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ORIGINAL ARTICLE

DENTAL IMPLICATIONS AND LABORATORY EVALUATION OF TOOTH DISSOLUTION IN MEDICATED LIQUID SYRUPS

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ABSTRACT:
Aim: To evaluate the associated weight loss of test teeth after immersion in the liquid medicated syrups for a fixed period of time so as to predict the erosive potential of them. **Material and Methods:** Twenty medicated syrups and caries free human teeth were selected .The study was in two parts: the pH and titratable acidity of the syrups were evaluated and secondly, the weight loss of the test teeth was determined. The pH of medicines was measured using a digital pH meter at the start of the study. 20 extracted test teeth were weighed to 0.01mg and randomly assigned to syrups under evaluation. The test medicines were placed in 10ml screw cap plastic containers and the test teeth were weighed after 5 days. **Results:** 85 % of the medicines caused reduction in weights of the test teeth after five days of immersion. Weight loss of the test teeth was also noticed with basic syrups. Also lowest pH syrup did not produce the greatest weight loss. **Conclusion**: Majority of the liquid medicated syrups caused loss of weight of the test teeth. Thus, they possess the potential to cause dental erosion.
Key words: Liquid Medicated Syrups, pH, enamel dissolution, dental erosion.

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INTRODUCTION

Dental erosion is defined as a progressive loss of dental hard tissues by chemical dissolution without bacterial involvement.[1] In modern society, the changing habits have contributed to an increased incidence of dental erosion, especially in children and adolescents.[2,3] Erosive tooth wear is a multifactorial irreversible process that may be caused by intrinsic, extrinsic or idiopathic factors.[3]

Erosion can lead to reduction in size of teeth and depending upon the severity and length of exposure, may lead to the total destruction of the dentition.[4] The most important sources of acids are those found in the diet, such as acidic foods and drinks. The increased consumption of acidic foods and soft drinks is becoming an important factor for the development of erosive wear. Therefore, most clinical research has focused on the dental impact of acidic drinks and foods.[5]

Chemical factors, such as pH, titratable acidity, phosphate and calcium concentration, and fluoride content are the prevalently used parameters of beverages in terms of their ability to affect dental erosion.[6] Other in vitro methods of measuring enamel erosion include surface microhardness,[7,8] loss of enamel weight,[9] SEM or light microscope,[10] microradiograph or image analysis,[11] electron probe analysis,[12] Profilometry,[13] light induced fluorescence[14] and computed controlled mapping.[15]

Majority of the carbonated drinks, non carbonated drinks, sports drinks and medicated syrups have a low pH rendering them acidic in nature and is considered one of the most important risk factor. Consumption of these drinks has increased dramatically over the past 50 years. However, it is more worrying when this condition is found in an alarming proportion among children. The solubility of enamel is pH dependent process and saliva contains calcium and phosphate ions which exist in a supersaturated state at neutral pH with respect to enamel hydroxyapatite. As the pH of saliva decreases, it crosses the saturation line at a point known as the critical pH. Since the critical pH of enamel is approximately 5.5, any solution with a lower pH may cause erosion, particularly if the attack is lengthy and intermittent over time.

Therefore, in view of the increased use of oral medicines by children for prolonged periods in recent years, especially those with chronic diseases, the aim of this study was to evaluate the loss of weight of deciduous teeth specimen after immersion in different medicated syrups and also determine their potential to cause tooth erosion.

MATERIAL AND METHODS

Twenty medicated syrups were selected and purchased from accredited sales representatives of the companies involved. 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. 20 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 20 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 37^0 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.

Table 1: % weight loss of the test teeth in different liquid medicaments.

	Syrup names	pHs of the syrups	Initial weight	Final weight	Loss in weight	% loss in weight
1	Alerpet	4.88	.165	.100	.065	39.4
2	Alpha Zedex	8.4	.303	.287	.016	3.3
3	Ambrodil	5.36	.339	.321	.018	5.3
4	Ambrol-AM	5.12	.338	.320	.018	5.3
5	Amrol-C	5.84	.280	.157	.123	43.9
6	Amidryl-DX	6.02	.298	.264	.034	11.4
7	Benadryl	4.58	.368	.362	.006	1.6
8	Bro-Zedex	7.10	.520	.509	.011	2.1
9	Bydex	5.70	.263	.263	.000	0.0
10	Bestoril-C	3.26	.502	.478	.024	4.8
11	Bliskof	3.06	.177	.155	.022	12.4
12	Brohex	6.02	.510	.487	.023	4.5
13	Broncorex	3.78	.523	.485	.038	7.3
14	Cufdip	4.40	.174	.166	.008	4.6
15	Codistar	5.14	.502	.471	.031	6.2
16	Codylex Linctus	5.58	.315	.298	.017	5.3
17	Cofnil plus	5.02	.252	.252	.000	0.0
18	Coform-AX	5.68	.151	.140	.011	7.3
19	Coldact	5.18	.194	.194	.000	0.0
20	**CZ-3 Cold**	**5.68**	**.463**	**.451**	**.012**	**2.6**

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. Since the teeth specimens were not identical in size, percentage of weight loss was the response variable computed and considered for the study.

RESULTS

Table I shows that 17 (85 %) syrups caused loss of reduction in weights of the test teeth after 5 days evaluation period. Sample 9 (Bydex), 17 (Cofnil plus), 19 (Coldact) and distilled water caused no loss of weight of the test teeth immersed in them. Sample 5 (Amrol -C) caused the greatest weight loss followed by sample 1 (Alerpet) and 11 (Bliskof) respectively. It should be noted that sample 5 and 1 caused about three times the loss weight observed with other samples. Despite having basic pH samples 2 (Alpha Zedex) and 8 (Bro-Zedex) caused loss of weight of the test teeth. Also the syrup with the lowest pH value did not produce the greatest weight loss.

DISCUSSION

This experiment exposed caries free whole tooth to a range of popular liquid medications continuously over a period of 5days. Measuring the loss of weight after a period of immersion is designed to be a simple, rapid and inexpensive method of evaluating the dental erosive potential of these medicines.

Apparently, this method does not yield absolutely accurate amount of hard dental tissue loss, i.e., enamel, dentine, cementum loss compared to experiments where enamel, dentine or cementum discs and blocks were used. However, measuring the percentage weight loss is sufficient for quantitative evaluation of hard dental tissue loss after a period of exposure to demineralization (acidic) agents. Thus the erosive potentials of the syrups as disclosed by their demineralizing actions can be estimated by percentage of weight loss computed.

Acids are added to drug formulations as buffering agents to maintain chemical stability, control tonicity or to ensure physiological compatibility and to enhance flavor, and thereby increasing the palatability to children.[16] Citric acid is the primary acid used in the oral medicines, and despite being a weak acid, citric acid is a potent erosive agent because of its ability to chelate calcium in hydroxyapatite, which reduces saliva super-saturation and increases the dissolution rate of hydroxyapatite crystals.[17]

Furthermore, due to the high content of organic material in dentine, cementum, the diffusion of demineralising agent into deeper regions is said to be hindered by the abundant matrix and so is the outward flux of dissolved tooth mineral.[18] This explains the use of entire tooth exposure to the liquid medications in this experiment.

As regards the five days test period, realistic testing of enamel dissolution in liquid medicines is demanding because of the inherent challenges of running the study for a complete course of liquid medication. Despite obvious limitations that can be advanced for such in vitro study, certain significant results are observable. Firstly, seventeen out of twenty cough medication under investigation caused loss of weight of the teeth immersed in them. We want to therefore opine that these liquid medicines dissolve hard dental tissues, thus possess the potential to cause dental erosion. This is of considerable importance because of the extensive commercial distribution and the use of liquid medicines. Findings show there was no strict relationship between the pH and the percentage loss of weight. These observations would appear to suggest that there are other factors besides pH responsible for the loss of weight of the test teeth in vitro. This is strongly supported by the fact that basic syrup samples (Alpha Zedex and Bro-Zedex) caused weight loss in the test teeth. Studies of the acidic properties of acidic foods and beverages have a long history and have been increasingly utilized in recent times. Furthermore, it is evident from the literature that other factors such as type of acid, chelating properties, calcium and phosphate concentrations, temperature, exposure time and frequency of exposure contribute to enamel erosion and demineralization. The protective factors such as saliva also play a role in the dynamism of dental erosive process. Saliva is known to modify dental erosion by causing the formation of an enamel pellicle, which protects the surface from dissolution.[19]

This way, oral hygiene or mouth rinsing with water after taking the medication, addition of calcium, fluoride or phosphate to formulations, consumption of the medication at meal times (i.e., not between meals) and use of topical fluoride agents are recommended to avoid tooth damage that is caused by the regular use of medication.[20]

CONCLUSION:

Most of the liquid medicines investigated caused dissolution and bulk loss of sound dental hard tissues after five days immersion of test human teeth. Thus they possess sufficient potential to cause dental erosion. Inappropriate use and bizarre habits can greatly enhance their dental erosive potential. It is therefore appropriate to advice against inappropriate use of various liquid medicines especially in patients with compromised dentition.

Patients should be advised to rinse the mouth with water immediately after the ingestion of these liquid medicines. Strategies should be implemented in order to broaden the knowledge of health professionals, drug manufacturers and general consuming public about the risks from the consumption of medicines potentially harmful to dental tissues.

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