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ORIGINAL RESEARCH

Effect of Different Commercially Available Biscuits on Salivary pH, Flow Rate and Oral Clearance Rate among Children

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ABSTRACT

Introduction: Snacks and bakery foodstuffs like biscuits are the most preferred food items in the present decade. Thus it is important to know its cariogenicity.

Aim: To study the effect of five commercially available biscuits on salivary pH, flow rate and oral clearance rate among children.

Materials and methods: The study consisted of five groups of commercially available biscuits: oats, salt, glucose, cream, chocolate biscuits. Samples of saliva were collected, and pH was measured using an electrode, the flow rate directly from the calibrated test tube and the oral clearance time was estimated based on the time taken for the salivary pH to return back to the baseline values. After which, children were given one biscuit each and stimulated saliva samples were collected at different time intervals. Obtained values were subjected to the paired t-test, one-way analysis of variance (ANOVA) and post-hoc Tukey's test.

Results: Salivary pH had decreased compared to baseline for all the five commercially available biscuits with maximum drop seen for glucose, cream and chocolate biscuit group at 5 minutes. Oats group showed a maximum drop in mean salivary pH at 15 minutes and salt biscuits at 10 minutes. Increased salivary flow rate was seen for oats, salt, and cream biscuit group at 15 minutes and chocolate and glucose group had reduced when compared to its baseline value. The pH at 15 minutes had not returned back to the baseline values for all groups.

Conclusion: The consumption of commercially available biscuits had an effect on salivary pH, flow rate and oral clearance rate in children.

Clinical significance: snacks and bakery foodstuffs are the most preferred diet in the present decade by most of the age group. Biscuits being the commonest snack, this study helps in choosing the right biscuits for the children causing less harm to the general and dental health.

Keywords: Children, Diet, Flow rate, Oats, Oral clearance rate, Saliva, Salivary pH, Salt, Snacks.

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INTRODUCTION

It is a known fact that, for the development and maintenance of general wellbeing of an individual, a good diet is essential. Diet being one of the etiological factors in causing dental caries, along with the general health it is also a very important factor in maintaining good oral health. While in the past, oral health was often isolated from the general health, the modern dentistry mainly focuses on maintaining the good interrelationship between the oral health teeth and the general health of an individual.[1]

In the present decade, there is a shift in dietary habits in most of the age groups with more preferences given to the snacks and bakery foodstuffs. These items vary widely in their carbohydrate content, tendency to be retained on the tooth surfaces and to be broken down by salivary enzymes, and in their capacity to stimulate salivary flow, thus having a variable effect on salivary pH and oral clearance time after consumption.

Saliva being a complex secretion of the oral cavity provides a physiologic environment for the interactions to occur between the agent, host and the environment. Salivary pH, flow rate, oral clearance and calcium, and fluoride ion concentration are the key salivary parameters which have an effect on the enamel stability.[2] As reported by Stephan et al.,[3] there is a drop in the plaque pH below the critical pH value of 5.5 on exposure to carbohydrates and microorganisms. But the pH again reverts to a resting pH level with neutralization or removal of acid from the oral cavity with time.[4]

Though biscuits are considered cariogenic food, their cariogenic nature may vary from low to moderate. Also, there are no studies are done till date as of our knowledge, wherein different types of biscuits are compared in term of their salivary changes and very few studies are done whereby biscuits are compared with other snacks.[5]

Thus keeping the above facts in view the aim of our study was to assess the effect of 5 different commercially

available biscuits, *viz*, cream biscuits, glucose biscuits, chocolate biscuits, salty biscuits and oats biscuits on salivary pH, flow rate and oral clearance rate among school children. The null hypothesis was set as there will be no difference in the salivary parameters on consumption of 5 different commercially available biscuits.

MATERIALS AND METHODS

This study was initiated after approval from the institutional ethics committee. This was an experimental *in vivo* intergroup comparative study carried out in children in the age group of 10–15 years, who visited the outpatient in the Department of Paedodontics and Preventive Dentistry of Manipal College of Dental Sciences, Mangaluru, India.

The study consisted of five groups—group I–oats biscuits, group II–salt biscuits, group III–glucose biscuits, group IV–cream biscuits, and group V–chocolate biscuits.

Sample Size Calculation

As per the study conducted by Desu et al.,[6] 10 samples per group were taken to achieve 83% power to detect differences among the null hypothesis and the alternative hypothesis with a 0.05 significance level (alpha). Thus a sample size of 50 subjects was considered for the study.

Allotment of the selected subjects to a particular group was made by the lottery system.

Inclusion and Exclusion Criteria

Children who were cooperative and who were willing to participate in the study and those with DMFT and/dft score value ranging from 0 to 3 were included in the study. Children with oral soft tissue pathology, with systemic diseases and who were on antibiotic coverage within 3 months of the study were excluded from the study. Also, the children who had not followed the instructions given prior to the saliva sample collection were excluded from the study.[7] All children selected had similar dietary habits, oral hygiene measures, and lifestyle.

Parents of the eligible participants were given an information summary to read, along with the verbal explanations of the procedure and made to sign the informed consent form.

- *Salivary pH assessment:* The time for the saliva sampling was standardized and was done in the morning. Thus, the collection of unstimulated salivary samples were done at least two hours after their breakfast for each study subjects. Thereafter, children were given one biscuit each and instructed to consume the test biscuit in two minutes and to chew the biscuit carefully around the teeth before swallowing to maintain a uniform method in eating after which at following fixed time intervals stimulated saliva samples were collected.[8]
  - 1st follow-up was done immediately after test food consumption.
  - 2nd follow-up at 5 minutes after the test food consumption
  - 3rd follow-up at 10 minutes after the test food consumption and
  - 4th follow-up was done at 15 minutes after the test food consumption.

Children were made to sit comfortably on a normal chair for the collection of stimulated saliva. Their head was bent forward and was asked to spit into a sterile calibrated test tube through a sterile funnel. At least 1 mL of unstimulated and stimulated saliva was collected at baseline and at each time interval. Digital pH meter was used to estimate the salivary pH. Before taking any recordings on the pH meters, the instrument was checked and standardized with the standard buffer of pH 4.00 and 7.00. The pH electrode was dipped into 1 mL of saliva to measure salivary pH. The electrode of the pH meter was cleaned with distilled water in between the readings. After the collection of saliva samples, the pH was measured as soon as possible and not later than 10 minutes.[8]

The measurement of the flow rate was done directly from the calibrated test tube after each sample collection. These test tubes were preweighed and then weighed after salivary sample collection, and the flow rate was calculated in g/mL which is almost equivalent to mL/min.

The estimation of the oral clearance time was done on the basis of the time taken for the salivary pH to return back to the baseline values.

An independent observer recorded all the digital pH readings to minimize bias or errors in the data..

Statistical Significance

A p value of ≤ 0.05 was considered significant for all statistical analysis. Changes in salivary pH and flow rate between various study groups were compared using one-way ANOVA, and within the group, the comparison was done using a paired t-test. To compare the mean salivary pH and flow rate after commercially available biscuit consumption at different intervals of time and the group-wise intergroup comparisons were made using the Post-hoc Tukey's test.

RESULTS

Determination of salivary pH was done for all the groups before the consumption of commercially available biscuits. Mean salivary pH values declined after consumption of biscuits in all the five groups at a different time interval. One way ANOVA shows the changes in salivary pH between various study groups. On comparison of 0 minute pH (immediate) between the five groups, the

mean values of oats biscuit (7.36 ± 0.22) were highest followed by salt biscuit, chocolate biscuit, cream biscuit and least in glucose biscuit (6.4267 ± 0.82). At 5 minutes mean values of salt biscuit (7.081 ± 0.36) were highest followed by oats biscuit, chocolate biscuit, cream biscuit and least in glucose biscuit (6.316 ± 0.76) and this was statistically significant with a *p* value of 0.011. On comparison of 10 minutes mean pH values were highest for a cream biscuit (7.09 ± 0.63) followed by oats biscuit, salt biscuit, chocolate biscuit and least in glucose biscuit (6.524 ± 0.52). At 15 minutes mean values of cream biscuit (7.1722 ± 0.59) was highest followed by salt biscuit, oats biscuit, chocolate biscuit and least in glucose biscuit (6.34 ± 0.58) with a statistically significant *p* value of 0.011 (Table 1).

The paired t-test was applied to compare the differences in pH over time for each commercially available biscuits. Oats biscuit group showed a maximum drop in the pH at 15 minutes (6.995 ± 0.53), salt biscuit group at 10 minutes (6.973 ± 0.44) and glucose biscuit at 5 minutes (6.316 ± 0.76) with a statistically significant *p* value of <0.05 on a comparison of the mean values of baseline pH over time. Cream biscuit group showed a maximum drop in pH at 5 minutes (6.632 ± 0.48) with a statistically significant *p* value of <0.05 at baseline to 5 minutes. Chocolate biscuit group showed a maximum drop in pH at 5 minutes (6.662 ± 0.04) with a statistically significant *p* value of <0.05 at baseline to immediate and 5 minutes (Graph 1).

Post-hoc Tukey test also showed statistically significant differences when intergroup comparison was done between oats biscuit, salt biscuit, cream biscuit and chocolate biscuit with glucose biscuit group at 0 minute (immediate) to baseline category, oats biscuit and salt biscuit with glucose biscuit at 5 minutes to baseline category and salt and cream with glucose biscuit group at 15 minutes to baseline category (Table 1).

One way ANOVA was done to see the changes in mean salivary flow rate between various study groups. At baseline, on a comparison of flow rate between the five groups, the mean values of cream biscuit (2.87 ± 1.12) were the highest followed by glucose biscuit, salt biscuit, oats biscuit and least with a chocolate biscuit (1.57 ± 0.41) with a statistically significant *p* value of 0.049. At 0 minutes (immediate) flow rate of cream biscuit group (3.65 ± 1.54) was highest followed by glucose biscuit group, oats biscuit group, salt biscuit group and least in chocolate biscuit group (1.97 ± 1.019) which was statistically significant with *p* value of 0.005. At 5 minutes mean values of cream biscuit (4.1 ± 1.66) was the highest followed by glucose biscuit, salt biscuit, chocolate biscuit and least in oats biscuit group (2.19 ± 1.07). On comparison of 10 minutes mean flowrate between the groups mean values were highest for a cream biscuit (4.033 ± 1.48) followed by salt biscuit, oats biscuit, glucose biscuit and least in chocolate biscuit group (1.43 ± 0.45) with a statistically significant *p* value of 0.004. At 15 minutes mean values of cream biscuit (4.14 ± 1.71) was highest followed by salt biscuit, oats biscuit, glucose biscuit and least in chocolate biscuit group (1.37 ± 0.17) with a statistically significant *p* value of <0.001 (Table 2).

The paired t-test was applied to compare the differences in flow rate over time for each commercially available biscuits. Oats biscuit group, salt biscuit group, and cream biscuit group showed improvement in salivary flow rate at 15 minutes when compared to its baseline values but in glucose biscuit group and chocolate biscuit group flowrate had dropped at 15 minutes when compared to its baseline flowrate with a statistically significant *p* value of <0.05 (Graph 2).

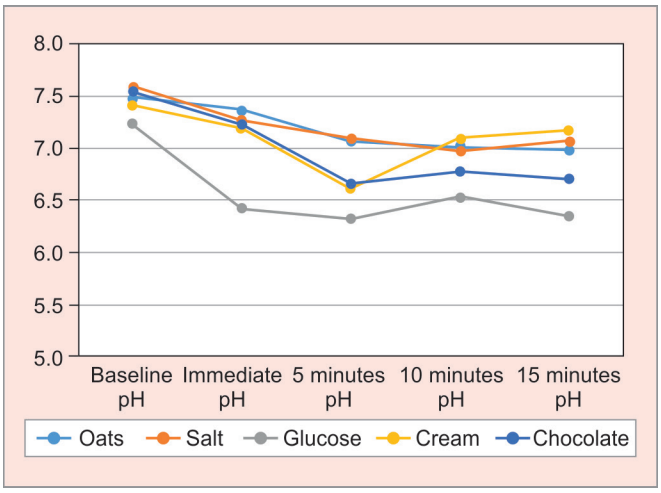
Post-hoc Tukey test also showed statistically significant differences when intergroup comparison was done

Table 1: Mean salivary pH at different interval of time after consumption of different commercially available biscuits

	One way ANOVA to compare the Salivary pH						
	0.558	*0.073*	*0.011*	*0.203*	*0.011*		
Biscuit groups	*Baseline*	*0 min*	*5 mins*	*10 mins*	*15 mins*		
Oats	7.483 ± 0.20	7.36 ± 0.22	7.067 ± 0.55	7.011 ± 0.56	6.995 ± 0.53	<0.05	Paired t test to compare the difference in pH over time
Salt	7.588 ± 0.32	7.262 ± 0.14	7.081 ± 0.36	6.973 ± 0.44	7.063 ± 0.38	<0.05	
Glucose	7.227 ± 0.62	6.4267 ± 0.82	6.316 ± 0.76	6.524 ± 0.52	6.34 ± 0.58	<0.05	
Cream	7.416 ± 0.27	7.1922 ± 0.46	6.632 ± 0.48	7.09 ± 0.63	7.1722 ± 0.59	<0.05 at baseline to 5 mins	
Chocolate	7.537 ± 0.28	7.2222 ± 0.40	6.662 ± 0.04	6.776 ± 0.44	6.705 ± 0.43	<0.05 at baseline to 0mins and 5 mins	
	<0.05 Oats, salt, cream and chocolate with glucose.	<0.05 Oats and salt with glucose.		<0.05 Salt and cream with glucose.			
	Post-hoc Tukey test						

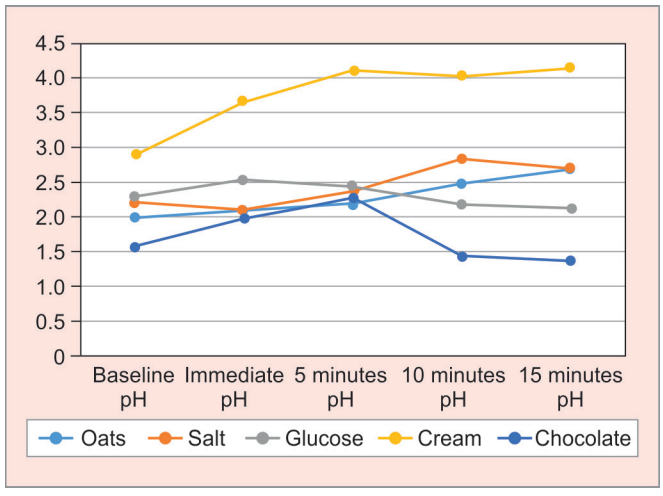
Table 2: Mean salivary flow rate at different interval of time after consumption of different commercially available biscuits

	One way ANOVA to compare the salivary flow rate						
	0.049	*0.005*	*0.031*	*0.004*	*<0.001*		
Biscuit groups	*Baseline*	*0 min*	*5 mins*	*10 mins*	*15 mins*		
Oats	1.98 ± 0.80	2.09 ± 0.78	2.19 ± 1.07	2.48 ± 0.86	2.68 ± 0.86	>0.05	
Salt	2.22 ± 0.84	2.09 ± 0.66	2.38 ± 0.46	2.84 ± 0.65	2.69 ± 0.73	>0.05	Paired t test to compare the difference in pH over time
Glucose	2.28 ± 0.79	2.52 ± 0.85	2.42 ± 0.60	2.17 ± 0.52	2.13 ± 0.76	>0.05	
Cream	2.87 ± 1.12	3.65 ± 1.54	4.1 ± 1.66	4.033 ± 1.48	4.14 ± 1.71	>0.05	
Chocolate	1.57 ± 0.41	1.97 ± 1.019	2.25 ± 0.81	1.43 ± 0.45	1.37 ± 0.17	<0.05 at baseline to 5 mins	
	<0.05 Cream with chocolate	<0.05 Oats, salt and chocolate with cream	<0.05 Oats, salt, glucose & chocolate with cream	<0.05 Oats and glucose with cream.	<0.05 Oats, salt, glucose, chocolate with cream		
	Post-hoc Tukey test						



Graph 1: Mean salivary pH of subjects at different time intervals following consumption of commercially available biscuits

Oats biscuit group showing maximum drop in the pH at 15 minutes, salt biscuit group at 10 minutes and glucose biscuit at 5 minutes on comparison to the mean values of baseline pH over time. Cream biscuit group showing maximum drop in pH at 5 minutes when compared at baseline to 5 minutes. Chocolate biscuit group showing maximum drop in pH at 5 minutes when compared at baseline to immediate and 5 minutes



Graph 2: Mean salivary flow rate of subjects at different time intervals following consumption of commercially available biscuits

Oats biscuit group, salt biscuit group and cream biscuit group showing improvement in salivary flowrate and glucose biscuit group and chocolate biscuit group showing drop in the flow rate at 15 minutes on comparison to its baseline flow rate

between cream biscuit with chocolate biscuit at baseline; oats biscuit, salt biscuit and chocolate biscuit with cream biscuit at 0 minutes (immediate) to baseline category; oats biscuit, salt biscuit, glucose biscuit and chocolate biscuit with cream biscuit group at 5 minutes to baseline category; oats biscuit and glucose biscuit with cream biscuit at 10 minutes to baseline and oats biscuit, salt biscuit, glucose biscuit and chocolate biscuit with cream biscuit group at 15 minutes to baseline category (Table 2).

In all the five commercially available biscuit groups, the pH at 15 minutes had not returned to the baseline values which suggests that oral clearance time was more than 15 minutes for all the biscuit groups.

From the above data, among five commercially available biscuits, none of the groups showed salivary pH value below critical pH, but glucose biscuit and chocolate biscuit group had maximum effect on the salivary pH and flowrate suggestive of more cariogenic in comparison to oats biscuit, salt biscuit group, and cream biscuit group.

DISCUSSION

Snacks are a part of a healthy diet for children providing nutritious food throughout the day.[1] Traditionally snacks are prepared from ingredients commonly available at home. But nowadays healthy nutritious snacks have been replaced by junk foods. These food are quite popular among children owing to their taste, appearance, and hype created by mass media.[9] It was found out that biscuits/cookies, cakes, and wafers were most commonly consumed snacks by the school children during their break time.[10] Many varieties of biscuits are available in the market. In our study, we selected five commercially available biscuits *viz.* cream biscuits, glucose biscuits, chocolate biscuits, salty

biscuits and oats biscuits based on the patient survey. All these varieties of biscuits are frequently consumed by children either as their evening snacks or at schools in tiffin box or as in between meal snacks.

Saliva being a complex biological fluid plays a diverse role in the functioning of the oral cavity such as the mastication, deglutition, taste sensation, speech and in the digestion. All these functions would be impossible without the salivary secretions. Along with these function it also serves as a host defense by buffering and enabling ion exchange.[11] Salivary pH, flow rate and oral clearance rate are the important dynamic effects of saliva. The salivary flow rate and its consistency contributes in flushing of the microorganisms and substrates from the oral cavity and thus maintains oral cleanliness.[12,13] Salivary pH and buffering capacity contributes to the ion exchange during remineralization and demineralization of the enamel.[14] Thus, we have used salivary pH, flow rate and oral clearance time to assess the cariogenicity of the commercially available biscuits.

Changes in the salivary pH in the present study were calculated using glass electrodes, as it is an accurate, sensitive and accepted methodology.[15] It is observed that the pH of saliva increases during the day, especially between 9 am and 11 am when metabolic activities usually become greater.[16] For this reason, the saliva samples were collected in the morning for all the study children and also all children selected had similar dietary habits, oral hygiene measures, and lifestyle because these factors could affect significantly on the result of the study.

The mean salivary pH in a healthy state is maintained at 6.7–7.4. Upon consumption of snacks, this pH drops at a lower value called a critical pH value which is 5.5. At this pH, there is the initiation of dissolution of the enamel taking place. Therefore along with the drop in pH, the length of the time for which the pH remains at this lower pH is also important. Our study results showed that there was a decrease in salivary pH compared to baseline for all the five commercially available biscuits with maximum drop seen for glucose biscuit (6.316 ± 0.76), cream biscuit (6.632 ± 0.48) and chocolate biscuit group (6.662 ± 0.04) at 5 minutes. But in cream biscuit group the salivary pH value had increased at 10 minutes. Oats group (6.995 ± 0.53) showed a maximum drop in mean salivary pH at 15 minutes and salt biscuits (6.973 ± 0.44) at 10 minutes. None of the groups the salivary pH returned to the baseline pH in 15 minutes. However, this pH drop was not below the critical pH for both enamel and dentin. The variation in the response among different groups of biscuit can be attributed to the differences in their composition[17] and the free sugar content. All the five groups of biscuits contained added sugar with highest in glucose biscuit group (25.5 g) followed by chocolate biscuit (7 g), cream biscuit (6 g), salt biscuit (3 g) and least in oats biscuit (1 g) as mentioned in the pack. On intergroup comparison statistical significant difference was seen for oats, salt, cream and chocolate biscuit group with glucose biscuit group at 0 minutes; and for oats and salt biscuit group with glucose biscuit group at 5 minutes and salt and cream biscuit group with glucose biscuit group at 15 minutes. These findings are in accordance with the findings observed by Pachori et al.[18] wherein different eatables and beverages were compared to evaluate the changes in salivary pH.

The salivary flow rate is a very important function of saliva which facilitates caries prevention by flushing and neutralizing effects, referred as "salivary clearance" or "oral clearance capacity".[19] In general, higher the flow rate, faster is the clearance of microorganism and the carbohydrates and higher the buffering capacity and vice versa. The normal daily salivary flow rate varies between 0.5 liters/minute and 1.5 liters/minute. The whole unstimulated saliva flow rate is approximately 0.3–0.4 mL/min and this rate decreases to 0.1 mL/min during sleep and increases to about 4, 0–5, 0 mL/min during eating, chewing and other stimulating activities.[20] In our study, the increased salivary flow rate was seen for oats biscuit, salt biscuit and cream biscuit group at 15 minutes when compared to its baseline value. This increase in flow rate with salt and cream biscuit group could be due to the taste which affects salivary flow. According to Dawes and Watanabe,[21] sour, sweet, bitter and even salty are considered as a stimulant of saliva. Chocolate and glucose group flow rate were reduced at 15 minutes in comparison to its baseline.

In the present study, the oral clearance rate for all the commercially available biscuits was found to be more than 15 minutes. This was probably due to the physical state and the retentive property of the food which plays a significant role in its cariogenic potential. Longer the sugar is stuck to the teeth, and the bacteria will act on sugars and produce acids, which leads to dental caries development. Biscuits being solid tends to retain for a longer time in the oral cavity leading to longer oral clearance time. This finding of the study was in agreement with the other studies wherein the oral clearance rate of biscuits was found to be in the higher range in comparison to other snacks.[5,22,23]

From the above findings, it was seen that glucose biscuit and chocolate biscuits had a major effect on the drop in salivary pH and the salivary flow rate and all the biscuit groups on oral clearance rate. However, the cariogenic potential of biscuits depends on many other factors such as frequency of intake, bedtime consumption, and critical pH, and moreover, children who do not follow proper oral hygiene measures are at greater risk.

Therefore parents and guardians should guide their children regarding the cariogenic potential of biscuits and to introduce oral hygiene measures after consumption of these commercially available biscuits like to avoid in-between meal snacking, after eating to properly rinse the oral cavity, brushing to be carried out twice daily and after eating especially at school, child can drink water so that food will be cleared from teeth.

CONCLUSION

The present study concluded that consumption of all the five different commercially available biscuits, *viz* cream biscuits, glucose biscuits, chocolate biscuits, salty biscuits, and oats biscuits had an effect on salivary pH, flow rate and oral clearance rate in children.

It was found that the glucose biscuit and chocolate biscuit group showed a maximum drop in the salivary pH but not below the critical pH value.

With the consumption of salt biscuit, oats biscuit, and cream biscuit group, the salivary flow rate had increased, and with glucose biscuit and chocolate biscuit group, the salivary flow rate had reduced.

The oral clearance rate was more than 15 minutes for all the commercially available biscuits.

CLINICAL SIGNIFICANCE

Biscuits being the commonest snacks preferred by the present generation, this study helps in choosing the right biscuit for children by their parents which are less cariogenic in comparison to other biscuits. Thus, it directly improves the general and dental health. Irrespective of the type of food consumed, this study also guides the parents the need to maintain good oral hygiene by monitoring child in undertaking proper oral hygiene measures.

REFERENCES

1. World health organization. Oral health fact sheet N0 318. 2012 Apr; Available on: http://www.who.int/mediacentre/factsheets/fs318/en/index.html.
2. Edgar M, Dawes C, O Mullanr D. Saliva and oral health. 3rd ed. London: British Dental Association; 2004.
3. Stephan RM. Changes in hydrogen-ion concentration on tooth surfaces and in carious lesions. JADA 1940;27(5):718-723
4. Touger- Decker R, Loveren C. Sugars and dental cares. Am J ClinNutr 2003; 78: 881-892.
5. Thaweboon S, Suddhasthira T, Thaweboon B, Soo- Ampon S, Dechkunakorn S. Plaque pH response to snack foods in children with different levels of mutans streptococci. South East Asian J Trop Med Public Health 2007;38(3):598-603.
6. Desu MM, Raghavarao D. Sample Size Methodology. Academic Press. 1990. New York. p. 172.
7. Nirmala S, Quadar MA, Veluru S. pH modulation and salivary sugar clearance of different chocolates in children: A randomized clinical trial. J Indian SocPedodPrevDent. 2016 Jan-Mar;34(1):10-16.
8. Hans R, Thomas S, Garla B, Rushabh J. Dagli, Manoj Kumar Hans. Effect of Various Sugary Beverages on Salivary pH, Flow Rate, and Oral Clearance Rate amongst Adults. Scientifica; 2016.
9. Roxie Rodgers Dinstel. Choosing healthy snacks for children. University of Alaska Fairbanks [internet].2015.
10. S.Vijayalakshmi, T.Kanchana, S.Vasantha, N.Devi, A.Arun. Restore our Indian traditional snacks among school going children. International Journal of Pharma and Bio Sciences. 2016 Oct ;7(4):121-124
11. Hicks J, Garcia-Godoy F, Flaitz C. Biological factors in dental caries: role of saliva and dental plaque in the dynamic process of demineralization and remineralization, part 1. J ClinPediatr Dent. 2003;28(1):47-52.
12. Silverstone LM. Effect of oral fluid and synthetic calcifying fluids in vitro on remineralization of enamel lesions. ClinPrev Dent. 1982;4(4):13-22.
13. Ranganath L, Shet R, Rajesh A. Saliva: a powerful diagnostic tool for minimal intervention dentistry. J Contemp Dent Pract. 2012;13(2):240-245.
14. Featherstone JD, Zero DT. An in situ model for simultaneous assessment of inhibition of demineralization and enhancement of remineralization. J Dent Res. 1992;71:804-810.
15. Wessinger GD. Comparative measurements of salivary pH. J Dent Res. 1941 Apr;20(2):123-127.
16. Hofman LF. Human saliva as a diagnostic specimen. J Nutr. 2001 May;131(5):1621S-1625S.
17. Vassilakos N, Nilner K, Birkhed D. Oral electrochemical action after soft drink rinsing and consumption of sweets. Scand J Dent Res 1990 Aug;98(4):336-340.
18. Pachori A, Kambalimath H, Maran S, BabitaNiranjan, GarimaBhambhani, Garima Malhotra. Evaluation of Changes in Salivary pH after Intake of Different Eatables and Beverages in Children at Different Time Intervals. International Journal of Clinical Pediatric Dentistry, May-June 2018;11(3):177-182.
19. Lagerlof F, Oliveby A. Caries-protective factors in saliva. Adv Dent Res.1994 Jul;8(2):229-238.
20. Iorgulescu G. Saliva between normal and pathological. Important factors in determining systemic and oral health. J Med Life 2009;2(3):303-307.
21. Watanabe S, Dawes C. The effects of different foods and concentrations of citric acid on the flow rate of whole saliva in man.Arch Oral Biol. 1988;33(1):1-5.
22. Konig KG. Diet and oral health. Int Dent J 2000;50:162- 74.
23. Dodds MWJ, Edgar WM. The relationship between plaque ph, plaque acid anion profiles, and oral carbohydrate retention after ingestion of several 'Reference Foods' by human subjects. J Dent Res 1988;67:861-865.