ORIGINAL RESEARCH

Evaluation of Tooth Dissolution in Medicated Liquid Syrups

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***ABSTRACT*:**
Background: Tooth wear can be classified as attrition, erosion and abrasion. Attrition is defined as the loss of enamel, dentin, or restoration by tooth-to-tooth contact. Erosion begins on the enamel surfaces and then proceeds to the underlying dentine if no timely intervention is instituted. In brief, the initial stage is softening of enamel surface and the degree varies with the immersion time and the type of acids involved. Subsequently, if the erosive attack continues, dissolution of enamel crystals takes place, which is a permanent loss with a rough layer on top of the remaining tissue. **Aim of the study:** To evaluate tooth dissolution in medicated liquid syrups. **Materials and methods:** The present study was conducted in the dental institution. Ten medicated syrups were selected. The study was in two parts: the pHs and titratable acidity of the syrups were evaluated and secondly, the weight loss of the test teeth was determined. 10 caries free human teeth were collected and sterilized in a 5% sodium hypochlorite (NaOCl) solution. Each specimen (test tooth) was weighed to 0.01 mg on a decicentimilligram balance. The teeth were assigned at random to the 10 syrups meant for evaluation. The control for the study was distilled water. **Results:** We observed that lowest pH was observed to be of CZ-3 Cold (4.6) followed by Ambrodil (4.65). Bro-Zedex and Bliskof had pH of 7.2 and 7.6 respectively. The highest pH was seen to be in Alpha Zedex (8.25). The loss of weight was seen to be significant in syrups with high acidic pH and observed to be mild in neutral and basic pH medicinal syrups. **Conclusion**: Within the limitations of the present study, it can be concluded that the pH of the liquid medicaments ranged between 4.6 and 8.25. The dissolution of tooth material was seen in all the samples but dissolution was more evident in medicines with acidic pH.
Keywords: medicinal syrups, medicated liquids, tooth dissolution

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INTRODUCTION:

Tooth wear can be classified as attrition, erosion and abrasion. Attrition is defined as the loss of enamel, dentin, or restoration by tooth-to-tooth contact. [1] Erosion is the loss of dental hard tissues by chemical action not involving bacteria. [2] It is further classified, according to the source of the acid, as either intrinsic or extrinsic. Intrinsic sources of acids originate in the stomach and are associated with eating disorders, such as anorexia and bulimia nervosa, [3] or with acid reflux and regurgitation. [4] Extrinsic sources are acids contained in dietary components, such as carbonated soft drinks and fruit, and fruit juices. Abrasion is the loss of tooth substance from factors other than tooth contact. [1] Erosion begins on the enamel surfaces and then proceeds to the underlying dentine if no timely intervention is instituted. In brief, the initial stage is softening of enamel surface and the degree varies with the immersion time and the type of acids involved. Subsequently, if the erosive attack continues, dissolution of enamel crystals takes place, which is a permanent loss with a rough layer on top of the remaining tissue. [5] Indeed, in a chemical sense, there is a "critical pH of enamel", which is defined as the pH at which a solution is just saturated with respect to mineral of enamel, and the enamel on tooth surface will be in equilibrium with no dissolution or mineral precipitation occurring. [6] That means below the critical pH, the solution is going to be under-saturated and the potential for enamel dissolution exists. Hence, the present study was conducted to evaluate tooth dissolution in medicated liquid syrups.

MATERIALS AND METHODS:

The present study was conducted in the dental institution. The ethical clearance for the study was approved from the ethical committee of the hospital. Ten medicated syrups were selected. The study was in two parts: the pHs and titratable acidity of the syrups were evaluated and secondly, the weight loss of the test teeth was determined. 10 caries free human teeth were collected and sterilized in a 5% sodium hypochlorite (NaOCl) solution. Each specimen (test tooth) was weighed to 0.01 mg on a decicentimilligram balance. The teeth were assigned at random to the 10 syrups meant for evaluation. The control for the study was distilled water. The study was performed at room temperature. The pH of syrups was measured using a digital pH meter (ELICO Model CL-361). The pH meter consists of two parts: glass electrode and an electronic meter. The electrode of the pH meter was calibrated using test solution of known pH before recording the pH of medicated syrups. 20 ml of every syrup specimen was placed in a glass beaker in a thermostatically controlled water bath at 370 C and the glass electrode was inserted into the syrup and the pH was displayed on the meter. After recording the pH of each sample, the electrode was rinsed in distilled water to prevent cross contamination. The test syrups (Table 1) and teeth were placed in 10ml screw cap plastic

containers and the specimens were weighed after 5 days. Prior to weighing, the teeth were blotted dry and air syringed. The test syrups were blinded before carrying out the experiment. That is, all identifications of each medicine were removed and labeled with roman numbers prior to their delivery to the laboratory. Data was recorded in study-specific charts and authenticated.

The statistical analysis of the data was done using SPSS version 11.0 for windows. Chi-square and Student's t-test were used for checking the significance of the data. A p-value of 0.05 and lesser was defined to be statistical significant.

RESULTS:

Table 1 shows the pH of the medicinal syrups and the loss in weight by immersion of samples in these syrups. We observed that lowest pH was observed to be of CZ-3 Cold (4.6) followed by Ambrodil (4.65). Bro-Zedex and Bliskof had pH of 7.2 and 7.6 respectively. The highest pH was seen to be in Alpha Zedex (8.25). The loss of weight was seen to be significant in syrups with high acidic pH and observed to be mild in neutral and basic pH medicinal syrups.

Table 1:

Syrup name	pH of syrup	Initial weight	Final weight	Loss in weight
Ambrodil	4.65	0.368	0.324	0.044
Bydex	6.89	0.263	0.226	0.037
Alpha Zedex	8.25	0.524	0.512	0.012
Cufdip	7.35	0.182	0.173	0.009
Bro-Zedex	7.2	0.335	0.303	0.032
CZ-3 Cold	4.6	0.189	0.139	0.05
Broncorex	6.23	0.523	0.483	0.04
Amrol-C	5.2	0.385	0.341	0.044
Bliskof	7.6	0.293	0.262	0.031

DISCUSSION:

In the present study, we observed that the pH of the medicinal syrups varies from acidic to basic and the dissolution and loss of weight of the teeth is more prominent in acidic medicinal syrups. The results were compared with previous studies. Lussi A et al analysed the erosive potential of 30 substances (drinks, candies, and medicaments) on deciduous enamel, and analyse the associated chemical factors with enamel dissolution. They analysed the initial pH, titratable acidity (TA) to pH 5.5, calcium (Ca), inorganic phosphate (Pi), and fluoride (F) concentration, and degree of saturation ((pK -pI)HAP, (pK -pI)FAP, and (pK−pI)CaF2) of all substances. Then, they randomly distributed 300 specimens of human deciduous enamel into 30 groups (n = 10 for each of the substances tested. They also prepared 20 specimens of permanent enamel for the sake of comparison between the two types of teeth, and they tested them in mineral water and Coca-Cola®. In all specimens, they measured surface hardness and surface reflection intensity (SRI) at baseline, after a total of 2 min (SH2min) and after 4 min (SH4min and SRI4min) erosive challenges. There was no significant difference in SHbaseline between deciduous and permanent enamel. Comparing both teeth, they observed that after the first erosive challenge with Coca-Cola®, a significantly greater hardness loss was seen in deciduous than in permanent enamel, but no differences between the two types of teeth were observed after two challenges (SH4min). After both erosive challenges, all substances except for mineral water caused a significant loss in relative surface reflectivity intensity, and most substances caused a significant loss in surface hardness. Multiple regression analyses showed that pH, TA and Ca concentration play a significant role in initial erosion of deciduous enamel. They conclude that drinks, foodstuffs and medications commonly consumed by children can cause erosion of deciduous teeth and erosion is mainly associated with pH, titratable acidity and calcium concentration in the solution. Carvalho TS et al investigated the effect of different dietary substances on deciduous and permanent enamel. Enamel specimens were prepared from human teeth. They measured the chemical parameters of nine dietary substances. The teeth were immersed in the respective substance, and they measured the baseline surface hardness (SH) in Vickers hardness numbers (VHN), and the changes in SH after 2 min (ΔSH2-0) and the 4 min (ΔSH4-0) immersion. They analysed the differences between deciduous and permanent teeth using the Wilcoxon test and correlated ΔSH to the different chemical parameters. Deciduous teeth were significantly softer than permanent teeth at baseline, but they were not more vulnerable to erosive demineralization.

Practically all chemical parameters significantly correlated with ΔSH. Substances with lower pH, higher titratable acidity, lower Ca, higher Pi and lower F concentrations, higher viscosity and more undersaturated solutions presented more erosive demineralisation. They concluded that different parameters in dietary substances affect erosive demineralisation in deciduous and permanent teeth, but they generally observed no differences in susceptibility to erosion between both types of teeth. [7, 8]

Lussi A et al assessed the erosive potential of different dietary substances and medications and determined the chemical properties with an impact on the erosive potential. They selected sixty agents: soft drinks, an energy drink, sports drinks, alcoholic drinks, juice, fruit, mineral water, yogurt, tea, coffee, salad dressing and medications. The erosive potential of the tested agents was quantified as the changes in surface hardness (ΔSH) of enamel specimens within the first 2 min and the second 2 min exposure. Erosive challenge caused a statistically significant reduction in SH for all agents except for coffee, some medications and alcoholic drinks, and non-flavoured mineral waters, teas and yogurts. By multiple linear regression analysis, 52 % of the variation in ΔSH after 2 min and 61 % after 4 min immersion were explained by pH, β and concentrations of F and Ca. pH was the variable with the highest impact in multiple regression and bivariate correlation analyses. Furthermore, a high bivariate correlation was also

obtained between (pK - pI)HAP, (pK - pI)FAP and ΔSH. Kulkarni P et al evaluated the erosive potential of pediatric liquid medicinal syrups on the deciduous teeth. A total of sixty extracted/exfoliated noncarious deciduous molars were used. Four medical syrups were used (viz., 1 – artificial saliva [control], 2 – Ferium XT, 3 – Crocin syrup, 4 – Ambrolite-D) and the teeth were equally divided into the four groups (n = 15) for the immersion cycle, following which the teeth were examined for surface microhardness at 7, 14, 21, and 28 days. The time and immersion media interaction demonstrated that antitussives produced a significant and gradual loss of surface microhardness on all days (viz., 7, 14, 21, and 28 days), but a statistically significant difference was seen only between 7th and 28th day. They concluded that the knowledge of the erosive potential of commonly used syrups is mandatory as erosion in children teeth may be associated with dental hypersensitivity, loss of the occlusal vertical dimension, eating difficulties, poor esthetics, pulp exposure, and abscesses. Mouth rinsing with water after taking the medication; addition of calcium, fluoride, or phosphate to formulations; and consumption of the medication at meal times have been recommended to avoid tooth damage that is caused by the regular use of medication. [9, 10]

CONCLUSION:

Within the limitations of the present study, it can be concluded that the pH of the liquid medicaments ranged between 4.6 and 8.25. The dissolution of tooth material was seen in all the samples but dissolution was more evident in medicines with acidic pH.

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