International Journal of Dentistry and Oral Science (IJDOS)
ISSN: 2377-8075

Analysis Of Cariogenic Potential Of Commercially Available Pediatric Oral Suspensions- An In-Vitro Study

Research Article

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Abstract

Introduction: There is an increasing prevalence in the prescription of drug therapy for the treatment of children with chronic conditions. Syrups have a long history of use in pediatric medicine. They are widely prescribed, and are easily available. Harmful effects occur when sucrose is metabolized by oral bacteria, particularly Streptococcus mutans, into weak organic acids. It is important to assess the cariogenic potential of commonly used pediatric oral suspensions. Therefore, the aim of this study was to assess the endogenous pH and cariogenic potential of commonly prescribed commercially available pediatric oral suspensions and their effect on the growth of Streptococcus mutans.

Materials and methods: The present study is an in vitro study. Oral suspensions used are Asthakind, Ambrolite, Ambrolite S, Moxikind CV, Maxtra, Cetzine, Ambrodil S, Azithral. Moxikind CV and azithral are effective against streptococcus mutans. The pH of oral suspensions are evaluated using a digital pH meter. Mueller Hinton agar plates were swabbed with Streptococcus mutans. Oral suspensions in concentrations of 25 µL, 50 µL, and 100 µL were loaded into those three wells. After that, the plates were incubated at 37°C for 24 hours to test for Streptococcus mutans. For statistical significance Kruskal wallis test was used with p value <0.05

Results: The Mean and SD of the zone of inhibition of Moxikind CV against Streptococcus mutans at 25µL is 37.33 ± 2.08, 50µL is 41.66 ± 2.0, 100µL is 43.66 ± 1.52 and the pH is 4.45. The Mean and SD of the zone of inhibition of Azithral against Streptococcus mutans at 25µL is 27.66 ± 2.15, 50µL is 29.66 ± 2.08, 100µL is 12.66 ± 2.08. The pH of Azithral is alkaline in nature (10.47). The other suspensions are not effective against streptococcus mutans but their pH are below the critical pH level which has more potential to cause dental caries in the oral environment.

Conclusion: Though there is sugar content in the oral suspension like moxikind CV and azithral, they are effective against streptococcus mutans. The pH of Moxikind CV is below the critical level and can influence the potential to cause dental caries but it is highly effective against the streptococcus mutans which further decreases the cariogenic potential.

Keywords: Pediatric Oral Suspensions; Cariogenic Potential; Cariogenic Properties; Endogenous pH; Streptococcus mutans.

Introduction

One of the most common oral diseases in childhood is Dental caries [1]. The etiology for dental caries occurrence is multifactorial and an imbalance between the tooth and oral environment, of which microbiota, diet and host are responsible for the disease initiation and progression. Considering the diet components, sugar and especially sucrose serves as a substrate for fermentation of the oral microbiota, in addition to the production of acids and the amount of biofilm formed [2].

Sugar addition to various medications for children is a supplementary source of carbohydrates for pediatric patients. Studies show a positive association between intake of oral suspensions

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Received: April 19, 2021
Accepted: July 09, 2021
Published: July 22, 2021

Citation: Hariprasath Nagarajan, Jayashri Prabakar, Sri Sakthi.D. Analysis Of Cariogenic Potential Of Commercially Available Pediatric Oral Suspensions- An In-Vitro Study. *Int J Dentistry Oral Sci.* 2021;8(7):3469-3473. doi: http://dx.doi.org/10.19070/2377-8075-21000708

and dental caries [3]. This represents a cause for concern for children's oral health, since many studies have shown increased prevalence of the disease and its relationship with the intake of oral suspension formulations. The use of sugar products (syrups, expectorants, antibiotics in solution, tonic and homoeopathic products) become potentially cariogenic with regular use as does any other product containing sugar, especially when used during the night.[4]

There is an increasing prevalence in the prescription of drug therapy for the treatment of children with chronic conditions. Syrups have a long history of use in pediatric medicine. They are widely prescribed, and are easily available. Their use is usually for a short duration, but for some children it may be a daily occurrence [5]. The inclusion of sugars, in children's medicines is, primarily to mask the less pleasant taste of active ingredients. However sugars added to medicines can be fermented by oral bacteria leading to acid formation and a drop in intra oral pH.

There is growing concern among pediatricians and dentists about the increased consumption of 'hidden sugars' by children, especially those who are chronically ill. It is important to assess the cariogenic potential of commonly used pediatric oral suspensions. Harmful effects occur when sucrose is metabolized by oral bacteria, particularly Streptococcus mutans, into weak organic acids [6]. These acids cause pH to fall below a critical value (5.5) resulting in demineralization of enamel and disease progression to dental caries.

Hence the aim of this study was to assess the endogenous pH and cariogenic potential of commonly prescribed commercially available pediatric oral suspensions and their effect on the growth of Streptococcus mutans.

Materials and Methods

Study design: In vitro study

Study setting: The study was done in BLUE LAB (microbiology and biochemistry lab), saveetha institute of medical and technical science (SIMATS), Chennai.

Oral suspensions: Eight commercially available commonly prescribed pediatric oral suspensions are brought from saveetha medical college and hospital as suggested by pediatricians. Oral suspensions used are Asthakind, Ambrolite, Ambrolite S, Moxikind CV, Maxtra, Cetzine, Ambrodil S, Azithral (Figure 1)

Ethical approval: Ethical approval was obtained from institutional review board, Saveetha University (SIMATS).

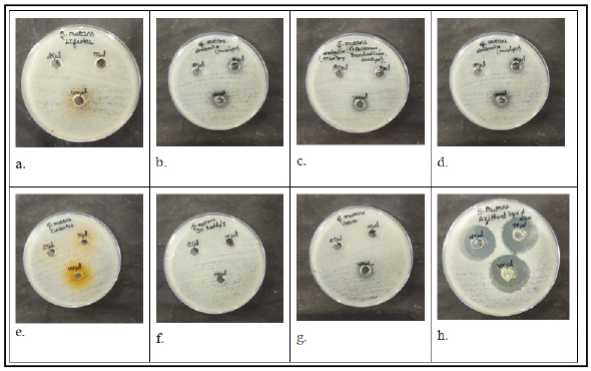
Antimicrobial assay: Streptococcus mutans Mueller Hinton agar media was prepared, sterilised, and then poured onto Petri plates. The plates were given time to solidify. The antimicrobial efficacy was determined using the Agar Well Diffusion process. After solidification, the plates were swabbed with Streptococcus mutans, an oral pathogen. After swabbing, a gel puncher was used to create three wells on each plate. Oral suspensions in concentrations of 25 µL, 50 µL, and 100 µL were loaded into those three wells. After that, the plates were incubated at 37°C for 24 hours to test for Streptococcus mutans growth by oral suspensions. This antimicrobial assay was carried out for 3 times in the same 3 different concentrations. (Figure 2)

pH estimation: 3mL of each oral suspension solutions are measured and poured into a glass dappen dish in room temperature then the pH of oral suspensions are evaluated using digital pH meter (ELICO LI 120 pH meter).

Statistical Analysis: For statistical analysis SPSS software used was IBM SPSS software 23. To know the statistical significance between and within 3 groups, a non parametric Kruskal Wallis test was used with p value <0.05.

Figure 1. Eight commercially available commonly prescribed pediatric oral suspensions.

Figure 2a-2h. Antimicrobial assay for 8 commercially available oral suspensions (a. Asthakind, b. Ambrolite, c. Ambrolite S, d. Moxikind CV, e. Maxtra, f. Cetzine, g. Ambrodil S, h. Azithral) at 25µL, 50µL and 100 µL concentrations respectively.



Results

The pH of all the oral suspensions are given in graph 1. The mean and SD of the zone of inhibition of oral suspensions against Streptococcus mutans is given in table 1. Mean and SD of the zone of inhibition of Asthakind against Streptococcus mutans at 25µL is 9.33 ± 0.57, 50µL is 9.66 ± 0.57, 100µL is 14.66 ± 1.15 and the pH is 4.1. Mean and SD of the zone of inhibition of Ambrolite against Streptococcus mutans at 25µL is 12.33±1.52, 50µL is 13.66 ± 1.52, 100µL is 16.66 ± 1.15 and the pH is 2.4. Mean and SD of the zone of inhibition of Ambrolite S against Streptococcus mutans at 25µL is 10.66 ± 2.08, 50µL is 13±1.73, 100µL is 13 ± 1 and the pH is 4.25. Mean and SD of the zone of inhibition of Moxikind CV against Streptococcus mutans at 25µL is 37.33 ± 2.08, 50µL is 41.66 ± 2.0, 100µL is 43.66 ± 1.52 and the pH is 4.45. Mean and SD of the zone of inhibition of Maxtra against Streptococcus mutans at 25µL is 10.66 ± 2.08, 50µL is 10 ± 1, 100µL is 13.33±1.52 and the pH is 3.38. Mean and SD of the zone of inhibition of Cetzine against Streptococcus mutans at 25µL is 9.33 ± 0.577, 50µL is9.66 ± 0.57, 100µL is 12.66±2.08 and the pH is 4.01. Mean and SD of the zone of inhibition of Ambrodil S against Streptococcus mutans at 25µL is 11.33±1.15, 50µL is9.66±0.57, 100µL is 12.66±2.08 and the pH is 4.01.

Mean and SD of the zone of inhibition of Azithral against Streptococcus mutans at 25µL is 27.66±2.15, 50µL is 29.66±2.08, 100µL is 12.66±2.08 and the pH is 10.47. The statistical significance between groups is presented in Table 2 and for within groups is presented in Table 3.

Graph 1. pH of Eight Commercially Available Oral Suspensions.

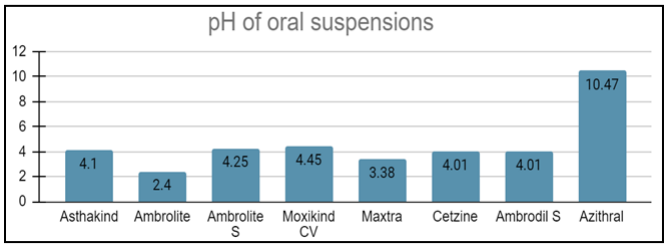


Table 1. Mean and SD of the zone of inhibition of oral suspensions against streptococcus mutans.

conc.	Mean zone of inhibition of streptococcus mutans							
	Asthakind	Ambrolite	Ambrolite S	Moxikind CV	Maxtra	Cetzine	Ambrodil S	Azithral
25µL	9.33 ± 0.57	12.33 ± 1.52	10.66 ± 2.08	37.33 ± 2.08	10.66 ± 2.08	9.33 ± 0.577	11.33 ± 1.15	27.66 ± 2.15
50µL	9.66 ± 0.57	13.66 ±1.52	13 ± 1.73	41.66 ± 2.08	10 ± 1	9.66 ± 0.57	11.33 ± 1.15	29.66 ± 2.08
100µL	14.66 ± 1.15	16.66 ± 1.15	13 ± 1	43.66 ± 1.52	13.33 ± 1.52	12.66 ± 2.08	15.66 ± 1.15	28 ± 3.60

Table 2. Kruskal Wallis test values for between groups.

Oral Suspensions	Kruskal wallis test	P value
Asthakind	6.054	0.048*
Ambrolite	6.108	0.047*
Ambrolite S	1.835	0.4
Moxikind CV	6.252	0.44
Maxtra	3.989	0.136**
Cetzine	6	0.050*
Ambrodil S	6	0.050*
Azithral	1.94	0.579

(*p value significance <0.05)

Table 3. Kruskal Wallis test values for within groups.

Concentration	Kruskal Wallis test	P value
25µL	17.86	0.013**
50µL	20.63	0.004**
100µL	19.45	0.007**

(*p value significance <0.05)

Discussion

The results of our current study evaluated the antimicrobial activity of oral suspensions against streptococcus mutans to know about the cariogenic potential of oral suspensions. Though there is sugar content in the oral suspension like moxikind CV and azithral, they are effective against streptococcus mutans. The Mean and SD of the zone of inhibition of Moxikind CV against Streptococcus mutans at 25µL is 37.33±2.08, 50µL is 41.66±2.0, 100µL is 43.66±1.52 and the pH is 4.45. The Mean and SD of the zone of inhibition of Azithral against Streptococcus mutans at 25µL is 27.66±2.15, 50µL is 29.66±2.08, 100µL is 12.66±2.08 and the pH is 10.47 The pH of Azithral is alkaline in nature. The other suspensions Asthakind, Ambrolite, Ambrolite S, Cetzine, Maxtra, Ambrodil S have not only not effective against streptococcus mutans but also their pH are below the critical pH level which has more potential to cause dental caries in oral environment. Though the pH of Moxikind CV is below the critical level that can influence the potential to cause dental caries but it is highly effective against the streptococcus mutans which further decreases the cariogenic potential.

Since the last decade, a number of studies on liquid medicines from various therapeutic groups have been performed in order to provide accurate data on the physicochemical profile of medicines used by children [7]. Due to the unpleasant taste of several active constituents, sugars are multifunctional ingredients added to drug formulations. Sucrose is also simple to process and comes in a variety of dry particle sizes, is chemically and physically stable, acts as an oxidant and solvent, and gives medicine viscosity [8]. It is less expensive and less hygroscopic, which has an effect on the final product price. In terms of the use of drugs containing sugary cars, it was discovered that sugar was present in nearly half of the samples studied, with a mean rate of 53.2 percent for antitussives, significantly higher than the 48.0 percent rate observed in a recent report [9]. Other reports, on the other hand, found higher sugar content, with percentages ranging from 65.0 to 86.9% [10]. There has been a link between sugar-based syrups and dental caries, especially when drugs are taken at night, when studies show that the protective buffering and cleaning effects of saliva are reduced due to a decrease in salivary flow rate. According to Tramontina MY et al., sugar-containing medications are potentially dangerous for children's teeth due to factors such as high frequency intake, bedtime consumption, low pH, dry mouth, and high viscosity [11].

Furthermore, bedtime intake, combined with decreased saliva production and a lack of mastication movements, increases medicine's cariogenic capacity [12]. Excessive oral clearance, which is affected by the viscosity of certain liquid drugs and impaired muscle control, can put children with neurological disorders like cerebral palsy at risk for dental caries. In people with oral motor dysfunctions, Gabre et al. discovered a higher initial saliva glucose concentration and a longer clearance time relative to controls, resulting in a more pronounced pH decrease [13]. Mosallam R., compared the pH changes caused by a 60-second rinse with seven different liquid drugs that are typically used for long-term care to the pH changes caused by a 10 percent sucrose solution rinse [14]. The seven drugs had a sucrose content ranging from 0 to 70 g/10 ml. Both drugs containing high sucrose concentrations were found to significantly lower the pH of dental plaque. The pH changes were similar to or even greater than those caused by sucrose. Oral bacteria can ferment sugars in medicines, resulting in acid formation and a decrease in intraoral pH. B S, Sabreen B et al., compared the indices for decayed (d), extracted (e), and filled (f) surfaces in 44 children aged 9 months to 6 years who had chronic medical disorders, had been taking sucrose-containing syrup medicines regularly for at least 6 months, and had been attending a hospital outpatient clinic for at least 6 months to a control group of 47 children of similar ages who either received no medicare or received medicare but were not in the hospital outpatient clinic for 6 months [15]. Chronic administration of liquid drugs sweetened with sucrose resulted in an increased incidence of dental caries and gingivitis, according to the findings. Goyal A et al., investigated the use of oral liquid medications and the occurrence of dental caries in a group of 20 chronically ill children from birth to 36 months [16]. During interviews with the parents, it was discovered that the children were given 3–4 doses of syrup drugs and elixirs each day, at least two of which were given just before or during a scheduled nap or bedtime. The repeated consumption of sugar-containing drugs was found to be a contributing factor in the caries found in these children. Daniëls R et al. calculated the sugar content of several widely prescribed liquid medicines in infants and young children. A sugar refractometer was used to assess the sugar content of the 24 liquid medicines. Sugar was present in all of the liquid medicines examined by the researchers [17]. Sugar concentrations ranged from 29.4 percent to 61.2 percent. Sucrose was the most widely used sugar, followed by fructose and glucose [18, 19].

The limitations of the study are that we did not evaluate the total sugar content of the oral suspensions, and it is a in vitro study that evaluated short term exposure. Further studies have to be carried out by evaluating the sugar content and evaluating its potential against extracted primary tooth.

Conclusion

Though there is sugar content in the oral suspension like moxikind CV and azithral, they are effective against s*treptococcus mutans*. The pH of Moxikind CV is below the critical level and can influence the potential to cause dental caries but it is highly effective against the *streptococcus mutans* which further decreases the cariogenic potential.

The pH of Azithral is alkaline in nature. The other suspensions Asthakind, Ambrolite, Ambrolite S, Cetzine, Maxtra, Ambrodil S are not so effective against *streptococcus mutans* and also their pH are below the critical pH level which has more potential to cause dental caries in oral environment.

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