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**EVALUATION OF pH AND OUTCOME OF COMMONLY PRESCRIBED
PEDIATRIC LIQUID MEDICAMENTS ON *STREPTOCOCCUS MUTANS*
GROWTH: AN *IN VITRO* STUDY**

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ABSTRACT

Background: There is enough evidence to support the information that long-term use of prescription medicines by children has increased in recent years. Determining the pH and effect of liquid medications on the growth of *Streptococcus mutans* could demonstrate the cariogenicity of these medicines. The aim of the study was to assess properties of pediatric liquid medicaments, such as pH and *Streptococcus mutans* growth & also to assess the carious activity of pediatric liquid medications.

Methodology – Three commonly prescribed analgesics (calpol), antibiotics (evox) and anti-tussive (decoff-dx) preparation were used in study. The pH value of each pediatric liquid medicament was evaluated using pH strips. Ethical clearance was taken from Institutional ethical committee. The microbiological laboratory procedures of Pediatric liquid medications on *Streptococcus mutans* were carried out by ditch plate method. The plates were then incubated for 24 hours at 37°C, following which the plates were observed for zones of inhibition and/or exhibition. Colony count was measured using microprocessor colony counting meter. Statistical analysis was estimated using SPSS version 22.

Results – Among three pediatric liquid medicaments, antibiotics (evoxil) showed highest pH value equal to 6. The analgesics syrup (calpol) and antitussives (Decoff-Dx) had same pH value equal to 4. Analgesic and Anti-tussives showed zone of inhibition in both 1:2 and 1:10 dilutions when *Streptococcus mutans* were incubated for 24 hours.

Conclusions – Anti-tussives (Decoff-dx) seemed to be carious as it was acidic and inhibition of *S. mutans* was prominent. Analgesic (calpol) was also carious because of acidic nature and inhibition of *S. mutans*.

Keywords: *Streptococcus mutans*, dental caries, antitussive

INTRODUCTION

High concentration of sugars, high titratable acidity and low pH are seen nowadays in most of the pediatric liquid medications [1]. There is enough evidence to support the information that long-term use of prescription medicines by children has increased in recent years. Pharmaceutical company have found that adding sucrose to flavor medications can mask the unpleasant taste [2].

The cariogenic potential of sucrose in many pediatric liquid medications are acidic [3]. Determining the effect of commonly prescribed oral medications on *S. mutans* biofilm formation could demonstrate the cariogenicity of these medicines [4]. However, if dentists note about sugar concentrations in pediatric liquid medications, they can move to alternative therapeutic agent to reduce caries in children [5].

Some pediatric liquid medicines in fact can affect oral health by progressing dental caries. The aim of the study was to assess properties

of pediatric liquid medicaments, such as pH and *Streptococcus mutans* growth & also to assess the carious activity of pediatric liquid medications.

MATERIALS AND METHOD

This was an in-vitro study carried out on pediatric prescribed syrup medications to evaluate *Streptococcus mutans* growth and pH value of each pediatric liquid. The commonly prescribed pediatric liquid medications suggested by pediatrician were bought from a medical shop in Mathura city. The Pediatric Liquid Medicaments (PLM) included one each of the most commonly prescribed analgesics, antibiotics and anti-tussive preparation. The pH values of each pediatric liquid medicament were evaluated using pH strips. Each Pediatric liquid medicament was placed in beaker, pH strips were dipped and then value was recorded at room temperature. The laboratory tests were done in microbiology department of K.D. Medical

College & Research centre, Chhata after obtaining their permission. Ethical clearance was taken from Institutional ethical committee of K.D. Dental College & Hospital before starting the study.

The microbiological laboratory procedures to check effect of Pediatric liquid medications on *Streptococcus mutans* were carried out by ditch plate method. Freeze dried form of *Streptococcus mutans* were employed in the study which was obtained from Microbial Type Culture Collection & Gene Bank (MTCC), Chandigarh. In sterilized Mueller Hinton agar medium 1 ml of inoculum suspension were mixed thoroughly after its preparation and 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 were pipetted into the prepared wells on the agar plate. The microorganism *Streptococcus mutans* were streaked on the agar plate. The plates were then kept at room temperature for 3-4 hours for pre-incubation diffusion. The plates were then incubated for 24 hours at 37°C, following which the plates were

observed for zones of inhibition and/or exhibition. Colony count was measured using microprocessor colony counting meter. The maximum diameters of the zone were measured using zone measuring scale.

Statistical Analysis

Descriptive statistics was tabulated using Statistical Package for Social Science software (SPSS) version 21. Descriptive statistics such as proportions, mean and standard deviation were estimated.

RESULTS

An in vitro study was conducted among three pediatric liquid medicaments in which one each from antibiotics, analgesics and anti-tussives were selected. The study was carried out in microbiological lab of K.D. Medical College and Hospital, Mathura in the month of July 2022.

Among three of pediatric liquid medicaments pH were measured in which antibiotics (evoxil) showed highest pH value equal to 6 (**Table 1**). The analgesics syrup (calpol) and antitussives (Decoff-Dx) had same pH value equal to 4 (**Figure1**). Decoff-Dx showed maximum diameter of zone of inhibition while Evoxil showed no zone of inhibition in both 1:2 and 1:10 dilutions (**Figure 2**). Calpol showed zone of inhibition in both 1:2 and 1:10 dilutions (**Table 2**).

Table 1: pH value seen in Pediatric liquid medicaments

| Drug class | Chemical composition | Brand name | pH value |
|---------------|---|------------|----------|
| Antibiotics | Amoxicillin oral suspension IP | Evoxil | 6 |
| Analgesics | Paracetamol oral suspension IP | Calpol | 4 |
| Anti-tussives | Chlorpheniramine maleate, Dextromethophen hydrobromide & Phenylephrine hydrochloride syrup. | Decoff-Dx | 4 |

Table 2: Zone of inhibition with *Streptococcus mutans* seen in Pediatric liquid medicaments.

| Drug class | Chemical composition | Brand name | Zone of inhibition (mean± SD) (in mm) | |
|---------------|--|------------|---------------------------------------|---------------|
| | | | 1:2 dilution | 1:10 dilution |
| Antibiotics | Amoxicillin oral suspension IP | Evoxil | Nil | Nil |
| Analgesics | Paracetamol oral suspension IP | Calpol | 87.28 ± 0.15 | 58.16 ± 2.01 |
| Anti-tussives | Chlorpheniramine maleate, extromethophen hydrobromide & Phenylephrine hydrochloride syrup. | Decoff-Dx | 32.15 ± 0.60 | 15.25±0.16 |



Figure 1: pH strips used for measuring pH value of Pediatric Liquid Medicaments



Figure 2: Growth of *S. mutans* on agar plate

DISCUSSION

In the present study, the antibiotics (evoxil) showed highest pH value which was 6 (**Table 1**). The analgesics syrup (calpol) and antitussives (Decoff-Dx) had same pH value equal to 4. The study conducted by Hegde *et al.*, [1] showed the pH value of antibiotic (wymox) was 5.73, analgesic (calpol) was 6.12, and antitussive (bromhexine) was 3.84 which is similar to our study except pH value of calpol. In the study conducted by Megha Gupta *et al.*, [3] the pH of analgesic (adol) was 5.78 and (medafen) was 5.66 which was in contrast to the study. The pH of amoxicillin trihydrate (julphamox) was 6.10, and of amoxicillin potassium clavunate was 5.39 which was similar to our study.

In study conducted by Sowmya *et al.*, [4] the pH values of paracetamol, Combiflam & ibuprofen syrups tested was below critical value of 5.5 which was similar to our study. In study done by Nankar *et al.*, [5] pH of analgesic syrup (Combiflam) was 5.01 and antibiotic syrup (augmentin Duo) was 6.20. In the study conducted by Girish Babu *et al.*, [6] pH of the liquid medicaments Analgesic (Salbid) was 6.05 which contradicts with our study. In the study conducted by Anshula Neeraj Deshpande [11] *et al*, acidic pH was recorded in most of the antibiotics, analgesics, and antipyretics, cough and cold preparations,

bronchodilators, and anticonvulsants with mean pH values of 5.6, 6.1, 5.7, 5.5, and 4.4, respectively which was similar to our study.

The study by Samantha Clark *et al.*, [2] showed that higher concentrations of amoxicillin had significantly decreased minimal inhibitory concentration of *S. mutans* and overall growth; and at lower concentrations, amoxicillin had significantly increased minimal inhibitory concentration of *S. mutans* and overall growth while in our study amoxicillin showed no zone of inhibition of *S. mutans*.

In the study conducted by Megha Gupta *et al.*, [3] the mean and standard deviation of zone of inhibition for analgesic (adol) was 0.68 ± 0.09 and for (medafen) was 1.41 ± 0.42 which contradicts with our study. The mean and standard deviation of zone of inhibition for amoxicillin trihydrate (julphamox) was 0.93 ± 0.23 , for (megamox) was 0.73 ± 0.07 , for metronidazole benzoate was 1.35 ± 0.05 and for amoxicillin potassium clavunate was 0.66 ± 0.06 which is in contrast to our study. Nankar *et al.*, [5] showed that the mean and standard deviation of zone of inhibition for analgesic syrup (Combiflam) was 5.03 ± 0.02 and for antibiotic syrup (augmentin Duo) was 6.22 ± 0.02 which was in contrast to our study. In the study conducted by Ana Carolina Valinoti *et al.*, [7] two antibiotics (11%)

presented basic pH values of 9.7 and 10.8, while the others presented pH values ranging from 4.1 to 6.9. Nine of the 29 analyzed amoxicillin group of antibiotics (52%) presented pH below the critical value for dissolution of hydroxyl-apatite (pH 5.5) which was in contrast to our study. In the study conducted by Vidhi Shah *et al.*, [8] the pH of anti-tussives (Benadryl) was 4.58 which was in contrast to our study.

In the study conducted by Isabela A. Passos *et al.*, [9] Medtrim F (antibiotic), and Belfactrim F (antibiotic) sugar was not detected which was similar to our study. Subramanian *et al.* [10] assessed the type and sugar concentration of 10 commonly prescribed liquid medications in India in which 50% of the preparations contained sucrose, glucose, and sorbitol with sucrose observed in 9 and glucose in 7 of the medications.

Suggestion and recommendation

It is suggested to educate parents to ensure adequate oral clearance after each dose of medication as a preventive step for minimizing the risk of dental caries related to long-term, and sometimes unsupervised, regimens with sugar-containing liquid oral medications. In the recent years due to increased prescription of pediatric liquid medicines by doctors and as well as self

prescribed uses of pediatric syrups have led to public health problem.

It is recommended that all sugar-containing medicines should be labeled with the concentration of sucrose present in them. It is hereby suggested that general practitioners, pediatricians and dentists should be informed about the underestimated side effects of these prescriptions. Each prescription of sugar containing medicine should include oral hygiene advice and preference should be given to those medicines sweetened with non-cariogenic sugars. Pharmaceutical companies should move on to sugar-free alternative of pediatric liquids which are tooth friendly.

Limitation

This *in vitro* study was conducted on very few Pediatric medicine syrups and could have assessed different types of sugars present in them. As this study was done under *in vitro* conditions, it is needed to be done *in vivo* for more clear perspective.

CONCLUSIONS

Antibiotic (evox) was acidic in nature and showed no zone of inhibition of *S. mutans*. Analgesic (calpol) was also acidic in nature and showed growth of *S. mutans*. Anti-tussives (decoff-dx) was acidic and growth of *S. mutans* was prominent. All three pediatric liquid medications seemed to be carious. Considering the cariogenicity and sweetened

nature of pediatric liquid medications, adequate oral clearance after every dose should be taken as preventive step in order to decrease caries development in children.

Declaration

Ethical approval: The present study was conducted after being approved by the committee for ethics in research, K.D. Dental College and Hospital Mathura (KDDC/ADMIN/101438/2022).

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Author's contribution: DT¹ and NB⁴ conceptualized and designed the methodology. DT¹ performed the microbiological lab work. NK² and MB⁵ performed the formal analysis and data analysis. MC³, DT¹ and NB⁴ prepared the original draft of the manuscript. RG⁶ and NK² edited the manuscript and prepared the final version. All authors read and approved the final manuscript.

Competing Interest: No competing interest

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