Influence of Soft Drink on Salivary pH

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Objective: *To investigate the effect of soft drink on human salivary pH.*
Methods: *Thirty healthy volunteers were included in this study. Cola, orange or lemon soft drinks were consumed (200 ml per day) by each participant for 3 days. Saliva was collected 10 min before drinking, immediately after, and at 30 and 60 min after drinking, and the pH of the saliva was measured.*
Results: *The pH of saliva collected immediately and 30 min after the consumption of all three types of drink was significantly lower than that of saliva collected before consumption (except for the lemon group between before and 30 min after consumption). There is no pH difference between the saliva collected before and 60 min after consumption of the three drinks (P > 0.05).*
Conclusion: *Soft drink intake can reduce salivary pH. Therefore, frequent consumption of soft drinks could be a high risk for dental erosion.*
Key words: *saliva, pH, soft drink*

Consumption behaviour plays an important role in oral health. Saliva has critical functions in oral homoeostasis, as it modulates the ecosystem within the oral cavity[1]. Lubrication of the alimentary bolus, protection against viruses, bacteria and fungi, buffer capacity, protection and repair of the oral mucosa and dental remineralisation are some of the functions of saliva[2–4]. Therefore, it is believed that quantitative or qualitative alterations in salivary secretion may lead to oral (caries, oral mucositis, candidiasis, oral infections, and chewing disorders) or extra-oral (dysphasia, halitosis, weight loss) adverse effects[5–7].

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The buffer capacity of saliva basically depends on its bicarbonate concentration[8], which in turn correlates with salivary flow rate[9]. The lower the salivary flow rate is, the less its buffer capacity and, therefore, the higher the risk of caries development[10]. Salivary flow rate and, therefore, the buffer capacity of saliva may also be influenced by nutrition, gender, smoking status, and diseases. Women show a lower salivary flow rate[11–13] and decreased buffer capacity[10]. Although the influence of smoking or alcohol consumption on salivary secretion was reported controversially, acidic food and beverages can influence buffer capacity of saliva[14–17].

Dental erosion is a result of mineral loss from tooth surface due to a chemical process of acidic dissolution, but not including acids of bacterial plaque origin[18]. Sources of acids can be endogenous or exogenous, and erosive intensity is modified by quality as well as quantity of saliva[19–21]. Acidic foods and beverages are the most common extrinsic factors that cause dental erosion[22]. Dietary awareness is an important issue in mod-

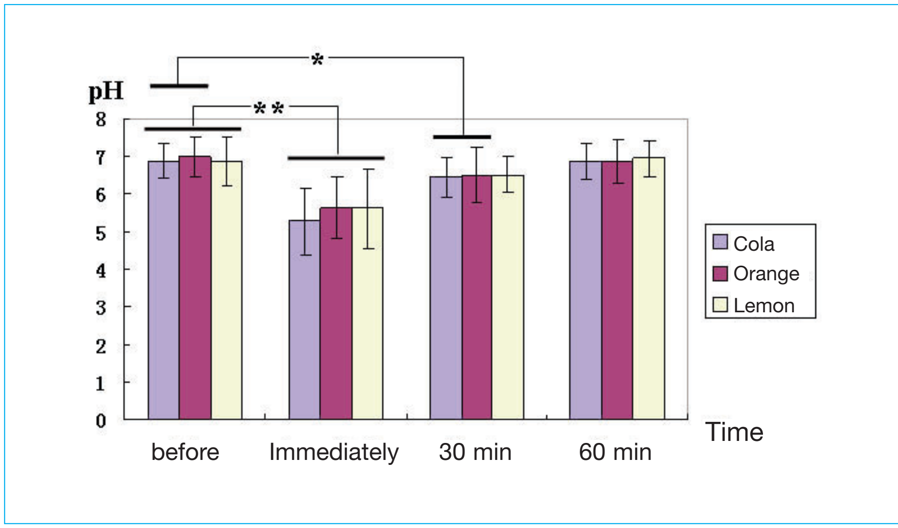

Fig 1 The pH changes of the saliva collected at different times with three types of soft drink consumption; *: $P < 0.05$, **: $P < 0.01$.

ern society. Currently, consumption of carbonated drinks is popular among the young population and this habit carries over into adulthood[19].

The objective of this study was to evaluate the effect of consumption of soft drinks on salivary pH in healthy volunteers in Iran.

Materials and Methods

Thirty healthy volunteers (female/male: 14/16) who had signed an informed consent were included in this study from August to September 2005. The volunteers were between 18 and 26 years old and free from acute or chronic diseases of general systems or oral cavities. Furthermore, they did not have any kind of oral addictions in their past history, such as smoking, alcohol or snuff consumption, and female volunteers were not pregnant.

The volunteers were examined by the same stomatological doctor to rule out acute or chronic diseases of the oral mucosa or salivary glands.

Three types of commercially available soft drink, cola with a pH of 3.24, orange with a pH of 3.20, and lemon with a pH of 2.35, which are products of Zam-Zam Company, Tehran, Iran, were selected in this study to evaluate their influences on human salivary pH.

Before consumption, saliva was collected in the morning (9–11 am) under room temperature and the volunteers refrained from eating and drinking for a minimum of 30 min before saliva collection. During this period, participants were seated in a relaxed position and trained to avoid swallowing saliva. The saliva was collected for 10 min (at least 5 ml) into a graduated test tube through a glass funnel. The participants were then asked to drink 200 ml of one of the soft drinks per day for 3 days; the drinks were maintained at room temperature (24–26°C) and opened immediately prior to use. Saliva was collected immediately after consumption and at 30 and 60 min after consumption of the drinks. All the saliva samples were maintained at 4°C until measured with a Radiometer ABL 250. The pH value of each saliva sample was calculated from the mean of three measurements.

Statistical analysis

Variables with a normal distribution were compared using Student's *t*-test or an analysis of variance (ANOVA) test. Nonparametric tests (Mann–Whitney U test) were used to compare variables without a normal distribution. The statistical analysis was performed with the SPSS 11.5 package for Windows. Statistical significance was accepted if $P < 0.05$.

Results

As shown in Fig 1, the pH of the saliva collected immediately and 30 min after the consumption of all three types of drink was significantly lower than that of saliva collected before consumption (except for the lemon group between before and 30 min after consumption). There is no pH difference between the saliva collected before and 60 min after consumption of the three drinks ($P > 0.05$).

Discussion

The results of this study demonstrate that drinking acidic soft drinks such as cola, orange and lemon could significantly decrease salivary pH for at least 30 min after drinking. Among the three types of soft drink, although the pH of the cola soft drink itself was not the lowest, it showed the largest effect on salivary pH immediately after drinking. Among the three types of soft drink, the pH of lemon soft drink itself was the lowest; however, its effect on salivary pH after drinking was less and short compared with the other two drinks.

Wongkhantee et al[23] evaluated the effect of acidic food and drinks on surface hardness of enamel, dentine, and tooth filling materials. They reported that, during a short period of contact, drinking a can of cola soft drink reduced significantly the surface hardness of enamel, dentine, microfilled composite, and resin-modified glass ionomer. Enamel surface was also softened by orange juice and sports drink. Van Eygen et al[24] showed that a short period of soft drink intake can cause reductions in enamel microhardness and that the frequency of soft drink intake is not decisive in enamel microhardness reductions. Hunter et al[25] also studied the frequency of intake, two versus four times a day, and reported that reduced exposure (frequency per day) to a low pH drink was not proportional with the reduction in tissue loss. However, it had been established in other studies that the decrease in microhardness is proportional to the duration of immersion.

The majority of the studies dealing with pH and food intake are carried out in relation to bacterial plaque and caries development[26–28]. Maximum salivary pH decrease after intake of different beverages is an important consideration in dental erosion, as apatite dissolution increases in the lower pH range[29]. All the beverages evaluated in this study caused a decrease in salivary pH immediately after drinking, but with different degrees. This variation in effect could be attributed to the different compositions of the beverages, the different intrinsic pH values and the different buffering capacities, as previously proposed[29,30]. Sanchez et al[31] evaluated the changes of salivary pH during consumption of soft drinks in children. They reported that the erosive effect of a soft drink depends not only on its intrinsic pH value, but also on its buffering capacity. They showed that the degree of salivary pH drop is ADESN > Sprite > Coca Cola > chocolate milk, and their buffering capacities are in the same rank order[29,30].

We studied the effects of soft drinks on salivary pH variations not only immediately after, but also at 30 and 60 min after soft drink consumption. Our results indicated that the maximum salivary pH drop after consumption of soft drinks was cola > orange > lemon immediately and 30 min after consumption. Cola soft drink is principally phosphoric acid based, while orange and lemon soft drink is citric acid based. Therefore, phosphoric acid was neutralised more slowly than citric acid, suggesting that the buffer capacity of phosphoric acid could be larger.

Conclusion

The results of this study showed that consumption of soft drinks such as cola, orange and lemon could significantly decrease salivary pH until at least 30 min after drinking. Therefore, frequent consumption of soft drinks could present a high risk for dental erosion.

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