Original Research Article

A RANDOMIZED CONTROLLED TRIAL TO EVALUATE THE EFFECTS OF DIFFERENT FORMS OF ORANGE JUICE ON DENTAL PLAQUE PH

Abstract:

Aim: To study the acidogenic response in human dental plaque in vivo with fresh orange juice compared to orange fruit drink with no added sugar and regular orange fruit drink that were currently available in the market. **Materials and methods:** Ninety subjects aged 18-30 years were allocated randomly for 3 different test drinks. Intrinsic pH of the test drinks was measured by the Digital pH meter. Plaque was collected at the baseline with a spoon excavator. Then, the subjects were asked to drink 100ml of the test drink in one minute and to swish the drink carefully around the teeth before swallowing in order to maintain a uniform method in drinking. Post consumption, the plaque samples were collected at 1, 15 and 30 minutes and the pH was estimated. **Result:** Inter group comparison by ANOVA showed significant difference among mean pH values and time intervals. There was significant drop in plaque pH in both Tropicana orange juice and minute maid pulpy orange juice at 30 minutes time interval. But more significant drop in dental pH was observed at 15 minutes time interval after exposure to Tropicana orange juice. **Conclusion:** All the fruit juices were acidic. Maximum drop in dental plaque pH was observed in Tropicana without added sugar and minute maid pulpy orange. But the dental plaque pH did not drop below the critical pH 5.5 in either of the orange juices.

Key words: Fruit Juice, Dental Plaque, Tooth Erosion, pH, Cariogenic

Introduction:

Even though there has been a noticeable reduction in dental caries over the past decades, its prevalence increased in countries where there is increased intake of sugary diet. Consumption of sugars or refined carbohydrates leads to drop in dental plaque pH due to production of organic acids, which increases enamel solubility and causes demineralisation of tooth. Diet has a local effect on oral health including teeth, pH, and composition of the saliva and plaque. Evidence from many studies has shown that dietary sugars have important role in tooth decay[1].

Fruits consist of many essential nutrients which are beneficial to health. Fructose is the major sugar found in fruit juice. All fruit juices contain fructose, but vary in their amount of sucrose, glucose, and sorbitol. Many people consume fruit juices as an easy alternate to whole fruit, unaware of the fact that fructose can be equally harmful as sucrose[2].

Towards the end of twentieth century when Early Childhood Caries got more attention, many mothers started using fruit drinks containing natural sugar or with no added sugar as they were believed to be safe. On the contrary, Frostell[3] proved that all sugars have similar potential to reduce plaque pH as sucrose. Further research by Duggal and Curzon[4] proved that these drinks had similar cariogenic potential as those contained sucrose.

Many in vivo studies have shown that with the intake of sugar containing drinks, there is a drop in the pH of the dental plaque. This acid is neutralised by saliva within 20-30 minutes, pH returns to normal levels[5]. With the frequent intake of soft drinks, saliva ability to neutralize the acid reduces. Hence, the danger is the frequent use of soft drinks over time[6].

Another study by Birkhed, assessed the total sugar and acidity concluded that fruit juices, fruit drinks, and carbonated drinks have the same carcinogenic potential, when testing the total amount of sugar and acidity[2].

The aim of the present study was to study the acidogenic response in human dental plaque in vivo with fresh orange juice compared to orange fruit drink with no added sugar and regular orange fruit drink that were currently available in the market.

Materials and methods:

Two commercially available orange fruit drinks i.e., orange fruit drink without added sugar (Tropicana 100%) and Pulpy orange juice (Minute maid) and freshly prepared orange juice were included as test drinks in this study. Ninety subjects aged 18-30 years, who were volunteers from Sathyabama Dental College and Hospital, Chennai, were considered as study subjects.

Inclusion Criteria

The inclusion criteria comprised of subjects voluntarily participating in the study with Decayed Missing Filling Tooth Index (DMFT) score 0

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.

Ethical clearance was obtained from the ethical committee of Sathyabama Dental College and Hospital, Chennai (SathyabamaUniversity/ IHEC/Study No 14) and informed consent was obtained from all the participants. The volunteers were asked to refrain from oral hygienic procedures for 24 hours and from having food or drinks for at least 2 hours prior to the procedure. On the examination day, the groups were allocated randomly for 3 different

test drinks and the intrinsic pH of the test drinks was measured by the Digital pH meter which was previously calibrated and standardized with pH 7 buffer solutions.

Plaque was collected at the baseline with a spoon excavator from all accessible surfaces of the upper central incisors, the buccal surfaces of the upper first molars and premolars, the lingual surfaces of the lower molars and the incisors. Then, the subjects were asked to drink 100ml of the test drink in one minute and to swish the drink carefully around the teeth before swallowing in order to maintain a uniform method in drinking. Post consumption, the plaque samples were collected at 1, 15 and 30 minutes and the pH was estimated. Each sample taken was pooled in 5ml of distilled water kept in a centrifuge tube and pH was determined immediately after collection using digital pH meter. After the collection of the last sample, the subjects were allowed to brush. Whole process was supervised and carried out by a single investigator.

The collected data was then analyzed by using the ANOVA with repeated measures, bonferroni post hoc test and wilcoxon signed rank test by using the SPSS 10 software. P-values of less than 0.05 [$P < 0.05$] were considered to be statistically significant.

Results:

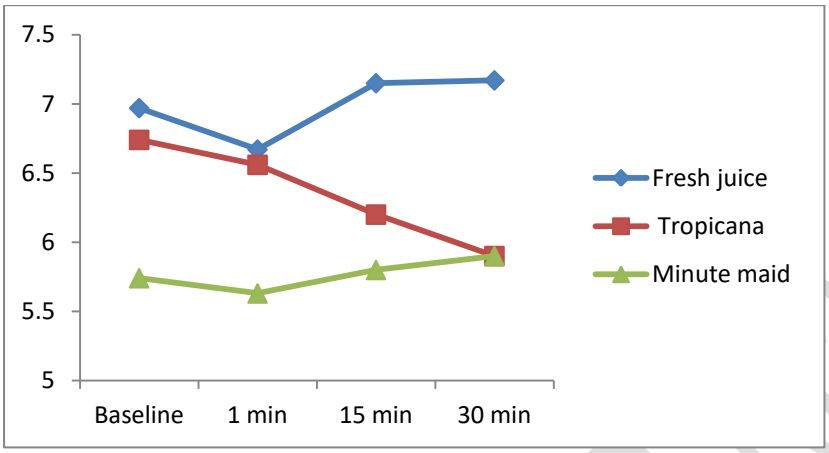
The endogenous pH of all fruit juices was estimated to be acidic. Among that, Pulpy orange showed the least pH, followed by Fresh orange juice, and Tropicana without added sugar [Table 1].

(Table 1) Endogenous pH of fruit juices

S.NO.	FRUIT JUICES	ENDOGENOUS pH
1.	Fresh orange juice without added sugar	3.4

2.	Tropicana orange juice without added sugar	3.8
3.	Minute maid pulpy orange juice	3.2

(Fig 1) Changes in Plaque pH levels



In all the groups, the maximum plaque pH fall was noted at 1 minute. Inter group comparison by ANOVA showed significant difference among mean pH values and time intervals. There was significant drop in plaque pH in both Tropicana orange juice and minute maid pulpy orange juice at 30 minutes time interval. But more significant drop in dental pH was observed at 15 minutes time interval after exposure to Tropicana orange juice [Fig 1]

Discussion:

Frequent consumption of the soft drinks has major role in dental health: (1) that as majority of them are fruit-based or carbonated or both, they may be acidic enough to cause dental erosion (2) that those which contain fermentable carbohydrates (i.e. generally speaking, sugars) may serve as a source of substrate diffusing into the dental plaque, which can generate the acid that brings about the destructive process of dental caries[7].

Citrus fruits are well endowed with a variety of phytonutrients that are vital in both health promotion and disease prevention. Also they are the main sources of citric acid in

one's diet[8]. The demineralising effect of citric acid is exceptionally great because of its chelating action on enamel calcium continues even after rise in plaque pH on the tooth surface[9].

Citrus fruits usually contain 7-8% of sugar, selenium, iron, and manganese which has cariogenic effect. But the high content of fluorides and phosphorus makes it cariostatic[10]. When citrus fruits were consumed more than twice a day, it was associated with an erosion risk 37 times greater than those consumed less often[11].

Three forms of orange juices used in the present study were: freshly prepared orange juice, Tropicana orange juice without added sugar and minute maid pulpy orange juice. Of these, only minute maid pulpy orange contained sugar. All the subjects were caries free in the present study. After exposure to the fruit juices there was initial rapid drop in dental plaque pH. Maximum drop in pH was observed in Minute pulpy orange juice followed by Tropicana orange juice without added sugar and Fresh orange juice without added sugar respectively. This was similar to results obtained by H Mythri et al[12], and Preethi et al [13] in their studies using Minute maid pulpy orange. After 15 minutes there was gradual rise in plaque pH of subjects exposed to fresh orange juice and minute maid pulpy orange juice**.** In subjects exposed to Tropicana orange juice the plaque pH did not rise even after a period of 30 minutes.

All the fruit juices were acidic. Maximum drop in dental plaque pH was observed in Tropicana without added sugar and minute maid pulpy orange. But the dental plaque pH did not drop below the critical pH 5.5 in either of the orange juices.

Conclusion: The following conclusions can be drawn from the data of present study

1. All the fruit juices were acidic.

2. Maximum drop in dental plaque pH was observed in Tropicana without added sugar and minute maid pulpy orange.
3. But the dental plaque pH did not drop below the critical pH 5.5 in either of the orange juices.

Ethical Clearance: SathyabamaUniversity/ IHEC/Study No 14

References:

1. Moynihan PJ, Petersen PE. Diet, nutrition and the prevention of dental diseases. Public Health Nutrition.2004; 7(1A): 201–226.
2. Birkhed D. Sugar Content, Acidity and Effect on Plaque pH of Fruit Juices, Fruit Drinks, Carbonated Beverages and Sport Drinks," Caries Research. 1984; 18(2): 120-127.
3. Frostell G. Effects of mouth rinses with sucrose, glucose, fructose, sorbitol and lyacsin on the pH of dental plaque. Odont Rev 1973; 24: 217-226.
4. Duggal M S, Curzon M E J. An evaluation of the cariogenic potential of baby and infant fruit drinks. Br Dent J 1989; 166: 327-330.
5. Meurman JH, Ryto¨maa I, Kari K, Lasko T, Mostomaa F. Salivary pH and glucose after consuming various beverages including sugar containing drinks. Caries Research 1987; 21: 353–359.
6. Lussi A, Jaegger T, Zero D. The role of diet in the aetiology of tooth erosion. Caries Research 2004; 38 (1):34–44.
7. Grenby T. H, Phillips A, Desai T, Mistry M. Laboratory studies of the dental properties of soft drinks. Br j nutr.1989; 62: 451-464.

8. Okwu, D. E., and I. N. Emenike. "Evaluation of the phytonutrients and vitamin contents of citrus fruits." Int. J. Mol. Med. Adv. Sci .2006; 2 (1): 1-6.
9. McCLURE, F.J. and RUZICKA, S.J. (1946): The Destructive Effect of Citrate vs. Lactate Ions on Rats' Molar Tooth Surfaces, in vivo, J Dent Res 25:1-12.
10. Nirmala, S. V. S. G., and VV Subba Reddy. "A comparative study of pH modulation and trace elements of various fruit juices on enamel erosion: an in vitro study." Journal of Indian Society of Pedodontics and Preventive Dentistry. 2011; 29 (3): 200-205.
11. Jarvinen, V. K., I. I. Rytomaa, and O. P. Heinonen. Risk factors in dental erosion. Journal of dental research. 1991; 70 (6): 942-947.
12. Mythri, H., et al. Effect of four fruit juices on pH of dental plaque-A four period cross- over study. Journal of Indian Association of Public Health Dentistry. 2008;11:53-58
13. Preethi, B. P., D. S. Maitreyee, and R. Dodawad. "The effect of Four Fruit Juices on the Ph of Dental Plaque-A Four Period Cross-Over Study." J Clin Diagn Res 4 (2010): 2587-2593.