Original Research Article

Comparison of changes in salivary pH levels after consumption of plain milk and milk mixed with Sugar

Aasim Farooq Shah*

Registrar, Department of Public Health Dentistry, Government Dental College and Hospital, Shireen Bagh, Srinagar, Jammu and Kashmir, India
*Corresponding author email: **dr_aasimshah@yahoo.com**

International Archives of Integrated Medicine, Vol. 3, Issue 10, October, 2016.

Available online at http://iaimjournal.com/
ISSN: 2394-0026 (P) **ISSN: 2394-0034 (O)**
Received on: 01-10-2016 **Accepted on:** 10-10-2016
Source of support: Nil **Conflict of interest:** None declared.
How to cite this article: Aasim Farooq Shah. Comparison of changes in salivary pH levels after consumption of plain milk and milk mixed with sugar. IAIM, 2016; 3(10): 174-178.

Abstract

Studies of dietary effects on saliva were common in the early part of this century, but it is now understood that such studies are of little value because the effects of other physiologic variables, such as time of day, were seldom controlled in the experimental design. The main salivary factors that, from theoretical considerations, might be expected to influence the process of caries are flow rate and the concentrations of calcium, phosphate, bicarbonate, hydrogen ions, fluoride, urea, and protein (particularly amylase). As the mankind has evolved, a drastic change has been seen in the dietary fermentable carbohydrate which eventually is associated with increased prevalence of dental caries. Milk is consumed with sugar syrups or honey to add flavor which eventually increases sugar content of milk, putting the children at a higher risk of dental caries. This study was conducted to evaluate and compare the acidogenic potential of milk as compared to milk and sugar at various time intervals. A total of 230 children aged 12 to 15 years were examined, 60 children which equal number of males and females (30 each) who satisfied the inclusion criteria were randomly selected and assigned to two groups, Group I: Plain milk (250 mL) and Group II: Milk and sugar (250 mL + 1 table spoon sugar =12.50 gm). After recording the resting pH, the change in the salivary pH in the respective groups after consuming the test meal was recorded after 5 minutes, 10 minutes, after 15 minutes, after 30 minutes and 120 minutes. The results show that there was no statistical significant difference in pH between the two groups. Statistically significant difference was seen at 10, 15, 30 minutes with highest at 15 minutes ($p = 0.001$) between plain milk (group I), milk and sugar (group II). The milk group showed a significant decrease in pH at 10 minutes. However, pH returned to normal at 15 - 30 minutes in group II. The study concluded that milk when added with sugar as did not pose a risk of demineralization as there was no decrease of pH below the limit of critical pH of 4.5 to 5.5.

Key words

Sugar, Salivary pH, Saliva, Demineralization, Acidogenic Potential.

Introduction

The composition of saliva is potentially of great importance to the prevention of caries. Saliva contains buffers that tend to reduce the fall in pH that is associated with acid formation from carbohydrate by the dental plaque; it also contains urea, a substrate for base formation by dental plaque. Saliva contains enzyme (amylase), which is involved in the first stages of the metabolism of starch, a component of many foods [1]. The main electrolytes in human saliva are sodium, potassium, calcium, chloride, bicarbonate, and inorganic phosphate; quantitative differences in the relative proportions of these electrolytes in the major salivary gland secretions have been shown [2]. Studies of dietary effects on saliva were common in the early part of this century, but it is now understood that such studies are of little value because the effects of other physiologic variables, such as time of day, were seldom controlled in the experimental design. Nevertheless, some interesting points have emerged from previous studies and various salivary components pertinent to caries will be considered in turn. The main salivary factors that, from theoretical considerations, might be expected to influence the process of caries are flow rate and the concentrations of calcium, phosphate, bicarbonate, hydrogen ions, fluoride, urea, and protein (particularly amylase). As far as dietary effects on saliva are concerned, Pickerill's work which dealt mainly with the local reflex effects of different foods that the composition of saliva "adapts" itself to the nature of the stimulus [3].

As the mankind has evolved, a drastic change has been seen in the dietary fermentable carbohydrate which eventually is associated with increased prevalence of dental caries. Milk is considered as an ideal food for the growing child. It is a more popular form of nutrition [4]. Children, however, need different amount of specific nutrients, such as vitamins, minerals, carbohydrates, proteins, and fats at different ages. An appropriate diet is one that provide adequate nutrition and is appropriate for a child's development [5]. Milk is consumed with sugar syrups or honey to add flavor which eventually increases sugar content of milk, putting the children at a higher risk of dental caries. In early 2014, World Health Organization (WHO) called for a dietary sugar intake restricted to 5% of total dietary calories in order to tackle public health problems, such as obesity and tooth decay.

The acidogenic potential of dietary products is well documented and there is sufficient evidence regarding the effect of saliva in controlling the plaque pH and that stimulation of saliva by foods is an important factor in determining their acidogenic potential [6]. This study was conducted to evaluate and compare the acidogenic potential of milk as compared to milk and sugar at various time intervals.

Materials and methods

The study was approved by the Ethics Committee of Government Dental College Srinagar. Subjects and their parents were informed about the experiment prior to obtaining their consents. Certain inclusion criteria as, age of 8 to 12 years, decayed missing filled teeth (DMFT) index score less than or equal to 3 and a positive consent from their parents were set. While children who were, physically challenged or had gross oro-facial defects, medically compromised or children who were on antibiotics in the last 30 days and children who had salivary gland disorders were excluded from the study.

Study subjects were selected after an initial oral screening at camp sites, a total of 230 children aged 12 to 15 years were examined for the study and DMFT was recorded. Children of lesser age were not taken into the study keeping in view the

eruption sequence and partially erupted teeth in oral cavity. 60 children which equal number of males and females (30 each) who satisfied the inclusion criteria were randomly selected by lottery method. Study subjects were randomly allocated into two groups. Group I: Plain milk (250 mL) and Group II: Milk and sugar (250 mL + 1 table spoon sugar =12.50 gm). 30 subjects were assigned in each group with equal number of subjects as per gender. Thus finally the Group I comprised of 15 male and 15 female subjects while Group II also comprised of 15 male and 15 female subjects who had satisfied the inclusion criteria and were randomly selected by a lottery method.

Thorough oral prophylaxis was done to the children 1 day prior to the conduct of the study to safeguard uniform baseline. Oral prophylaxis was carried out by house surgeons in the Department of Periodontics, Government Dental College Srinagar on the 1st day of study. The children were instructed not to eat any food prior to coming for the collection of saliva samples. The study was conducted between 8 and 11 am. Baseline unstimulated saliva was collected into a dry, millimetric, sterile plastic tube and the pH was recorded. After recording the resting pH, the change in the salivary pH in the respective groups after consuming the test meal was recorded after 5 minutes, 10 minutes, after 15 minutes, after 30 minutes and 120 minutes using a Digital pH meter (pHCal pH/mV/°C Analyzer, Analab, India.)

The data were analyzed after data were entered into an Excel sheet database (MS Office Excel 2000; Microsoft Corporation, Redmond, WA, USA). The Data was analyzed using SPSS Statistics 19.0. Mann-Whitney test was used and p value of < 0.05 was accepted as significant.

Results

The average baseline salivary pH in both the groups was 7.26. The mean pH at different time intervals among the groups was as per **Table - 1**. At baseline, there was no statistical significant difference in pH between the two groups. However, at different time intervals within 10, 15 and 30 minutes the pH values between the two groups showed a significant difference. Statistically significant difference was seen at 10, 15, 30 minutes with highest at 15 minutes ($p = 0.001$) between plain milk (group I), milk and sugar (group II). **Graph - 1** showed the fall of pH at 5 minutes, 10 minutes, 15 minutes, and a further rise of pH to baseline level was seen at 30 minutes and 120 minutes. The comparison of baseline pH with pH at different intervals within each group was as per **Table - 2**. The milk group showed a significant decrease in pH at 10 minutes. However, pH returned to normal at 15 - 30 minutes in group II. Milk and sugar group showed no statistical difference at any time interval.

Table - 1: Mean pH with between-groups comparison at different time intervals.

Groups	Baseline pH	5 minutes	10 minutes	15 minutes	30 minutes	120 minutes
I	7.20	7.01	6.92	7.09	7.15	7.25
II	7.46	7.18	7.29	7.40	7.44	7.51
***p* value**	0.233	0.218	0.004*	0.001*	0.017*	0.066
**Statistically significant values obtained using Mann-Whitney test*						

Discussion

Saliva plays a very important role in the maintenance of oral health. The ability of the saliva to buffer acids maintains the pH above critical levels, which thereby protects the teeth from demineralization [7]. The critical pH of saliva is 4.5 to 5.5. The regular baseline pH of saliva of all the subjects was 7.26. This finding is

similar to the salivary pH seen in previous studies [8, 9, 10]. The acidogenic potential is dependent on various contributing factors. Saliva has many essential functions and salivary buffering capacity has been recognized as one of the factors that affects caries risk. The capability of saliva to buffer the acids is vital to maintain the pH above the critical pH level, thus shielding teeth against demineralization [11]. Drinking of milk or milk and sugar all lead to a fall in salivary pH, at 5 minutes, which may lead to decalcification [12]. The effect of this acidogenic challenge makes the tooth surface more prone to dental caries; hence this study was commenced to evaluate and compare the acidogenic potential of plain milk or milk with sugar. The mean baseline pH in the present study showed was similar in both groups. The occurrence of phosphate and bicarbonate ions in the saliva repels the effect on the enamel when the pH falls. Milk was higher than Milk added with sugar in the order of acidogenicity at 5 minutes after consumption. The pH drop in milk group to 6.99 at 5 minutes was observed, which improved quickly at 15 minutes and touched baseline at 120 minutes. Milk has got a defensive effect against dental caries even after addition of sugar in the second group; here the decrease in pH was not significant at 10 minutes. This study highlights the that though a alike pattern of pH drop at similar time intervals in both groups was appreciated, the recovery back to the baseline was bit prolonged only when sugar was added, hence demonstrating that the milk has got a protecting effect against dental caries even after addition of sugar. This finding is similar to some previous findings [13]. Previous studies have also suggested that adding sugar did not decrease pH significantly which is similar to the current findings [14].

Table - 2: Comparison of baseline pH with pH at different time intervals within each group.

Group		Baseline-5 minutes	Baseline-10 minutes	Baseline-15 minutes	Baseline-30 minutes	Baseline-120 minutes
I	**Difference in pH from Baseline**	–0.19	–0.28	–0.11	–0.05	+0.05
	***p* value**	*0.088*	*0.023**	*0.231*	*0.786*	*0.298*
II	**Difference in pH from Baseline**	–0.28	+0.17	+0.06	+0.02	–0.058
	***p* value**	*0.332*	*0.435*	*0.176*	*0.022**	*0.045**

*– Decrease in pH; + Increase in pH; *Statistically significant obtained using Mann-Whitney test*

In order to evaluate the findings of the present study we believe that the salivary pH immediate after the consumption should be evaluated with a larger sample size keeping in view the confounding factors which might affect the outcome of the study.

Conclusion

The present study determines that milk when added with sugar as did not pose a risk as there was no decrease of pH below the limit of critical pH of 4.5 to 5.5. Hence, milk alone or milk with sugar can be recommended as a part of diet.

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Graph - 1: The pH at different time intervals in both the groups.