**20**	**7.31**	**0.29**		
pH at base line	20	7.39	0.27	2.378	0.028
pH after 30 minute	**20**	**7.31**	**0.23**		

Table 2. Change in salivary pH after consumption of Fresh fruit juices. (*Statistically significant)

	N	Mean	Std. Deviation	paired t	P-value
pH at base line	20	7.17	0.29	6.746	**<0.001***
pH after 1 minute	**20**	**5.65**	**1.09**		
pH at base line	20	7.17	0.29	3.905	**0.001***
pH after 5 minute	**20**	**6.52**	**0.79**		
pH at base line	20	7.17	0.29	1.928	0.069
pH after 15 minute	**20**	**7.05**	**0.28**		
pH at base line	20	7.17	0.29	0.119	0.906
pH after 30 minute	**20**	**7.17**	**0.28**		

Table 3. Change in salivary pH after consumption of commercially available fruit juices. (*Statistically significant)

Table 4 shows the intergroup comparison regarding the difference in pH drop. The difference in drop observed at 1 minute and 5 minute intervals were statistically significant.

Time	Group A (n = 20)		Group B (n = 20)		paired t	P-value
	Mean	Std. Deviation	Mean	Std. Deviation		
Resting pH	7.39	7.31	7.17	0.29	2.483	0.018
pH after 1 minute	6.58	0.47	5.65	1.09	3.504	**0.001***
pH after 5 minute	7.08	0.33	6.52	0.79	2.925	**0.005***
pH after 15 minute	7.31	0.29	7.05	0.28	2.884	0.006
pH after 30 minute	7.31	0.23	7.17	0.28	1.728	0.092

Table 4. Difference in pH value at different time intervals between group A & Group B. (*Statistically significant)

Figure 1 shows that the maximum drop in salivary pH of all the subjects was noticed after 1 minute of fruit juice consumption. After consumption of any juice, pH of saliva gradually reached back to the baseline within 30 minute.

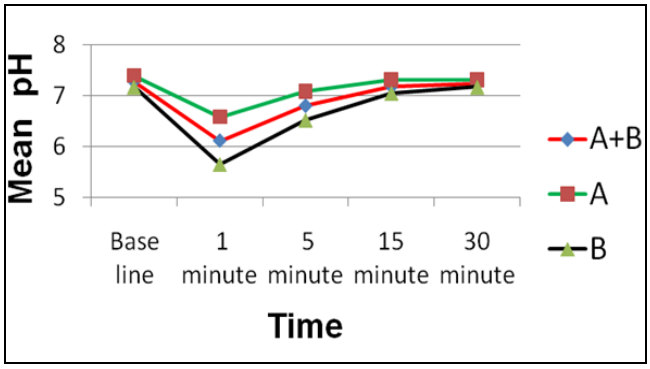


Figure 1. Variations in salivary pH after consumption of different fruit juices.
A= Change in salivary pH after consumption of freshly prepared fruit juice.
B= Change in salivary pH after consumption of commercially available fruit juice.
A+B= Overall change after consumption of juices.

Among the groups consuming freshly prepared fruit juice and commercially available fruit juice, the latter group showed more drop in salivary pH. Among all the juices Apple juice caused the maximum fall in salivary pH.

Paired t–test value showed that drop in salivary pH after consumption of commercially available fruit juices was significant at 1 minute and 5 minute. Similarly drop in salivary pH after consumption of freshly prepared pomegranate juice was significant at 1 minute and 5 minute, whereas the drop was significant at 1 minute interval after consumption of freshly prepared sweet lime juice.

Discussion

The study was conducted as a pre and post effect of fruit juice consumption on salivary pH among undergraduate dental students with proportionate representation for age and sex. The consumption of fruit juices though widely prevalent, varies greatly among populations. Acidified sugar containing drinks have shown to be cariogenic and erosive in rats.[9] Foods and beverages, specially fruit juices, can contain variety of acids that have the potential to damage the teeth.[6]

The fruit juices can have either of the following effect or both on teeth:

a. They may be acidic enough to erode the surfaces of teeth.
b. They may contain fermentable carbohydrates, which may serve as a substrate for acidogenic bacteria which might result in dental caries.

It has been shown that carbonated beverages are more efficiently buffered by contact with saliva than fruit juices.[10]

In the present study the group consuming commercially available packed fruit juices showed maximum drop in salivary pH, even dropping to critical pH level (5.5 ± 3) at 1 minute interval, followed by a gradual recovery within 30 minutes of study. This greater 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*, 2005. The probable reason for immediate drop in salivary pH could be that intrinsic acidity of packed fruit juices rendered it more able to combat salivary buffers.[10]

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.[11] 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.

The drop in salivary pH among the groups consuming sweet lime and pomegranate was similar and minimal. For the groups consuming packed fruit juices, there was significant drop in salivary pH in Apple juice group.

Appropriate comparison could not be made due to unavailability of similar study. In present study the degree of pH drop was – Apple > Guava > Pomegranate > Sweet lime. A single acidic attack is of minor importance but if repeated, the ability of saliva to deal with the acid decreases. Hence, the danger is the frequent use of these fruit juices over time.

If the challenge is frequent enough and there are few or no protective factors as in caries susceptible people, this can be quite aggressive.

Conclusions

It was found that commercially available fruit juices caused greater drop in salivary pH than that of fresh fruit juices. The results provide the basic information to the general dental practitioner regarding the consumption of fruit juices and their potential role in the development of dental erosion and / or dental caries.

It could also provide basis for the development of less acidic (erosive) fruit juices. It is suggested that dietary advice and preventive care is mandatory for individuals who frequently consume fruit juices.

Declaration of Interest

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