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COMPARATIVE EVALUATION OF ANTIBACTERIAL EFFECT OF STEVIA AND XYLITOL ON S.MUTANS - AN IN VITRO STUDY.

Dental Science

Dr. Shivani. B* Lecturer, Department Of Pedodontics And Preventive Dentistry, Bapuji Dental College And Hospital, Davangere. *corresponding Author

Dr. Ila Srinivasan Professor And Head, Department Of Pedodontics And Preventive Dentistry, M.r.ambedkar Dental College And Hospital, Bangalore.

Dr. Jyothsna.V. Setty Professor, Department Of Pedodontics And Preventive Dentistry, M.r.ambedkar Dental College And Hospital, Bangalore.

Dr. Neeraja .R Reader, Department Of Pedodontics And Preventive Dentistry, M.r.ambedkar Dental College And Hospital, Bangalore.

ABSTRACT

Aims and objectives: The present study was conducted to evaluate and compare antimicrobial efficacy of Xylitol and Stevia against S.mutans.
Methods: The bacterial suspensions of S.mutans were distributed over the Brain Heart Infusion agar using a sterile swab. 8 agar plates were prepared. In each agar plate four wells of 6mm diameter were made of which two wells were utilized for xylitol and remaining two wells were utilized for stevia. 100 microliters of xylitol and stevia solutions were introduced in to the wells. Plates were incubated at 37°C with 5% CO2 for 48hrs. After 48 hrs, zones of inhibition were measured, data were tabulated and subjected to statistical analysis. Student t-test was used.
Results: Both xylitol and stevia significantly inhibited the growth of S.mutans. xylitol exhibited significantly higher growth inhibition than stevia.
Conclusion: Xylitol exhibited a superior antibacterial activity compared to stevia. Unlike xylitol, stevia had modest, but significant inhibitory effect on the growth of cariogenic S.mutans.

KEYWORDS

Stevia, Xylitol, S.mutans, Antimicrobial, Oral Health.

INTRODUCTION

Dietary sugars, particularly sucrose are abiotic environmental factors that can shift the delicate balance of the ecosystem towards a more cariogenic microbiota. Sugars that are fermented by plaque microorganisms favor the establishment of a Cariogenic microflora that cause dental caries.[1]

Increased calorie intake associated with sugars and carbohydrates, especially when associated with physical inactivity, has been implicated in childhood obesity. Fortunately, non-nutritive artificial and non-/low-caloric natural sugars have been developed as alternatives to fermentable sugars and have shown promise in partially addressing these health issues.[2]

One strategy for treating dental caries is to suppress streptococcus mutans, the chief pathogen responsible for the disease.[3] the use of sucrose substitutes that provide the hedonistic appeal of sucrose yet are not fermented by the plaque flora that are associated with caries, is a reasonable approach to caries control.[4]

Many non- or low-cariogenic sucrose substitutes are currently available and are added as ingredients to variety of candy, chewing gum, and drinks. Recently the role of sugar alcohols in promoting remineralisation of enamel has attracted much attention. The use of a greater variety of confectionary containing sucrose substitutes and the development of newer substitutes with higher nutritional value are essential to combat dental caries.[5]

Among various sweeteners, xylitol has been widely investigated for its effects on dental caries. It is a polyol Sweetener that does not support the growth of cariogenic streptococcus mutans due to their inability to metabolize xylitol. Xylitol has been credited for its role in reducing S.mutans levels in various studies. However excessive use of xylitol may aggravate symptoms of crohns disease and irritable bowel syndrome.[2]

Therefore, use of safe and effective sucrose substitutes is vital for long-term oral and general health.

Recently, there is growing interest in using natural compounds, especially extracted from plants, for the preservation of foods, drugs and other products. One such compound is Stevia also called sweetleaf, a natural sweetener derived from a South American plant called Stevia rebaudiana bertoni. The leaves of Stevia contain diterpene glucosides viz. stevioside and rebaudioside with a sweet taste but which are not metabolized in the body. The major part of the sweet glycosides consists of the stevioside molecule. Stevioside sweetener extracted from the plants is 300 times sweeter than sugar.[6] In addition to its natural, noncaloric intense sweetening properties; stevia extracts have produced beneficial non-cariogenic antihypertensive, antihyperglycemic, antioxidant, chemoprotective, anti-inflammatory, immunomodulatory, and antiviral effects on human health.[7]

Comparative studies available on stevia are few. Considering the importance of prevention dental caries in dentistry and the necessity of expanding the clinical research on substances that present antibacterial effect, the present study was planned to evaluate and compare the antibacterial activity of a herbal sweetner and xylitol, an established sweetner with anticariogenic property against S. mutans.

MATERIALS AND METHODS

Antibacterial Assay

The S. mutans (ATCC: 35668) strain was obtained, grown and maintained on Brain Heart Infusion agar (BHI) supplemented with blood. The bacterial suspensions standardized to 10^8 CFU/ml of S. mutans were distributed over the Brain Heart Infusion agar using a sterile swab. Wells (6 mm) were made in the agar plate with a sterile cork borer (6 mm). 8 agar plates were prepared. In each agar plate four wells were made of which two wells were utilized for xylitol and remaining two wells were utilized for stevia. 100 microliters of xylitol and stevia solutions were introduced in to the wells. Plates were incubated at 37°C with 5% CO2 for 48hrs. Antibacterial activity of xylitol and stevia was determined by measuring the diameter of the inhibition zone. Sweeteners used were considered active if the inhibition zone diameter is 8mm.[8]

After 48 hrs, zones of inhibition were measured, data were tabulated and subjected to statistical analysis. Student t-test was used.

RESULTS:

- The inhibition zone measurements for xylitol were in a range of 13-15 mm with a mean of 14.06mm.
- The inhibition zone measurements for xylitol were in a range of 18-20 mm with a mean of 18.93mm.
- Results have shown that both stevia and xylitol significantly inhibited the growth of Streptococcus mutans
- When xylitol and stevia are compared, Xylitol (18.93$\pm$0.77) showed significantly higher ($p>0.001$) activity than the stevia (14.06+0.77). Figure (1)

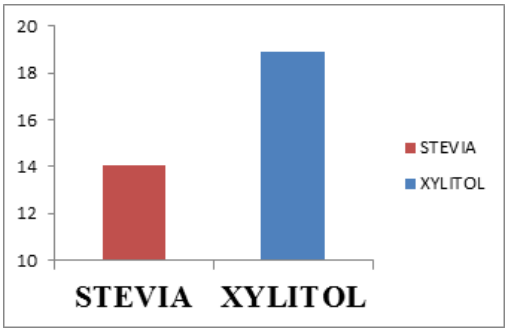

FIGURE 1: Bar graph shown mean zone of inhibition for Stevia and Xylitol

DISCUSION

Caries and obesity are two common conditions affecting individuals of all age groups. Considerable amount of evidence supports the fact that fermentable sugars and prepared starches in the diet are significant contributors to these two health issues[2].

The risk of dental caries is related to both the amount and frequency of sucrose intake, with a steep rise in occurrence concurrent with increased consumption of sucrose.[9] Increasing the availability of safe and effective replacements for dietary sucrose is vital to long-term oral health and general well being of an individual.

Several sugar substitutes have been tested with an objective of reducing caries risk. First human trial conducted in the field of dental caries research is the Turku Sugar Studies, involving total substitution of all dietary sugars with xylitol.[10]

Xylitol is a polyol sweetener, which is not fermented by oral bacteriavarious studies in the literature have demonstrated that Mutans streptococci are target organisms of xylitol. It is found to inhibit the growth of Mutans streptococci via the inducible fructose transport system.[11] In addition, habitual consumption of xylitol decreases counts of Mutans streptococci as well as the amount of plaque.[12]In the present study xylitol showed significant growth inhibition zones of Streptococcus mutans.

Despite the many oral health benifits of xylitol, their consumption is frequently linked to irritable bowel syndrome (IBS) and abnormal flatulence, affecting the quality of life. a noted side effect reported among users of sweeteners is diarrhea that needs special attention when used in children.[13]

Considering the side effects of xylitol and its restricted amount of use in children, Stevia, a natural calorie free sweetener was therefore investigated for its ability to suppress the growth of cariogenic *Streptococcus mutans*, and was compared against xylitol which is a present day established anticarious sweetner

Stevia was approved in 2008 by the US Food and Drug Administration as generally recognized as safe (GRAS) for use as a tabletop sweetener.[14] It is available as a leaf, white powder or clear liquid. "Stevia sweeteners are a natural source of sweetness. *Stevia* is a natural sweetener indigenous to the northern regions of South America. Its extracts were being used commercially in Japan for sweetening and flavoring foods and beverages. The sweetener, stevioside extracted from the plants is 300 times sweeter than sugar. Most of the ingested stevia is not metabolized and is utilised by enterobacteria. the remainder is excreted in the stools. It is recommended for diabetes and has been extensively tested on animals and has been used by humans with no side effects hence Stevia is considered as an ideal sweetener.[6]

In a study conducted by Das and Murphy et al the cariogenic potential of the intense natural sweeteners stevioside and rebaudioside A was evaluated and concluded that neither stevioside nor rebaudioside A is cariogenic.[15]

In the present study stevia showed significant growth inhibition of streptococcus mutans.

In studies conducted by Debnath et al[6] and Mohammadi-Sichani et al.[8] stevia exhibited antibacterial activity against mutans. The results of the present study are in line with the above findings

The results of various studies indicate that the major cariogenic organism, *Streptococcus mutans*, experiences growth suppression and secretes less acid when grown on media containing stevioside than when grown on sucrose, glucose or fructose media.[9]

In the present study Xylitol showed significant growth inhibitory effect when compared to stevia.

- Considering the side effects of xylitol- Mild diarrhoea or slight cramping and its restricted use in children, stevia can make a significant contribution to dental health.

CONCLUSION:

Thus, both xylitol and stevia did not support the growth of *S. mutans* under the conditions of this experiment. Xylitol exhibited a superior antibacterial activity compared to stevia. Unlike xylitol, stevia had modest, but significant inhibitory effect on the growth of cariogenic *S.mutans.*

- Both Xylitol and stevia are promoted as a healthful and low-calorie sugar alternative, but the decision is still out on which one is the sweetest and safest option. Further research is required to prove clinical efficacy of Stevia as a sugar substitute having anti caries activity

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