

## ORIGINAL ARTICLE

### ASSESSING THE EFFECT OF XYLITOL CHEWING GUM ON SALIVARY STREPTOCOCCUS MUTANS LEVELS IN 8 TO 12 YEAR OLD CHILDREN

Meena Syed<sup>1</sup>, Mohd. Shafi<sup>2</sup>

<sup>1</sup>MDS, Consultant Pedodontist, Pune, <sup>2</sup>Department of Oral Pathology and Microbiology, Govt. Dental College, Srinagar


#### ABSTRACT:

**Background:** The modern concepts of cariogram demonstrate microorganisms as one of the major etiological factors apart from dietary factors and host factors in the formation of dental caries. Hence; we planned the present study to assess the effect of xylitol (XYL) chewing gum on Streptococcus mutans levels among 8 to 12-year-old children. **Materials and methods:** Sixty children aged 8 to 12 years were selected with moderate and high salivary S. mutans levels. The subjects were asked to chew XYL chewing gum twice daily. The S. mutans colony-forming units (CFUs) were counted by using the mitissalivarius agar plate at the beginning of the study and at 15 days, 1 month, 2 months, and 6 months from the start of the study. **Results:** The XYL group showed reduction in S. mutans scores throughout the study period. **Conclusion:** The S. mutans score was found to be significantly reduced in the xylitol group.

**Key words:** preventive strategies, dental caries, Streptococcus mutans, Xylitol.

Corresponding author: Dr Meena Syed, 1MDS, Consultant Pedodontist, Pune, Maharashtra, India

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## INTRODUCTION

More than a century back, the chemo-parasitic theory was postulated by W.D. Miller for the formation of dental caries.<sup>1</sup> At present, the modern concepts of cariogram demonstrate microorganisms as one of the major etiological factors apart from dietary factors and host factors in the formation of dental caries. It is well established that mutans streptococci, especially Streptococcus mutans, are an important caries-associated member in dental plaque.<sup>2</sup> Due to its adhesive and acidogenic potential it causes mineral loss which keeps the local pH low.<sup>3</sup> Hence, targeting S. mutans forms an important measure for the prevention of dental caries, which can be achieved by mechanical and chemical aids.

Many preventive approaches focus on the reduced sugar intake and replacement with non fermentable sweeteners, like polyols. At present, the most commonly used polyols are sorbitol and xylitol (XYL)<sup>4</sup> which are introduced in chewing gums. Unlike sorbitol, XYL exhibits a dose-related inhibition of S. mutans growth in vitro.

Xylitol is a polyalcohol derivative that does not initiate dental caries.<sup>5,6</sup> Substitution of sugars by XYL is non cariogenic and anticariogenic<sup>7-11</sup> and it is mainly indicated to be used as a sugar substitute between meals<sup>9</sup>

since it is not metabolized by oral bacteria<sup>6,12</sup> and leads to no drop in the pH in the biofilm.<sup>13,14</sup> XYL also penetrates the bacterial cytoplasm where it gets accumulated as xylitol 5-phosphate, impairing the glycolysis and adenosine triphosphate production and resulting in impaired cell growth.<sup>6,12</sup> Since XYL chewing gums reduce the levels of S. mutans and not many clinical trials have yet been conducted; hence, we conducted the present study to evaluate the effect of XYL chewing gum (extra XYL) on S. mutans in 8 to 12 year old children.

## MATERIALS AND METHODS

This study was undertaken in the Department of Pedodontics and Preventive Dentistry, ITS Dental College, Ghaziabad, India, in coordination with the Department of Microbiology, ITS Dental College, Ghaziabad, India. Prior to the study, an informed written consent was obtained from the parents. A randomized experimental study was designed and approved by the Ethical Committee, ITS Dental College, Ghaziabad, India. Initially, 500 children from a nearby school were examined, and 150 children were selected based on the following criteria.

### Inclusion Criteria

- Children in the age group of 8 to 12 years
- Caries-free children
- Children who agreed to participate in the study with the consent of parents

**Exclusion Criteria**

- Medically compromised children
- Children with a history of taking antibiotics 3 months prior to and during the study period
- Presence of any intraoral soft tissue pathology

Baseline saliva samples were taken from these 150 patients and subjected to microbiological analysis. A sterile tongue blade (180 × 18 mm) was inserted into the child’s oral cavity and then moved in the buccal mucosa up to ten times, with both sides being then pressed on a Rodac® plate (Kracjeler Scientific, Inc) containing 12 mL of mitis salivarius agar base (Becton, Dickinson & Company, Sparks, MD, USA) containing 0.2 g/mL sorbitol, 0.01 mg/mL potassium tellurite, 1.66 µg/mL bacitracin, and 1.275 µg/mL kanamycin sulfate.<sup>17</sup>

The plates were then incubated at 37°C for 72 hours in an anaerobic jar (BBL Gás Pak, Becton Dickinson and Co., Cockeysville, MD, USA) with an atmosphere of 80% N<sub>2</sub>, 10% H<sub>2</sub>, and 10% CO<sub>2</sub>. The period of time elapsed between inoculation and anaerobic incubation did not exceed 4 hours. Colony-forming unit (CFU) scores were counted in the spatula impression using a stereoscopic microscope.

The CFU scores for *S. mutans* were expressed according to the criteria described by Weber as follows:

- 0 = absence of *S. mutans*,
- 1 = low level (1–10 CFU),
- 2 = moderate level (11–100 CFU),
- 3 = high level (101–250 CFU),
- 4 = very high level (>250 CFU).

60 children with CFU scores equal to or above moderate CFU level were included for further evaluation of the effect of antimicrobial agents. XYL chewing gum was chewed by children twice a day, half an hour after breakfast and half an hour after dinner. For using XYL chewing gums, the subjects were instructed to chew the gum for 5 minutes after meals. Fresh saliva samples were then analyzed after 1, 3, and 6 months. The microbiologist was blinded to the grouping of the samples.

Data was compiled and analyzed by using the statistical program Statistical Package for the Social Sciences (SPSS) version 11.0. Analysis of variance (ANOVA) was done with post hoc Bonferroni test for multiple comparisons at 5% significance level.

**RESULTS**

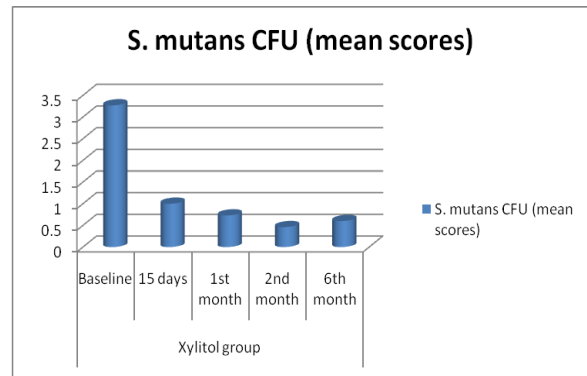
The total sample size was 60 children (males 30, females 30) in the age range of 8 to 12 years with the mean age of 7.40 ± 0.669 years.

Table 1 shows that the mean baseline scores for CFU in children who chewed xylitol chewing gum was 3.27. In all the time intervals, significant reduction in *S. mutans* was found as compared with baseline values at four different time intervals. Maximum reduction was seen at the end of 15 days, after that there was a gradual decline up to 2 months and later the difference was found to be statistically insignificant.

**Table 1:** Levels of *S. mutans* during the four time intervals

Group	Time interval	<i>S. mutans</i> CFU (mean scores) <sup>a</sup>
Xylitol group	Baseline	3.27
	15 days	1
	1 <sup>st</sup> month	0.73
	2 <sup>nd</sup> month	0.46
	6 <sup>th</sup> month	0.6

**Graph 1:** Levels of *S. mutans* during the four time intervals



**DISCUSSION**

During the formation of biofilm, the *S. mutans* is an important factor for the modification of biofilm into a cariogenic state.<sup>15,16</sup> With the increase in the level of *S. mutans*, the level of plaque accumulation also increases which leads to greater risk of dental caries. Therefore, the control of *S. mutans* levels is an important target for caries prevention and control.

In our study, the spatula method was used for saliva collection as it was more practical and easy for children. Moreover, the saliva collected does not need dilution before inoculation, thus making it more appropriate for epidemiological studies.

The miti ssalivarius, sorbitol, kanamycin, and bacitracin agar medium was used as it has a long shelf life and is specific for *S. mutans* colonies with a long shelf life.<sup>15</sup>

Out of all the variety of chemical agents used, XYL is observed to have strong antimicrobial activity with different modes of action. Recently, various polyalcohols are incorporated into products like chewing gums. Xylitol functions by inhibiting the glycolysis pathway which results in loosely attached biofilms. But the use of XYL as a sugar substitute in food does not cause decreased salivary *S. mutans* levels.<sup>17,18</sup> Therefore, sustained and frequent effect of XYL in the form of candies or gums is mandatory in order to achieve reduced *S. mutans* levels.<sup>17,18</sup>

Some studies have shown XYL-associated decrease of MS counts in plaque (Mäkinen et al; Milgrom et al; Haresaku et al)<sup>20,21</sup> and in resting saliva (Milgrom et al) and stimulated saliva (Haresaku et al)<sup>22</sup> In one 2-year study, the *S. mutans* levels of plaque of 11 to 12-year-old children was decreased and remained low throughout the study (Mäkinen et al)<sup>23</sup> On contrary, in another 2-year

study, no significant decrease was observed in the salivary *S. mutans* levels of 10-year-old children (Mäkinen et al)<sup>20</sup>. In our study, in the XYL group, initial *S. mutans* suppression was observed just after 15 days when compared with baseline. These results were statistically significant, which are in accordance with other studies in which the *S. mutans* CFU reduction did not persist for a long time after XYL therapy. Several studies have shown the short-term effect of polyol on *S. mutans*, and in our study, we observed the CFU scores remained consistent from 2 to 6 months (69.16%). In another study, Moraes<sup>24</sup> showed that at the end of 3 months, the values for XYL group returned to mean base-line scores (2.67) and remained the same at 6 months<sup>24</sup>. Similarly, Hildebrandt et al<sup>25</sup> demonstrated that 4.4 gm/ day of XYL mouth rinsing did not show a significant decrease of MS level.

XYL chewing gums were used for the present study as they are economical and do not require any separate clinical setup. Subjects between 8 and 12 years were chosen for this research as it is the late mixed dentition stage.

In our study, no side effects like diarrhea were reported in any of the children in the XYL group. Even in a short span of time, which is a limitation of this study, xylitol proved effective as demonstrated by the results. Autio JT evaluated the effect of xylitol gum in salivary *S. mutans* levels in preschool children. Sixty-one children were randomly assigned into the xylitol group and the control group. The xylitol group chewed gum sweetened only with xylitol (XyliFresh100%, Hershey Food Corporation, U.S.A.) three times a day for three weeks. *S. mutans* counts were tested using the Dentocult-SM Strip Mutans-test (Orion Diagnostica, Finland) at baseline and after three weeks. The shift from higher *S. mutans* scores to lower was greater in the xylitol group than in the control group ( $p < 0.05$ ). This study supports the suggestion that chewing xylitol gum may reduce salivary *S. mutans* levels. Xylitol chewing gum may provide a feasible caries prevention method for preschool children.<sup>26</sup>

## CONCLUSION

We conclude that in the XYL group, there is overall reduction in *S. mutans* counts. However, future studies are recommended in this field.

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