A comparative study of acidogenic potential of milk and commonly used milk formulae
Updesh Masih, Manisha Prabhakar, J. L. Joshi, Pooja Mahay

Abstract
Aims & Objective: Oral health of an individual has its origin mainly during infancy and early childhood. The present study was designed with the objectives of comparing the human plaque pH changes after consumption of milk and infant milk formulae. Materials & methods: The study was carried out on thirty school going children of 8-12 years. The acidogenic potential of following commonly used milk formulae was observed i.e.: Lactogen 2, Lactodex 2, Amulspray, along with sweetened and plain milk (verka), in terms of their effect on the hydrogen ion concentration of human dental plaque. Results: A sharp plaque pH fall in the case of sweetened milk was observed which was below the critical value of 5.5. The acidogenic potential of milk and commonly used milk formulae was observed in terms of their effect on the hydrogen ion concentration of human dental plaque. Results: A sharp plaque pH fall in the case of sweetened milk was observed which was below the critical value of 5.5. Conclusion: In diet counseling procedures, we recommend usage of all the above mentioned infant formulae, but Lactodex-2 should be given preference.

Key Words: milk, plaque, infant formulae, caries

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Introduction
The introduction of fermentable carbohydrates into the modern diet has been associated with the increase in the prevalence of dental caries. Various experimental studies, like that of Vipeholm, (1) on the relationship between sugars (carbohydrates) and dental caries, have led to the conclusion that factors such as physical form, oral clearance and frequency of meal consumption are of equal importance as the causative agents. “Diet”, thus is the most important factor to be looked after, as it is not only essential for a growing child or for sustaining good health, but also could be a modifying agent in dental caries. Milk is universally considered as the ideal food for the growing child. It is the most popular form of nutrition from birth to adolescence and beyond, for peoples both, rich and poor.

Methods
This study was conducted in the Department of Pedodontics and Preventive Dentistry, Christian Dental College and Hospital, Ludhiana, Punjab. The study sample includes thirty school going children in the age group (8 – 12 yrs) (3, 4) who were randomly selected. The acidogenic potential of following commonly used milk formulae was observed i.e. Lactogen 2, Lactodex 2, Amulspray, along with sweetened and plain milk (verka), in terms of their effect on the hydrogen ion concentration of human dental plaque. A letter providing all information and details of the study was given to the guardian and the study was carried out only after permission was granted. Inclusion criteria (5): Healthy, co-operative children with restoration free labial, buccal and lingual surfaces having DFT / dft not more than 3.

Exclusion criteria: (6) Children having:- Xerostomia, Lactose intolerance, General allergy to milk and children on antibiotic therapy in the past three months. Selected tooth surfaces: (7) a) Palatal surface # 16, b) Lingual surface # 46, 44, 84, c) Lingual Surface # 36, 34, 74

The study was done under the following three stages. Stage 1 (Pre-study Preparation) at the commencement of the study, the children were given thorough oral prophylaxis so as to obtain “zero” plaque score to ensure uniform baseline (5). This was determined with the help of a disclosing solution (Basic Fuchsin – 0.075 %) (8) and the following instructions were given to the children: They were asked to abstain from brushing their teeth or performing any method of oral hygiene for 48 hours to allow sufficient plaque deposition(9). On the day of the study (3rd day) the children were brought to the department of Pedodontics and Preventive Dentistry at 8:00 AM in the morning without eating any form of breakfast or food, except plain water. Appointments were always scheduled at the same time of the day for each subject, between 08:00 & 11:00 hours.

Stage 2 (Recording of Resting pH)
Standardization of plaque pH testing apparatus: This pH meter was fitted with a calomel combination type of single electrode. The apparatus was standardized using buffer solutions 4 and 7 provided by the manufacturer. This calibration was done every day before the...
experiments commenced. The electrodes were cleaned in a stream of distilled water, and blotted dry with filter paper. This ensured stable readings from the meter and constant check on the drift. All readings were taken 60 seconds after the placement of plaque suspension on the electrode system to standardize the time allowed for the electrode reading to stabilize.

When the child reports back to the department, the supra gingival plaque samples were collected from the palatal surface of # 16 with the help of a standardized excavator using the plaque sampling technique. The plaque was dissolved in 2 ml of double distilled water, sufficient enough to submerge the glass of the electrode, completely. This entire procedure was completed within 1 minute. Recordings were taken from the digital display of the pH meter directly. This first reading served as baseline or resting plaque pH.

Stage 3 (Recording of pH After Consumption of Test Food) After recording the resting pre-consumption plaque pH, each child was given 10 ml of the prepared test food and asked to swish it around the mouth for 40 seconds (10) and then either swallow or spit it, depending on preference of the child. Fresh samples of the plaque was taken to record the pH according to the plaque sampling technique (5, 11). Rankine et al (12) viewed a marked difference in plaque pH in different quadrants of the mouth in the same individual, revealing the limitations of any observations on pooled plaque, so the following teeth were taken which showed a slightly less acidic plaque accumulation when compared to the maxillary teeth. (13) The changes in plaque pH after consuming the test food were recorded as follows: a) After 5 minutes from # 46, b) After 10 minutes from # 4484, c) After 20 minutes from # 36, d) After 30 minutes from # 3474. After each test food experiment in an individual, the pH meter was again checked and standardized against buffer of 4.00 and 7.00 pH.

The children were then asked to use the normal oral hygiene regime for 5 days and abstain for 2 days, and then report back to department. Thereafter the experiment was carried out with the remaining test foods. The results were tabulated and put to statistical analysis.

Results

Minimum value for pH was observed for all drinks at 10 minutes time interval, after consumption. Mean resting plaque pH of the children in the test group was 6.82 ± 0.14. Plain milk showed a mean minimum pH of 6.77 ± 0.15. Sweetened milk showed a mean minimum pH of 5.48 ± 0.05. Milk caused the least drop in plaque pH and had a minimum plaque pH of 6.602 ± 0.146, followed by Lactodex – 2 (6.487 ± 0.142), Lactogen (6.323 ± 0.131) and Amulspray (6.024 ± 0.130). The maximum drop in the pH among those tested was for sweetened milk with a mean minimum plaque pH of 5.481 ± 0.054.

Discussion

The average resting plaque pH of all the children was 6.81 ± 0.13. This finding is comparable to the resting plaque pH seen in studies conducted by Anderson et al (14), Saigal et al (4), Jensen et al (11). The importance of the resting pH lies in the fact that, the children having less cariogenic potential had high resting pH approx 6.8 when compared to the children with active carious lesions (15). The buffering capacity of milk is almost twice as compared to the infant formulae available in India. Buffering capacity is the ability of a solution to resist a change in pH when acid or base is added (16).

Though milk has been proven low in cariogenicity, various reasons can be attributed to the low cariogenicity of milk. Lactose as compared to sucrose is metabolized slowly by oral micro organisms. However if the organism is adapted to lactose, the acid production takes place faster and pH fall also increases (17). When sugar was dissolved in the same milk and given to the children, a fall of 1.32 units in plaque pH was observed at 10 minutes time point. This value is comparable to the value observed by Rugg-Gunn et al (18) – 1985, where a drop from 6.83 to 5.40 was seen on drinking 7 % sucrose solution.

The results of the infant milk formulae tested showed that Amulspray was highly acidogenic and the least acidogenic was Lactodex – 2. Though the carbohydrate content is less in Amulspray than Lactogen 2 and Lactodex 2 but the maximum drop was seen with this milk formula. With the Lactodex 2 infant milk formulae the drop seen was minimum and it was 0.13 units lower from the baseline plaque pH (graph - 1). Munshi et al (6) compared the buffering capacity of all infant formulae marketed in India and found Amulspray having the buffering capacity of 11.92 % as compared to Lactogen 2 i.e. 18.48 and Lactodex 2 to be 20.13%. This drop in the Lactogen 2 is not attributed to its high carbohydrate content but to its low protein, fat, sodium and calcium content as compared to Lactodex 2. It is difficult to predict the cariogenicity of formulae based on
their carbohydrate content alone as shown on the product label as either, this information does not specify the quantum, or the nature of the carbohydrate. It also appears that noncarbohydrate constituents may influence the cariogenicity of the sugars present in the formula.

The mineral content varies in each of the test formulae. There have been few notable studies which concentrate upon the effect of iron in the cariogenic process. Though iron does not directly exert its influence on the plaque pH, it is considered to be cariostatic according to many researchers (19, 20). Among the three test formulae studied Lactodex 2 had the highest iron content (8.0 mg) followed by Lactogen2 (7.9 mg) and Amulspray (5.0 mg).

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