Research Article

Cariogenic Potential of Most Commonly Prescribed Liquid Oral Medicines for Children

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Abstract:

Consumption of liquid oral medicine by frequently ill children, significantly increases the risk of tooth demineralization. In this study a survey was conducted wherein the pediatricians, pharmacist and medical representatives of Bhopal city were enquired about the most commonly prescribed liquid oral medicines for children. The four categories of medicines reported were: antipyretics/analgesics, antibiotics, antihistaminics/antitussives and multivitamins. Three samples from each category were taken. Sugar concentration was evaluated by Lane-Eynon general volumetric method and pH was measured by using digital pH meter (EU-TECH). High concentration of sugar was found in 50% of samples and 90% samples showed low pH. Sugar concentration was in a range of 20.6 to 68.2% and pH in a range of 3.8 to 8.5. As sugar in medication is a potential threat to teeth, therefore, alternatives including sugar substitute should be considered.

Key Words: Cariogenic potential, Liquid medicines, Sucrose, Critical pH

Introduction:

Dental caries is a dynamic disease involving the calcified tissues of the teeth and requires the presence of bacterial plaque, a dietary fermentable carbohydrate like sugar which results in acid production and subsequent demineralization of the tooth surface. The bacteria metabolizes sugar which increases local concentration of organic acid in the inner layer of plaque on the tooth surface, which lowers the pH resulting in a process of demineralization in which calcium and phosphate diffuse out of tooth enamel (Foster & Fitzgerald, 2005).

Medications increases the risk of caries (Feigal et al, 1981). The use of liquid pharmaceutical preparations frequently used for children with conditions such as congenital heart disease, asthma, juvenile idiopathic arthritis (JIA) and other immuno-compromised conditions, and they are called as "high caries risk" children (Foster & Fitzgerald, 2005). To improve palatability and perhaps patient's compliance, many liquid medicines are sweetened with sucrose (Robert, 1979). Sucrose acts as a preservative, an antioxidant, a solvent, a demulcent and a bulking agent. It is widely used because it is cheap, non-hygroscopic and easy to process (Bigeard, 2000). However, it is one of the most cariogenic sweetener (Rubin & Simunovic, 1989).

In vitro studies showed drop in pH of dental plaque produced by different sucrose-sweetened medicines like iron containing syrups and antitussive syrups. On consumption of sugar containing medicines, intraoral plaque pH drops. This drop is significantly more after 15% sucrose containing medicines than after rinsing the mouth with 10% sucrose solution (Feigal et al, 1981). Most studies addressing this core issue have helped policy decision makers and health professionals to control, avoid or replace sugar in medicines to non-cariogenic sugar and showed promising results (Peres et al, 2005).

The present study was carried out with the aim to determine the cariogenic potential of most commonly prescribed liquid oral medicines for children by estimating the percentage of sugar concentration and pH of these medicines.

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Materials and Methods:

The study was divided into two phases. In the first phase various Pediatrician, Pharmacist & Medical Representative of Bhopal city were asked regarding the generic name, trade name, duration of usage and doses of most prescribed liquid oral medicines. According to survey, 12 medicines under four categories were found to be most commonly prescribed medicine and were labelled as: Group A- antipyretics/analgesics (sample no. 1,2,3); Group B- antibiotics (sample no. 4,5,6); Group C- antihistaminics/ antitussives (sample no. 7,8,9) and Group D- multivitamins (sample no. 10,11,12).

In the second phase, determination of sugar level was carried out in these 12 samples of medicines. All procedures were performed at Biochemistry Research Laboratory at People's Centre for Scientific

Research & Development, Bhopal. Preliminary qualitative analysis was carried out for the presence of sugar by Benedict's test. This was followed by the quantitative analysis where type of sugar and its concentration were estimated under the following steps:

(a) Preparation of aqueous extract of sample: First the samples were weighed using digital weighing machine followed by dilution with distilled water. Then samples were treated with clarifying agent to remove active compounds of medicine followed by removal of excess of clarifying agent and then remnant was filtered to get an aqueous extract.

(b) Estimation of reducing sugar: It was done by using Lane –Eynon general volumetric titration based method. In the titration assembly burette was used to add unknown sugar sample which was titrated against Fehling's solution with an indicator. The end point was indicated by change in colour from blue to pink.

(c) Estimation of total reducing sugar in aqueous extract of samples by inversion method: As sucrose is a disaccharide it needs inversion for estimation. Samples were treated with hydrochloric acid, then kept at 70°C in water bath for 30 minutes and then kept at room temperature for 24 hours. It was then neutralized with sodium hydroxide followed by titration with same method.

(d) Calculation:

$$\text{Reducing sugars \%} = \frac{\text{Fehling factor} \times \text{dilution} \times 100}{\text{Weight of sample} \times \text{titer value}}$$

Sucrose% = [total reducing sugar% after inversion - reducing sugar % before inversion] × 0.95

(e) Determination of pH: Digital pH meter (EU-TECH) was calibrated by using buffer solution of pH 7 and 4 (by buffer standard capsule). Sample was diluted to 50% with distilled water and then pH was measured.

All the readings were taken three times and standard deviations (SD) was calculated.

Results:

All 12 most commonly prescribed medicines were analyzed for their sugar concentration (Table I) and pH (Table II). The drug with highest concentration of sugar i.e. 68.26±1.84% was found in sample no. 12 of group D followed by sugar concentration in sample no. 7 of group C (62.89±1.80%), sample no.1 of group A (61.87±1.77%) and sample no. 6 of group B (58.14±1.49%). Lowest pH of 3.82 was found in sample number 9 of Group C. Lowest pH in Group A was 4.22 (sample no. 2), in group B lowest pH was 4.36 (sample was no. 4) and in group D lowest pH was 4.0 (sample 11). High concentration of sugar was found in 50% of samples (55.84±1.57 to 68.26 ±1.84) & 90% samples showed pH below critical value (5.5).

Among 12 most commonly prescribed medicines, three did not have sugar contents (sample no. 4,8,9) and one contained artificial sweetener (sample no. 11). The sugar concentration was found to be in range between 20.62 to 62.89 % while the pH was found in the range of 3.82 to 8.5.

Table I: Showing sugar percentage of commonly prescribed liquid oral medicines (*Syrup, **Suspension).

GROUP OF MEDICINES		BENEDICT'S TEST	REDUCING SUGAR% (± SD)	SUCROSE% (± SD)	TOTAL REDUCING SUGAR % (±SD)
Antipyretic/ Analgesics (Group A)	SAMPLE 1*	++	4.08 ± 0.26	54.9 ± 1.21	61.87 ± 1.77
	SAMPLE 2**	+	2.27 ± 0.23	17.42 ± 0.33	20.62 ± 0.55
	SAMPLE 3**	++	4.1 ± 0.26	53.17 ± 1.15	60.08 ± 1.69
Antibiotics (Group B)	SAMPLE 4**	+	0	0	0
	SAMPLE 5 **	+++	1.34 ± 0.20	23.44 ± 0.57	26.02 ± 0.68
	SAMPLE 6**	+	0	58.14 ± 1.22	58.14 ± 1.49
Antitussives (Group C)	SAMPLE 7 *	++	4.36 ± 0.12	55.60 ± 1.31	62.89 ± 1.80
	SAMPLE 8 *	+	0	0	0
	SAMPLE 9 *	-	0	0	0
Multivitamins (Group D)	SAMPLE 10*	+++	19.5 ± 0.21	34.52 ± 1.06	55.84 ± 1.57
	SAMPLE 11*	-	0	0	0
	SAMPLE 12*	+++	6.95 ± 0.26	58.24 ± 1.23	68.26 ± 1.84

Table II: Showing pH of commonly prescribed liquid oral medicines.

GROUP OF MEDICINES		pH VALUE
ANTIPYRETIC/ ANALGESIC (GROUP A)	SAMPLES NO. 1	5.41
	SAMPLES NO. 2	4.22
	SAMPLES NO. 3	5.44
ANTIBIOTIC (GROUP B)	SAMPLES NO. 4	4.36
	SAMPLES NO. 5	4.91
	SAMPLES NO. 6	8.5
ANTITUSSIVE (GROUP C)	SAMPLES NO. 7	5.44
	SAMPLES NO. 8	5.08
	SAMPLES NO. 9	3.82
MUTLIVITAMIN (GROUP D)	SAMPLES NO. 10	4.22
	SAMPLES NO. 11	4
	SAMPLES NO. 12	4.62

Discussion:

The loss of tooth minerals during caries progression is caused by the formation of acids by bacteria, which lowers the pH to the point where the hydroxyapatite mineral of enamel dissolves (Nikiforuk, 1985), a process called demineralization. With increase in pH, the inverse process occur called re-mineralization, in which there is a reprecipitation of minerals in the damaged area. Thus, the carious process is a dynamic process which over a period of time may result in a net loss of mineral and subsequently lead to cavitation (Pierro et al, 2004). Time factor in caries development is associated with frequency of sugar exposure. Classical example is Vipeholm dental caries study (Newburn, 1989). In children who have to use medicines several times per day for long periods of time, sucrose-based medicines with acidic pH have potential for increasing dental caries (Girish et al, 2008). Caries as expressed by dmft index (decayed missing, filled teeth) increases significantly with increasing number of times the intake of snacks and drinks per day (Holt, 1991)

In our study 50% of the most commonly prescribed liquid oral medicine showed high sugar percentage and 90% of the medicines showed pH below the critical value of 5.5. The concept of critical pH was initially applied to indicate the pH at which saliva was no longer saturated with respect to calcium and phosphate ions, thereby permitting hydroxyapatite to dissolve. The critical pH may, therefore, be the pH at which the environment of the enamel becomes unsaturated and at which sufficiently high concentrations of un-ionized acid is present to ensure the inward diffusion of enough acid to extend the lesion (Nikiforuk, 1985).

In our study medicine contained sugars in a range of 20.62 to 68.26%. The results are at par to the studies conducted by Rubin (1989) and Peres et al (2005) who reported sugar content in medicines to be 20.0 to 74.5% & 8.6 to 67.0 % respectively. In the present study pH of liquid oral medicine was in the range of 3.82 to 8.5 range which was found similar to the range of 2.6 to 6.2 in commonly prescribed medicines for children. (Nunn et al, 2001).

Bigeard in 2000 suggested following guidelines to reduce liquid medicine related dental caries:

1. Inform parents and children about cariogenic potential of medicines and also the importance of tooth brushing after taking these medicines.
2. General practitioners, pediatricians and dentists should preferably prescribe non-cariogenic forms of medicines e.g. tablets or capsules. It they prescribe sugar containing medicine then they should give advice for proper oral hygiene.
3. All medicine should be labelled with the type of sweetener, whether sugar containing or sugar free. If it is a sugar containing medicine, it should be labelled with a warning for tooth decay.
4. Pharmaceutical companies should be urged to either reduce the sugar content in medicine or replace it with alternative sweetener agent.

Reducing the cariogenic potential of medication for children should be of concern to all health professionals. A public health policy must be implemented in order to limit sugar in medicines. (Peres et al, 2005)

Conclusion:

Frequent & long term consumption of liquid oral medicines was seen in chronically ill children. On basis of a survey, 12 most commonly prescribed liquid oral medicines were analyzed for their sugar concentration & pH. High concentration of sugars was found in 50% of samples & 90% samples showed pH below critical value. These drugs form high cariogenic formulations. Hence, their cautious use and education to parents and children is essential.

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