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Saliva buffering power in contact with some vitamin syrups available in Iranian pharmaceutical market

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Original Article

Abstract

Introduction: Since pharmaceutical syrups are widely taken by children in Iran, drop of pH in oral cavity and dental decay resulted from the syrups are of high importance. This research aims to study buffering properties of saliva when in contact with some of vitamin syrups available in pharmaceutical market of Iran.

Methods: In the present study, 1 milliliter (ml) of 6 samples of vitamin syrups including Vitamin C, Vitamin B-Complex, Vitamin AD, Vitamin syrup Sandros (E, D_3, C, B_{12}, B_6, A, Folic Acid, Biotin), Eurho syrup (B-Complex, Vitamin C) and Vitane Droplets (Multivitamin) and also a sample of distilled water as control were examined. Initially, pH was measured in each sample, and then 1 ml of stimulated saliva collected from children (6-12 years old) and 2 ml of deionized water was added to them and mixed. Finally, pH was measured in 5 and 20 minutes after mixing by the use of TECHNO Digital pH Meter.

Results: Five minutes after adding saliva to the syrup samples, pH of all the samples increased. The minimum increment was observed in Vitamin C and the maximum was observed in both Eurho and Vitane. The increment was significant just in Eurho and Vitane ($P<0.05$). PH of all the samples after 20 minutes was higher than the initial pH. However, it was somehow less than the pH after 5 minutes. The difference was statistically insignificant ($P>0.05$).

Conclusion: Increase of pH in Eurho and Vitane after 5 minutes contacting with saliva was significant compared with the initial pH. It shows the positive buffering effect of saliva on the pH of these two syrups and; consequently, reducing the probability of decay after consuming them.

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Introduction:

Dental caries is one of the most common childhood diseases (1). Having multi-factorial etiology, dental caries is the outcome of organic acids produced from the fermentation process and its subsequent effect on the structure of the tooth enamel (2). Among the ingredients comprising a diet, sugars; especially sucrose, act as a substrate for mouth bacterial flora. This leads to acid production and reduction of pH in the mouth (1).

The surfaces of teeth are always exposed to substances in the diet and drug products including pharmaceutical syrups (3).

Epidemiological studies have emphasized that long-term use of pharmaceutical syrups are associated with dental caries (4-6). Researchers have also demonstrated the potentiality of erosion development and dental caries even in children taking small doses of pharmaceutical drugs (7).

Sucrose, as a carbohydrate source, is generally added to the medications taken by children to cover the unpleasant taste of some active ingredients so that the children can better accept the medication (2). Sucrose acts as a preservative, antioxidant, solvent and a bulking agent. It is extensively used, because it is inexpensive and non-hygroscopic and its processing is simple (8). Unfortunately, this substance – among other sweeteners – is one of the most important factors causing tooth decay (9).

Medication used for children likely have higher erosion potential for dental tissues due to the presence of acids in the formulation of the drugs, inherent low pH of the drugs, high acidity titration and absence or lack of ions such as Calcium, Fluoride and Phosphate in the drugs (10). Acids commonly used as preservatives in vitamin syrups for children contain Sorbic acid, Benzoic acid and Ascorbic acid. They all contribute to low pH of pharmaceutical syrups (11).

Repeated and long-term ingestion of acidic liquids is considered as the etiologic factor of dental erosion (12,13). Thus, since pharmaceutical syrups for children inherently have low pH, they are able to cause further progression of dental erosion, particularly if they are in a long time contact with the surfaces of the teeth (1,14,15). Consumption of medication containing sugar, especially if taken at night, like other products containing sugar, is likely to cause decay. Drugs reducing saliva secretion such as antihistamines and sedatives also increase the likelihood of dental decay (1,14). The inverse relationship between buffering capacity of saliva and caries experience is well shown in many studies (16,17). Studies have shown positive relationship between consumption of medication and dental caries (1,2,14,18). Arora et al. showed pediatric analgesics widely prescribed for children, can prone the patients to dental erosion and caries (19). Bamise et al. evaluated some cough syrups and found sixty percent of the sampled syrups were acidic with pH values below 5.5 (20). When the medicine's pH is below 5.5, they may activate dental erosion (21). However literature about the effect of multivitamin syrups on dental caries is absent.

In the present in vitro study, the buffering property of saliva on some of vitamin syrups in Iran pharmaceutical markets was studied in 6-12 year-old children in Shiraz (Iran).

Methods:

In this cross-sectional study, 50 stimulated saliva samples were collected from male and female children ranging from 6 to 12 years old in Shiraz (Iran). Samples were collected after obtaining parental consent. One milliliter of whole saliva was prepared from each subject after chewing paraffin (22). Saliva pH was measured by a Digital pH Meter (TECHNO, JAPAN). It was done at 24.6°C and half an hour after brushing without taking any food from one hour before the test. To measure the pH, the electrode of the device was placed in the saliva samples. The device was able to show up to two decimal digits. The results were recorded. PH was measured two times for each sample, and the mean pH was considered for final analysis. In this study, the commonly consumed vitamin syrups were used in Iranian pharmaceutical market, including:

1. Drop Vitamin A + D (Osve, Iran)
2. Syrup B-Complex (Exir, Iran)
3. Multivitamin solution contains vitamins E, D_3, C, B_{12}, B_6, B_1, A, Folic acid, Biotin (Sandros, Iran)
4. Vitamin syrup contains B complex, vit C (Eurho, Germany)
5. Multivitamin drop (vitane, Germany)
6. Solution vitamin C (1 tablet in 250 cc water) (Osve, Iran)

At the beginning, 1cc of the above-mentioned drugs and 2cc of deionized water were randomly added to separate sterile 50 ml centrifuge test tubes and the pH was measured separately. Then 1cc of the stimulated saliva from each subject was added to each test tube. The pH of the combination (Saliva and the vitamin syrup) was measured after 5 minutes and 20 minutes intervals. In a control

group, 1cc of distilled water was used to be mixed. PH was measured as stated above. Collected data were imported to SPSS statistical software (Version 17). The data were analyzed by ANOVA. P values below 5% were considered statistically significant.

Results:

As Table 1 shows pH of AD vitamin syrup is higher than other syrups. Changes of the pH in the syrup after 5 and 20 minutes were neither high nor significant.

Changes of the pH in Vitamin C syrup 5 minutes and 20 minutes after mixing with saliva were lower than other syrups. Syrups Vitane and Eurho with initial higher acidity compared with other syrups showed higher pH variations after 5 and 20 minutes, this change was statistically significant ($P<0.05$). While the increased pH was not significant in the other drug groups ($P>0.05$).

Slight pH reduction was observed in most syrups in 5-20 minutes interval. The reduction was not statistically significant ($P>0.05$).

In all combinations, the pH after 20 minutes was slightly higher than the pH of the syrup itself.

Table 1 also shows the pH of the control group (combination of saliva and pure distilled water) at the beginning and at 5 and 20 minutes after adding saliva.

Table 1. PH of the drugs at the beginning and 5 and 20 minutes after mixing with saliva

Drug Name	pH drug	pH: 5 minutes after adding saliva	pH: 20 minutes after adding saliva
B-Complex	4.80	5.03	4.85
Sandros	4.40	4.65	4.61
Vit C	4.35	4.39	4.42
Eurho	3.22	3.68	3.55
AD	5.64	5.92	5.96
Vitane	3.54	4.01	3.94
Stilled water	6.75	6.85	6.84

Conclusion:

The pH of all the examined syrups was acidic. This is a remarkable issue for onset of dental decay process.

A laboratory study showed that the consumption of different types of drugs sweetened by sucrose such as iron and antitussive syrups led to reduction of pH in the dental plaque. The reduction was significantly more at the time of the consumption of medication containing 15% sucrose compared with medication containing 10% sucrose (3).

Among the tested syrups, the acidic pH of vitamin AD was less than other syrups. It has a lower risk for demineralization of the teeth. While Eurho and Vitane showed more acidic properties.

The study showed that the buffering properties of saliva after mixing with each of the Vitamin syrups was effective for maintaining the reduction of the pH of only Vitane and Eurho. Slight reduction of pH was observed in the combinations after 5 and 20 minutes from the addition of saliva. The phenomenon may be due to fermentation by microorganisms in the saliva. Since plaque microorganisms were not added to the mixture, the level of reduction was low.

According to Figure 1, pH changes of vitamin C syrup when in contact with saliva after 5 and 20 minutes was lower than other syrups and remained almost constant. It may be due to the chemical composition of the syrup ingredients. The preservative ingredients of the syrup are a combination of calcium carbonate and magnesium or potassium hydroxide, which provide a basic environment. It is likely that buffering agents (which increase the pH of saliva) cannot act effectively in presence of strong basic substances and they cannot cause changes in direction of further pH increase.

Eurho and Vitane which had higher acidity at the beginning in comparison with other syrups showed higher pH change 5 and 20 minutes after adding saliva. It shows that saliva had further effect on reducing the acidity and subsequently on neutralization of the drugs. This effect can depend on the composition of the syrups. In total, the drugs

with higher acidity properties are more affected by the buffering properties of saliva.

Slight effect of saliva on vitamin C may be associated with the chemical composition of vitamin C (Ascorbic acid) which is a weak organic acid. Because the arrangement of the acid atomic formulation, buffering compounds of saliva cannot change the pH of solution even slightly. Therefore, in addition to the acidic or basic status of the solutions affecting the pH changes of syrup when mixed with saliva, the type of ingredients of the solutions are also involved. Accordingly, Vitamin AD solution with higher alkaline properties compared with other syrups shows higher pH changes in comparison with vitamin C syrup.

Moreover, the type and quantity of sugar used in the syrups affect the fermentation phenomenon and acid production. It is worth understanding that in this study the number of microorganisms is less than normal mouth environment because of the limited number of them in pure stimulated saliva.

If the volume of saliva is increased, the quantity of the buffering agents in the saliva is also increased. This is able to further increase the pH of the medication to get closer to its initial pH.

It should be noted that the amount of drug remaining in the mouth will be proportionately less than the amount of saliva secreted at the initial minutes after syrup consumption. Thus, for the future researches, it is suggested to work on the buffering characteristics of saliva with larger amount of saliva compared to syrup drugs.

Another limitation of the current study is lack of evaluation of the syrup's sugar content and viscosity, which are other risk factors for caries development (23).

Increase of pH for Vitane and Eurho syrups was remarkable after 5 minutes from mixing vitamin syrups with saliva. This shows the buffering effects of saliva on these two syrups. While buffering properties of saliva was not able to increase the pH of other syrups significantly. This results in maintaining an acidic environment and exposing the teeth to demineralization and decay.

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