Original Article

International Journal of Dental and Health Sciences
Volume 05,Issue 05

EFFECT OF PEDIATRIC LIQUID MEDICATIONS ON *STREPTOCOCCUS MUTANS* GROWTH: AN INVITRO STUDY

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ABSTRACT:

AIM: Liquid oral medicines contain sugars in their formulation to increase bulk, palatability and consequently, compliance. Determining the pH and effect of liquid medications on the growth on Streptococcus mutans could demonstrate the cariogenicity of these medicines. The aim of this study is to assess the pH of three pediatric liquid medicaments and their effect on the growth of Streptococcus mutans.

MATERIALS AND METHODS: An in-vitro study was conducted for evaluation of pH and effect of three commonly prescribed liquid medications on Streptococcus mutans growth. The Pediatric Liquid Medicaments (PLM) included one each of the most commonly prescribed analgesics, antibiotics and antitussive preparations The labels of each medicament were examined to gather information on their composition. The endogenous pH of each PLM was measured using a digital pH meter. The effect of PLM on Streptococcus mutans was done by ditch plate method. The maximum diameter of the zones was measured using Vernier calipers.

RESULTS: The pH of PLM ranged from 3.84 to 6.12. The pH was lowest for the antitussive medication. The antibiotic preparation and analgesic preparation showed zones of inhibition against growth of Streptococcus mutans.

CONCLUSION: The cough syrup can be regarded cariogenic because of its acidic and high sugar content. The antibiotic preparation appears to be less detrimental due to its negligible amounts of sugars and inhibition of Streptococcus mutans growth.

Key words: Streptococcus mutans, antitussive agents, dental caries, analgesics

INTRODUCTION:

Oral liquid pharmaceutical preparations like syrups, solutions and suspensions are the therapeutic choice for the treatment of pediatric patients. Pediatric liquid preparations are well accepted by both parents and children. Syrups have a long history of use in pediatric medicine. They are widely are easily available and widely prescribed.[1,2] Even though most children over 6 years of age can take other forms of medication, many children prefer the liquid medication delivery system until adolescence.[3]

The formulation of liquid oral medicines contain agents to improve their appearance, bioavailability, stability, and palatability. Sugars like as sucrose, fructose and glucose are added to increase bulk, palatability and compliance. These sugars are extensivey used because they are cheap and easy to process. Acids are also added to medicines and commonly act as buffering agents to maintain chemical stability, control tonicity and to ensure physiological compatibility. They may be also used to enhance the flavor. Due to

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these inactive ingredients, many pediatric liquid medicines are characterized by having a high concentration of sugars, high titratable acidity and low pH.[4]

Sucrose is one of the most cariogenic carbohydrates because it is easily fermentable leading to acid formation and a decrease in intra oral pH. The association between sugar-containing syrups and dental caries has been reported, particularly if medications are administered at bedtime where studies report a reduction in protective buffering and cleansing effects of saliva due to a fall in the salivary flow rate. Many factors like high frequency consumption, bedtime consumption, low pH, dry mouth, and high viscosity make sugar-containing medicines, potentially harmful for childrens' oral health.[1]Determining the pH and effect of liquid medications on the growth on streptococcus mutans could demonstrate the cariogenicity of these medicines. This would allow for further education of healthcare providers when prescribing medications.

AIM

1. To assess the pH of three Pediatric Liquid Medicaments.
2. To assess the effect of Pediatric Liquid Medications on *Steptococcus mutans* growth

MATERIALS AND METHODS:

An in-vitro study was conducted for evaluation of pH and effect of three commonly prescribed liquid medications on *Streptococcus mutans* growth. The pediatric liquid medications were brought from a local medical shop in Mangalore. The Pediatric Liquid Medicaments (PLM) included one each of the most commonly prescribed analgesics, antibiotics and antitussive preparations.

Laboratory procedures

All the laboratory procedures were done in Mangalore Biotech Laboratory, Pumpwell Mangalore.

Evaluation of pH

The endogenous pH of each PLM was measured using a digital pH meter. Approximately 25 mL of each medication was placed in a beaker, the electrode was immersed and then the value was recorded. All the readings were taken at room temperature.(Fig 1)

Evaluation of Effect on *Streptococcus mutans*

The effect of PLM on *Streptococcus mutans* was done by ditch plate method. Freeze dried

forms of *Streptococcus mutans* were used. After preparation of the inoculum, 1ml of inoculum suspension was added to sterilized Muller-Hilton agar medium and mixed thoroughly. About 20ml was then dispensed into petridishes and allowed to solidify. Cylindrical wells were bored in the media after solidification using sterile borer. Two dilutions of each sample of PLM were prepared using sterile water to

give 1:2 dilution (1ml of sample + 1 ml of sterile water) and 1:10 dilution (1ml of sample + 9ml of sterile water). 0.1ml of each diluted sample was pipetted into the prepared wells on the agar plate. The plates were then kept at room temperature for 2-4 hours for pre-incubation diffusion. The plates were then incubated for 24 hours at 33 °C, following which the plates were observed for zones of inhibition and/or exhibition. The maximum diameter of the zones was measured using Vernier calipers.[5](Fig 2)

Statistical analysis: Descriptive statistics (mean and standard deviation) was tabulated using SPSS for Windows version 17 software (Chicago, IL, USA).

Sciences (SPSS for Windows, version 16.0, SPSS Inc., Chicago, IL, USA) for analysis. Descriptive statistics including proportions, means and standard deviations were estimated. Chi-square test and Independent sample t test with significance level kept at $P<0.05$ was performed to compare the proportions and means respectively. Pearson correlations between Quality of life score and sub domains in children with and without TDI were done.

RESULTS:

The pH of the liquid medicaments ranged between 3.84 and 6.12. The lowest pH was seen in the cough syrup (Servil syrup) whereas the analgesic syrup (Calpol syrup) had the highest pH. Zones of inhibition were seen with Wymox syrup and Servil syrup. Wymox syrup showed zone of inhibitions in both the dilutions.(Table 1)

DISCUSSION:

Pediatric liquid medicaments (PLM) have a long history of use in the field of medicine. They are very commonly prescribed, widely available, and are easily accepted by both parents and children. Young and chronically ill children with cardiac disease, leukemia,epilepsy,cystic fibrosis, renal disease and asthma are the significant groups of children receiving a variety of oral liquid medications on a routine and regular basis.[6] A high and regular intake of oral liquid medications may constitute possible etiological or aggravating factors for dental erosion and dental caries as these preparations are acidogenic and cariogenic in nature.[1 ,3, 4] Many parents are aware that sugar causes tooth decay, but commonly believe that this only related with the consumption of sweets and biscuits. They are often unaware of the hidden added sugar in many foods and drinks, including pediatric liquid medicines.[6]

On an average, 60% of the population of developed countries take some form of medicine, of which about half are bought over-the-counter and 17% of children are given non-prescription cough medicine. Analgesics and cough medicines are the commonly dispensed over-the-counter liquid preparations given to children.[6,7] These observations formed the basis for the selection of PLM in the present study.

Many liquid medications have an endogenous low pH that may itself contribute to demineralization or at least inhibit the demineralization–remineralization process in newly erupted teeth.The present study showed pH values ranging between 3.84 and 6.12.The cough syrup had the lowest pH of 3.84.All the three drugs selected for the study had an acidic pH. Studies conducted by various other authors also showed that many pediatric liquid medications had an acidic pH..[1, 4- 9]. A pH of 5.5 is traditionally considered to be the critical pH for enamel dissolution although mineral loss may begin at higher pHs.[10] But apart from the pH, dental erosion resulting due to dissolution of enamel also depends on other physicochemical properties of the medication like its titratable acidity, buffer capacity, type of acid, chelating properties mainly with respect to calcium, adhesiveness and viscosity.[11]

In the present study, the antibiotic syrup showed zone of inhibitions of 23.16± 0.28 and 17.16±1.04 at 1:2 and 1:10 dilutions respectively.This was in accordance with studies conducted by Subramaniam et al and Babu et al.[5,6] Although zone of inhibition was expected with the antibiotic, zone of inhibition with the cough syrup was not expected. The reason for the same could be the presence of menthol as one of the ingredients of the cough syrup. Menthol has moderate antibacterial effects against both Gram-positive and Gram-negative bacteria.[12,13] In vitro studies done by two other authors [13,14] showed that menthol inhibited the growth of streptococcus mutans. Karjalainen S concluded in his study that even if an antibacterial syrup is high in sugar content, it may be anticariogenic if it has a strong antistreptococcal spectrum.[15]But their use in children who are on long-term medication should not be ignored, as these preparations have an enamel-erosive potential.[4]

This *in vitro* study was limited to a small number of PLM and could have assessed different sugars present in each of them. As this study was done under *in vitro* conditions, it is clear that the results are not completely transferable to the *in vivo* situation.

CONCLUSION:

In conclusion, the pediatric antitussive medication evaluated in this study showed low endogenous pH value, below the critical value for enamel dissolution (pH<5.5) The antibiotic syrup showed inhibitory action against *Streptococcus mutans*.Considering the cariogenic and erosive potential of sweetened and acidic medications prescribed to children, it is important that health professionals, especially pediatricians and pediatric dentists, are engaged in educating parents to ensure adequate oral clearance after each dose of medication as a primary step for minimizing the risk of dental caries and erosion of dental structures related to long-term, and sometimes unsupervised, regimens with sugar-containing liquid oral medications.

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FIGURES:

Fig 1: Estimation of pH of the liquid medications using digital pH meter.

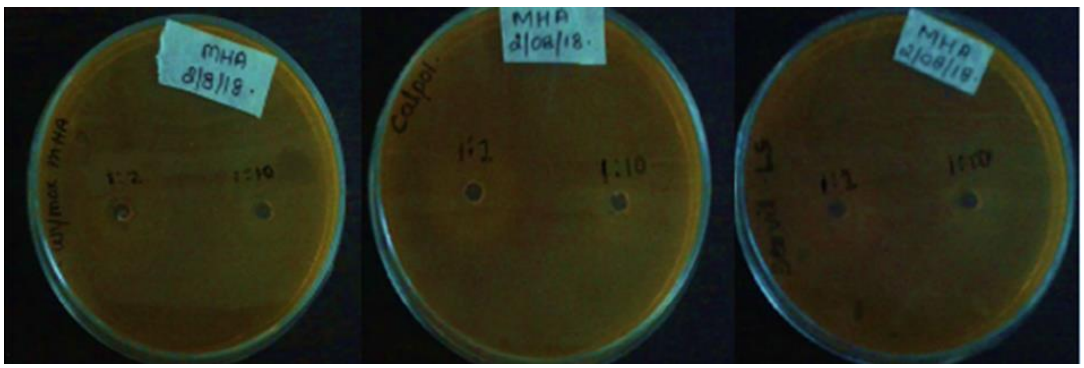

Fig 2: Zone of inhibitions of Antibiotic syrup, analgesic syrup and antitussive syrup

TABLES:

Table 1: pH and zone of inhibition of PLMs

PLM	Chemical composition	Brand name	pH of PLM	Zone of inhibition with Streptococcus mutans) (mean±SD) (in mm)	
				1:2 dilution	1:10 dilution
Analgesic	Paracetomaol	Calpol syrup	6.12	Nil	Nil
Antibiotic	Amoxicillin	Wymox syrup	5.73	23.16± 0.28	17.16±1.04
Antitussive	Guaifenesin,Bromhexine	Servil LS syrup	3.84	16.66± 0.57	Nil