

# Effect of different sweets of Indian staple diet on Salivary Acidogenicity: A Comparative Study

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## Abstract

**Purpose:** The purpose of the study was to compare salivary pH changes at different time intervals of various groups after consumption of four different kinds of Indian sweets. **Materials and methods:** A cross-over study was conducted among the total of 20 volunteers aged 19-21 years who fulfilled a selection criteria. After recording the resting salivary pH using GC pH strips, the subjects were asked to eat the test foods (chocolate, barfi, gulab jamun and kheer). The pH was measured at time intervals of 5, 15, 30 and 40 minutes. **Results:** There was no significant difference in pH between different sweet groups. Similarly, there was no difference in pH at different time intervals. **Conclusion:** As there were no major differences in pH values on intake of traditional sweets, they are more or less equally detrimental for oral health.

**Keywords:** salivary pH, GC strips, Indian sweets, high risk caries

## Introduction

Dental diseases are the most prevalent worldwide; an estimated 5 billion people suffer from tooth decay. Dental disease treatment accounts for between 5% and 10% of total health care costs in industrialized countries (1). Various classical experimental studies, like that of Hopewood house study, Vipeholm study etc., have been carried out on the relationship between sugars (carbohydrates) and dental caries. The pioneering study by Vipeholm clearly demonstrated that cariogenicity depends more on physical form of carbohydrates (stickiness, oral clearance time, frequency of intake) rather than the entire quantity of sugar ingested (2). "DIET", thus is the most important factor to be looked after, as it could be a modifying agent in dental caries (3).

Measurement of plaque pH after consumption of food is a convenient way of assessing the possible cariogenicity. If the acidogenic theory of caries etiology is

accepted, measurement of plaque pH might be expected to be a reasonable guide to a food's cariogenicity (4). Studies have been conducted to test the effect of fruit juices (5) chocolate (6), drinks, cereals, juices (7-9) on plaque and salivary pH and these products have been compared with other commonly consumed food stuffs and assumptions were made about their relative acidogenicity and cariogenicity. There is sufficient evidence that saliva plays a vital role in controlling plaque pH and stimulation of saliva by foods is an essential factor in determining their acidogenic potential. This is especially important when saliva is stimulated after plaque pH and is lowered by an acidogenic challenge (10).

As the literature revealing studies on sweets of Indian staple diet on salivary acidogenicity was found to be scanty, research in this area to generate necessary evidence is required. This study is undertaken to compare the effect of commonly consumed traditional sweets of

Indian staple diet on salivary acidogenicity among adolescents novice of People's Dental Academy, Bhopal.

## Materials and methods

A cross over study design was conducted among a total of 20 subjects aged 19 to 21 years. All the study subjects were recruited from People's Dental Academy for the convenience purpose. The study protocol after administrative verification was given to the experts and was approved by the institutional Research and Ethical Committee. The informed consent was obtained from the subjects after explaining the entire research protocol.

## Sample Selection and Allocation

The individuals who are fond of sugar were identified and screened for exclusion criteria. Individuals if had presence of any factors indicating periodontal disease like stains, calculus, gingival recession, mobility etc, presence of carious lesion, subject on medication and presence of any systemic disease like fever, jaundice, cough etc. and a

deleterious habit of smoking or other tobacco/alcohol related habits were excluded from the study, as this factors have a role in altering salivary pH.

A list of all the subjects who are fulfilling the selection criteria was prepared. Among that, a total of 20 participants were randomly selected by the investigator using a lottery method. The study subjects were equally distributed in to four groups (Group A, B, C and D). As cross over study design was adopted for the study; each group of subjects was exposed to four different sweets. The sweets (test groups) used in the current study were: Test product 1: Chocolate, Test product 2: Barfi, Test product 3: Gulab Jamun and Test product 4: Kheer

#### Study Duration

The study was conducted for a period of four days from 10/9/2012 to 13/9/2012.

#### Study procedure

**Intervention:** Intervention was done once a day separately for each group. On day 1, group A was given first test product i.e. chocolate and on the three next consecutive days, they were given 2, 3 and 4 test products. Similarly on day 1 group B was given the test product 2 and on the three next consecutive days they were given 3, 4 and 1 test products. Likewise group C was given 3, 4, 1 and 2 test products. And group D was given 4, 1, 2 and 3 test products respectively. During a study period, no attempt was made to change the oral hygiene habits of the subjects and they were asked to continue with their routine oral hygiene procedures.

**Recording of Salivary pH:** The study was conducted in the department of Public Health Dentistry. Before the investigation begins, the participants were instructed not to take any food items for two hours. At the time of investigation, the subjects were asked to sit in upright position. To obtain a baseline data, each subject's unstimulated/resting saliva was collected by Navazesh spitting method (11) by pooling saliva for 1 minute and then spitting it out in a plastic disposable container. Saliva sample of approximately 1 ml was collected in a sample container provided in GC saliva check kit. Care was taken to record pH in the first 45 seconds by inserting a GC test strip in saliva to avoid the ambiguity while recording the data. After 30 seconds the acids produced react to pH indicators (of a saliva test strip), thus leading to a colorimetric change which was compared with the color code chart provided. The pH value was then noted while the paper was moist (12). After determining the resting salivary pH, the participants in each intervention group were offered the test products (i.e. sweets). In each group, the same amount of sweet was distributed (25 gms). All the subjects were instructed to chew the sweet for one minute. The salivary pH after the sweet consumption was measured at the time intervals of 5, 15, 30 and 40 minutes. This was done to compare the time taken for the salivary pH to return to its baseline values after an exposure with acidogenic challenge created by all the four sweets. (13, 14). The pH curve (pH versus time in minutes) was

obtained for each group after eating different sweets. (Figure 1)

All the collected data was entered into a personal computer and statistical analysis was performed by using SPSS version 20. The appropriate statistical tests were applied in consultation with a statistician. One way analysis of variance (ANOVA) was used to compare the salivary pH changes between different sweet groups. Similarly, a repeated measure of analysis of variance (RMANOVA) and post hoc analysis was done using Bonferroni test were used to compare the salivary pH changes at different time intervals after consumption of different sweets.

#### Results

All the test groups i.e. Chocolate (Test product 1), Barfi (Test product 2), Gulab Jamun (Test product 3) and Kheer (Test product 4) were compared at baseline, 5 minutes, 15 minutes, 30 minutes and 40 minutes respectively. It was observed that there was no statistically significant difference in all the groups at different intervals (Fig 2, Table 1).

##### Comparison of mean salivary pH at different time intervals in different groups

##### Comparison of mean salivary pH at different time intervals in group 1 (chocolate)

There was a statistically significant difference in group 1 at different time intervals ( $p=0.000$ ). A significant difference in mean salivary pH values was found in between 10 mins Vs 5 minutes ( $p=0.001$ ), 5 minutes Vs 15 minutes ( $p=0.000$ ), 5 minutes Vs 30 minutes ( $p=0.000$ ), 5 minutes Vs 40 minutes ( $p=0.001$ ) and 30 minutes Vs 40 minutes ( $p=0.047$ ).

##### Comparison of mean salivary pH at different time intervals in group 2 (barfi)

There was no statistical significant difference in group 2 at different time intervals ( $p=0.10$ ).

##### Comparison of mean salivary pH at different time intervals in group 3 (gulab jamun)

There was a significant difference in group 3 at different time intervals ( $p=0.000$ ). A significant difference in mean salivary pH values was found in between 10 mins Vs 15 minutes ( $p=0.084$ ), 5 minutes Vs 15 minutes ( $p=0.000$ ), 5 minutes Vs 30 minutes ( $p=0.016$ ) and 5 minutes Vs 40 minutes ( $p=0.003$ )

##### Comparison of mean salivary pH at different time intervals in group 4 (kheer)

There was a statistical significant difference in group 4 at different time intervals ( $p=0.000$ ). A significant difference in mean salivary pH values was found in between 10 mins Vs 15 minutes ( $p=0.043$ ), 10 mins Vs 30 minutes ( $p=0.084$ ), 5 minutes Vs 15 minutes ( $p=0.000$ ) and 5 minutes Vs 30 minutes ( $p=0.000$ )

#### Discussion

Appropriate diet is one of the key factors to prevent dental caries. Dental Caries is a multifactorial disease: Oral environment is one of the factors to determine caries occurrence. Eating patterns and food choices

among children and teens are imperative factors that affect the oral environment and initiation of tooth decay quickly. Always, all the time bacteria come in contact with fermentable sugar or starch in the mouth, acid is produced, which attacks the teeth within initial 20 minutes of contact or more. This eventually demineralizes the enamel and results in tooth decay (15).

Many human intra-oral model systems (16-23) and animal caries models (24, 25) have been exercised over the past century to estimate the invariable effect on acidogenic oral environment. Plaque pH and various salivary parameters have also been utilized for the same. The volume of time that pH remains depressed is important and the time spent under different pH values is probably indicative of any foods retentiveness and may definitely have an effect on its cariogenicity. Different evaluations of 'critical pH' have varied from 4.5-5.5 (26) or even lower. Prolonged drop of pH is considered to be more detrimental than that of short duration.

The acidogenic potential of food can be estimated by assessment of the degree of the pH response following ingestion of food. Consequently, methods to measure oral pH include plaque sampling, touch electrodes and built in electrodes (27). In the contemporary study the salivary pH was estimated with GC pH strips subsequently consuming various sweets including gulabjamun, chocolate, barfi and kheer. Though it was not an accurate test but it can be used as a chair side preliminary test for high risk caries patients.

Sweets like chocolate have always been concomitant with dental caries in innumerable literatures both positively and negatively, although yet nothing of great significance has been proved for or against them. Correspondingly traditional Indian sweets tested in the present study may be harmful for teeth. In supplementary words the cultural importance of customary sweets are very extraordinary. They have nutritional value, are stress relievers (28) and an obligation during social exchanges. At present, people have a preference for more of chocolates than ethnic sweets (29). Barfi, gulabjamun and kheer are the regularly disbursed sweets in Indian staple diet. Not voluminous studies have been reported on association of these traditional sweets of Indian staple diet with occurrence of caries.

This study was commenced with the intention to compare the effect of different sweets of Indian staple diet on salivary acidogenicity. The study was conducted among students of peoples dental academy, India. This age group was preferred because in a study done by Hugoson A et al (2000), it was established that plaque retention and caries increased significantly in 3, 5, 15 and 20 years old children (30).

David J et al (2005) had found the prevalence of dental caries and associated factors in 12-year-old school children in Thiruvananthapuram, Kerala, India. The study indicated that children residing in urban areas had more dental caries (31). Thus study

participants from urban population were targeted. Time intervals chosen were at baseline, 5 minutes, 15 minutes, 30 minutes and 40 minutes. As according to Stephan curve, the pH starts returning to baseline within 40 minutes (32).

This study found no significant difference in pH values in all the four intervention groups when inter group comparison was done. But when assessed individually in the same intervention group, there was a significant difference at different time intervals in each group. Due to the difference in methodology, sweets used and geographical location, valid comparisons could not be drawn. Nevertheless, similar and closely related studies were compared to get into insights. Before consumption of test products resting salivary pH was measured which was in the range of 6.9 to 7.2. The values obtained were quite analogous to former reports (33). The results are likely to confirm previous reports of salivary testing viewing a subject-to-subject variation in pH response to different food items as the caries susceptibility varies noticeably in different individuals (34). Commercially available Cadbury chocolate bar was used as first sweet. The maximum drop in pH in first group (chocolate) was observed at 30 minutes period (pH = 6.5) which is similar to the results done by Richardson B (1981) (35) and Cohen H et al (2008) (36). In another study, the results were contrary to the findings obtained by Hegde et al (2009) (37), where they found the maximum drop in pH at 15 minutes (pH = 5.8). This shallow pH response to chocolate maybe attributed to the difference in the method of assessing oral pH since, most studies assessed plaque pH. There was a significant difference found at different time intervals: baseline Vs 5 minutes. Also in between 5 minutes Vs 15 minutes, 30 minutes and 40 minutes, then 15 minutes Vs 30 minutes, 40 minutes, 30 minutes and 40 minutes.

Barfi is prepared with condensed milk and sugar cooked until it solidifies. The maximum drop in pH in second group (barfi) was observed at 15 and 30 minutes (pH=6.8) which is in contrast to the result found by Jensen M et al (1983) in which cookie was used as a sweet with solid consistency (pH=3.8) (38). This comparison is not valid because in our study sweet which is used is barfi which is different from Jensen M et al (1983) study. This difference can be attributed to the consistency and content of sweet as well as the difference in the method of assessing acidogenicity. In this study GC strips are used while in Jensen M et al (1983) study touch electrodes are used. In our study significant difference in pH values were found at time interval 5 minutes Vs 15 minutes.

Gulab jamun is a milk solid based dessert soaked in sugar syrup popular in India. The consistency of the sweet is solid as well as sticky because of the sugar syrup. The maximum drop in pH in third group (gulabjamun) was found at 15 minutes (pH = 6.7). No relevant studies could be found for comparison of the results for this sweet. pH values were significantly different at 5 minutes Vs 15 minutes and 40 minutes. Kheer is a South Asian rice pudding made by boiling rice, broken wheat, or vermicelli with milk and sugar; it is flavoured with cardamom, raisins, saffron, cashew nuts, pistachios or almonds. The maximum drop in pH in fourth group (kheer) was found at 15 minutes (pH = 6.6) which is dissimilar to the study done by Masih U et al (2010), in which sweetened milk has been used (pH = 5.4) (39). This could be due to the different amount of sugar and other products used in the sweet. Significant drop in pH was observed at 5 minutes Vs 15 minutes and 30 minutes.

After the baseline measurement, initially there was a rise in pH in first five minutes followed by the drop in pH (acidic) at 15 minutes and again a rise in pH (alkaline) at 30

and 40 minutes period. On having any test product the initial rise in pH is due to the gustatory stimulus. Salivary flow is increased which causes elevation in salivary buffering capacity preventing the drop in pH and thus explains the rise in salivary pH in the first few minutes.

### Conclusion

As no statistical difference can be noted in the pH values on consuming four test products but the difference was statistically significant at different time intervals in each group. It can be concluded that all the four sweets had similar acidogenicity but they may play a potential role in development of dental caries if frequently used. However traditional sweets can be preferred more over chocolate as the maximum drop in pH was seen in chocolate group.

Effective educational methods should be identified which can be accepted on a routine basis and successfully brought into practice.

### Limitations

The current study had following limitations-

- The study was conducted for a short duration of four days so the effect on salivary acidogenicity might not be assessed precisely.
- Plaque pH gives a better estimate for acidogenic potential as compared to saliva, but estimation of drop in plaque pH was not chosen because there was possibility of neutralization of plaque when it is dissolved in distilled water.
- The present study could not assess the exact amount of sugar and other ingredients in different sweets.
- In addition since the subjects had good oral hygiene with minimal plaque it may have contributed to the lack in change seen in salivary pH.

### References

References are available on request at [editor@healtalkht.com](mailto:editor@healtalkht.com)

Table 1: Changes in salivary pH after consumption of different sweets at different time interval in different groups

Groups	Salivary pH (Mean ± SD)					Statistical Inference
	Baseline	5 mins	15 mins	30 mins	40 mins	
Group 1 (chocolate)	6.95±0.7	7.85±0.4	6.90±0.6	6.55±0.6	6.90±0.6	p value 15.48 a Vs b, b Vs c, b Vs d, b Vs e
Group 2 (barfi)	7.15±0.6	7.40±0.7	6.80±0.5	6.80±0.6	7.10±0.6	4.33 Not applicable
Group 3 (gulabjamun)	7.25±0.6	7.55±0.6	6.75±0.7	7.05±0.6	7.05±0.6	0.10 b Vs c, b Vs d, b Vs e
Group 4 (kheer)	7.20±0.6	7.35±0.7	6.65±0.6	6.70±0.5	6.90±0.7	0.93 b Vs c, b Vs d, b Vs e
ANOVA	0.72	2.3	0.52	2.01	0.49	b Vs c, b Vs d
p value	>0.05	>0.05	>0.05	>0.05	>0.05	b Vs d

Figure 2: Comparison of mean salivary pH at different time intervals in different intervention groups

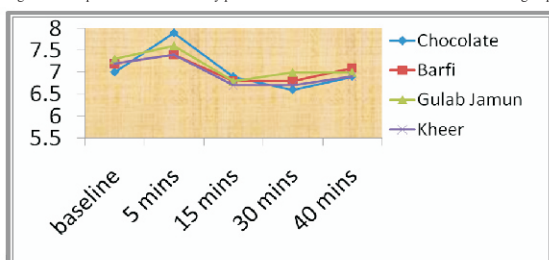


Figure 1: Research study design

