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Erosive potential of some beverages on the enamel surface of primary molars

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Abstract:
Dental enamel erosion is a prevalent dental condition that arises as a result of the immense consumption of soft drinks among children. The aim of the present study is to evaluate the erosive potential of four types beverages: cola carbonated beverage, orange juice, milk and tap water (control beverage) on human primary molars. Four test human primary molars were sectioned into 16 specimens that were immersed for 8 hours in one of the test and control beverage. The specimens were gold plated and scanned using scanning electron microscope (SEM) at 5000X. The results revealed the highest erosive effect of carbonated beverages among the investigated soft drinks. It is recommended to reduce the consumption and exposure time to acidic beverage and to postpone brushing of teeth after rinsing to prevent erosion and wearing of dental enamel.

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I. Introduction

The consumption of soft drinks among children and adolescence is highly increased; about 40% of children consumed daily about 250ml of soft drinks[(1)]. West and Hughes in a study stated that "the underlying acidity of beverages is believed to be the primary factor in the development of dental erosion" . They related the effect mainly to the total acid level (titratable acid), rather than the PH level , this assumption is related to the actual hydrogen ion available for interaction with the enamel surface. Other related factors pointed out in the study are the type of acid and its calcium chelating properties, exposure time and temperature [(2)]. Sugary carbonated soft drinks with other additives with low PH may lead to acid dissolution and erosion [(3)]. Dale et all also related the frequency of soft drink consumption to dental erosion and signified its damaging effect particularly among young people [(4,5)] . However , the rate of beverage consuming proved to have demonstrable bearing on erosion. Data showed that teeth are less effected by consuming the beverage at once than continuous sipping [(4,6).]

Shipley, Taylor and Mitchell distinguished the dental erosive factors into extrinsic and intrinsic categories. Gastroesophageal reflux disease (GERD) and voluntary regurgitation of gastric acids seen in anorexic and bulimic individuals are considered intrinsic factors, whereas, environmental factors such as medicaments, lifestyle and diet are intrinsic contributors [(7).]

Although several studies [(8-12)] in the western society related the consumption of the soft drinks to dental erosion, none was conducted among the Egyptian population which has different health behavior pattern and lifestyles.

II. Material and Methods

The PH of 4 beverages (cola carbonated beverages, orange juice, milk and tap water as control beverage) was measured at the start of the study using a PH meter (PHep, Hanna Instruments, Melbourne, VIC). The readings were recorded using a PH meter calibrated according to an accuracy of 0.1 manufacturer's instruction [(13)]. Four sound human primary molars near shedding were extracted.

After sterilization using a 5% sodium hypochlorite (NaClO) solution, the teeth were sectioned in a *buccolingual* and mesiodistal directions into 4 specimens using a medium grit diamond bur mounted on a high speed hand piece under water cooling. The specimens were randomly assigned to each of the beverage group and were immersed in each solution for 8 hours. The specimens were mounted and sputter-coated with the palladium-gold in a Hammer VI cathodic evaborator (Anatech LTD, Alexandria, VA, USA) and scanned using scanning electron microscope (SEM).

Samples were examined and photographed in a JEOL JSM T220Ascanning electron microscope operating at 15 KV, under 5000x magnification.[(14)]

The enamel erosion data were subjected to (ANOVA) and Post Hoc (Scheffe) testing at an apriori α = 0.05, 0.01 and 0.001.

F-statistic of one-way ANOVA is lower than 0.05, suggesting that the one or more treatments are significantly different. Post-hoc tests would likely identify which of the pairs of treatments are significantly different from each other.

III. Results:

Table 1and graph 1 shows there were no significance between milk and control group. Orange juice and cola carbonated beverage had significantly mean surface enamel erosion than control ($p<0.01$). Also there was statistical significant difference between milk versus orange juice and cola carbonated beverage ($p<0.01$)

Material	Surface enamel erosion (Micron)			F (P value)
	Min	Max	Mean±SD	
Control	0.03	0.06	0.05±0.003	83.7 (0.00000*)
Milk	0.08	0.90	0.29±0.05	
Orange Juice	0.36	1.04	0.70±0.066	
Cola Carbonated beverage	0.80	2.20	1.5±0.11	

Table 1: Mean of surface enamel erosion of 4 groups

Graph 1: mean of erosive effects of 4 groups (in micron)

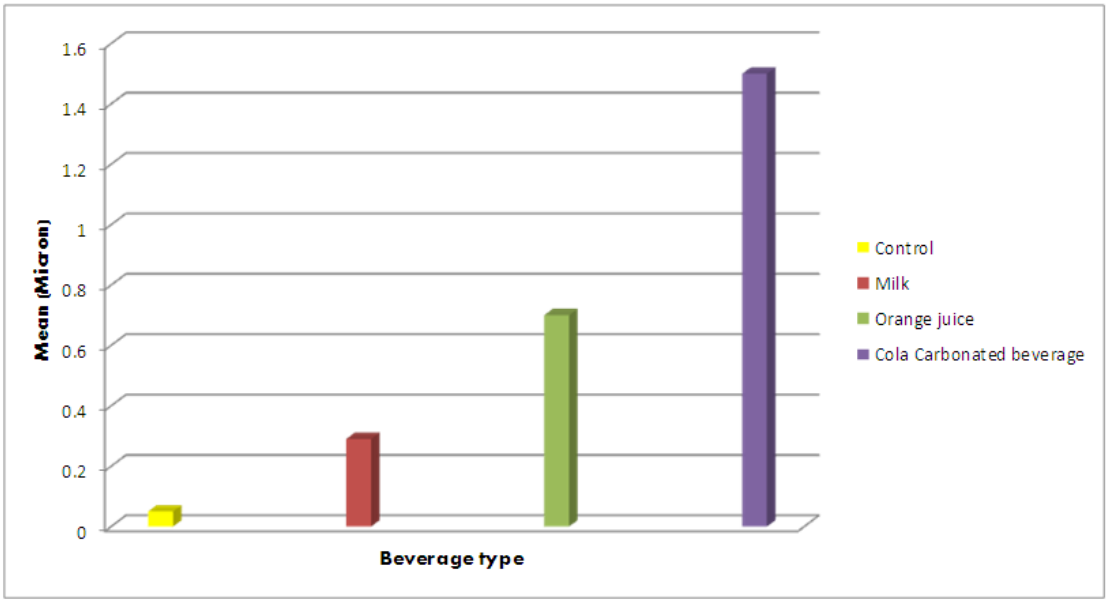

Fig 1- 4 shows erosion of enamel of primary molars with distinct variation. The image of carbonated beverage showed marked frostiness appearance whereas, the image of orange juice showed moderate frostiness. The least of all was observed in milk compared to the control beverage (tap water).The erosive effect of cola carbonated beverage was higher than in the orange juice. The erosive effect of orange juice on the enamel was slightly higher than that of the milk. The test beverages displayed enamel erosion in the following order: cola carbonated beverage, orange juice, milk and tap water.

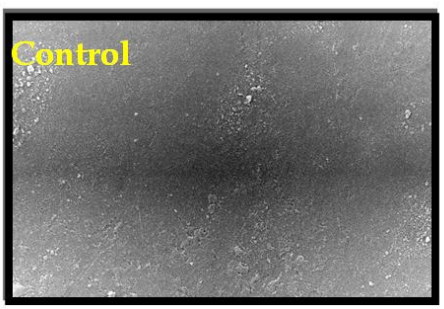

Fig 1

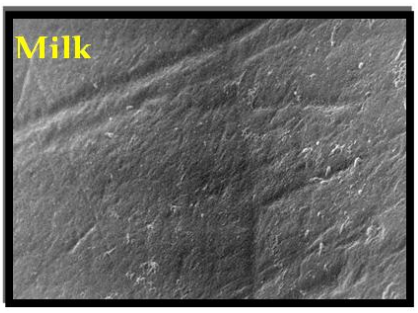

Fig 2

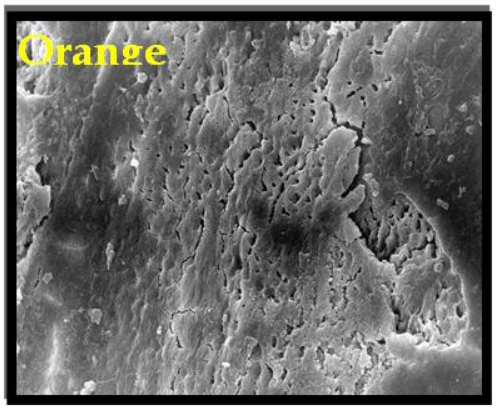

Fig 3

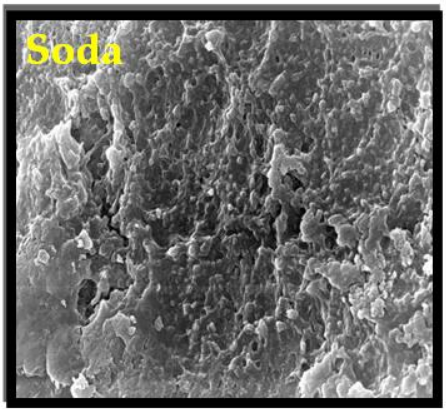

Fig 4

IV. Discussion :

The cola carbonated and orange juice beverages had P H of (2.56 &3.56) respectively. This PH is less than the P H threshold of caries. Accordingly, we can assume that they have no major role in dental caries. However, their P H level could be impliucated in the erosion process, although other factors related to the composition might play important role in this condition. This coincides with the conclusion of Jain P et al who stated that (the erosive potential of the soft drinks was not related to their P H value).[15]

The present study revealed that acidic drinks like carbonated beverage and orange juice showed marked erosion of dental enamel, such result agree with the study of Lussi A et al who reported the greatest effects on the enamel, by most of acidic drinks.

The finding of this study is in agreement with other studies, in which different soft drinks especially carbonated beverages exhibited enamel erosion.[17,18]

It appears that the duration of consumption of acidic beverages should be kept short in order to minimize their continuous aggressive effect on the enamel surface.(15)Moreover after consumption of food and beverages. Many people are accustomed to brush their teeth which might result in wearing of surface enamel.(3) Erosion of enamel by acidic beverages may expose the enamel surface for wearing during brushing.[11,19]

V. Recommendation

It is recommended to reduce the consumption and the residence time of acidic beverages as much because of the significant erosive effect on the enamel.

It is recommended also that rinsing the mouth after consumption of acidic beverages may be more useful than tooth brushing which should be postponed after rinsing to

Further studies are recommended for more beverages and different immersion time of beverages.

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