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EFFECT OF THREE TYPES OF CHEWING GUM ON ORAL STREPTOCOCCUS MUTANS AND LACTOBACILLI BACTERIA IN SCHOOL CHILDREN: A CONTROLLED CLINICAL STUDY

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ABSTRACT

Objectives: This study aimed to evaluate and compare the antibacterial effect of three types of chewing gum on oral streptococcus mutans and lactobacilli in school children, and the effect of them on dental debris accumulation. **Subjects and Methods**: A sample single blinded randomized control study included 60 healthy children age between 6-12 years with specific inclusion criteria. Three types of chewing gum were used in the present study; sugar-containing "chiclets", sugar-free "xylitol", and sugar-less "mastic". Saliva samples were collected in a sterile plain tube from participating children in the first day before taking chewing gum and then after taking chewing gum in a sterile plain tube for 3 successive days, after three days debris index was recorded. **Results:** There was a statistically significant reduction in *S. mutans* and *lactobacilli* count from baseline to the third day in the three studied groups. Through the intergroup comparison, there was also a statistically significant percentage of reduction of *S. mutans* and *lactobacilli* count at different time intervals, there was a statistically non-significant difference between the three studied groups according to debris index score. **Conclusion:** The use of sugar-free "xylitol" chewing gum has the higher significant effect on the reduction of *S. mutans* and *lactobacilli* count at different time intervals followed by sugar-less chewing gum "mastic" when compared to sugar-containing "chiclets" chewing gum.

KEYWORDS: Antibacterial, Chewing gum, Children, L*actobacilli*, *Streptococcus Mutans*.

INTRODUCTION

Dental caries is considered one of the commonest oral diseases, which are usually induced through the metabolic activity of the microbial plaque through reducing pH of saliva [1,2]. Tooth caries occur when the hard tooth tissues are softened by the process of demineralization caused by the action of cariogenic bacteria on foods debris especially polysaccharides[3]. However, saliva plays a significant role in controlling the incidence of dental caries through its buffering capacity, and promotion of the process of remineralization[4].

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The bacteriological etiology of tooth decay is commonly due to the presence of *S. mutans* and *lactobacilli* microorganisms in dental plaque [1]. It was reported that *S. mutans* has the responsibility to initiate the carious lesion, while lactobacilli were only responsible for the caries progression [5]. The substance which can act against cariogenic bacteria such as *S. mutans* and *lactobacilli* can potentially decrease the incidence of tooth caries [6]. Therefore, targeting *S. mutans* and *lactobacilli* is considered one of the most important measures for caries prevention [6, 7].

Chewing gum considered a commonly practiced habit that could stimulate the saliva and increases the salivary flow rate (SFR) and it is also could act as the delivering vehicle for therapeutic agents [2]. However, chewing sweetened gum could involve the incidence of the carious process [8]. The use of sugar-free or sugar-less chewing gums may be the convenient way to increase SFR and decrease the incidence of dental caries.

Therefore, this study was conducted to evaluate the effectiveness of sugar-free and sugar-less chewing gums in reducing the salivary count of *S. mutans* and *lactobacilli* bacteria and compare it with the sweetened chewing gum in a small group of school-aged children.

SUBJECTS AND METHODS

This study was started after the approval of the ethical committee of the Faculty of Dental Medicine (Boys, Cairo), Al-Azhar University (EC Ref No: 156/022019/121G). The sample size was determined based on the results of the previous study of Shinde et al, [2]. This Simple single blinded randomized control clinical study included 60 healthy children age between 6-12 years. The involved children were medically free, and don't have orthodontic appliances or periodontal lesions, and have no allergic response to any ingredients of the study products (xylitol - maltitol - mannitol - sorbitol - mastic) [2,9,10].

This study was conducted on outpatients who attended the clinics of Pedodontics and Oral Health Department, Faculty of Dental Medicine (Boys, Cairo), Al-Azhar University. After subject selection, a written consent was signed by the guardians before starting the investigation. The involved children in this study were divided into three equal groups (n=20) according to the received chewing gum, the group I; children receive sugar-less chewing gum (mastic gum), group II; children receive sugar-free chewing gum (xylitol gum), and group III; children receive sugar-containing chewing gum (chiclets).

During the study period, the involved children were asked to maintain normal dietary and oral hygiene habits and were instructed to refrain from using commercial chewing gum which is available in the market [9, 10]. Each enrolled child in each group was asked to chewing gum for 3 days (3 times per day after meals) using a single gum piece for10 minutes each time. Unstimulated saliva samples were collected daily from each enrolled child in each group in a sterile plain tube before and after chewing the gum in a sterile plain tube for 3 days [2].

Microbiology and salivary samples collection:

Before the collection of a saliva sample, the involved children were instructed not to drink or eat for at least 1 hour. To avoid the contamination of the collected saliva with food debris, the involved children were asked to rinse their mouths with water. Then, each involved child was asked to spit in a sterile plain tube [2, 9]. The collected saliva samples were transferred Directly to the microbiological lab in the Regional Center for Mycology and Biotechnology, Al-Azhar University.

The collected saliva samples were vortexed for about 15 seconds and diluted in isotonic saline solution for five different dilutions (1: 10, 1: 100, 1:1000, 1:10000, and 1:100000) before inoculation. About 20 ul diluted saliva sample of each dilution was spread on plates containing one of the appropriate agar mediums for *S. mutans* (Mitis Salivarius

Agar with potassium tellurite medium) and *lactobacilli* (Rogosa SL Agar). After that, all plates were incubated anaerobically using anaerobic Gas pack system at 37°C for 48 hours. The growing colonies were identified and then counted and the number of the colony-forming units (CFU)/ml for the collected saliva samples in each group was calculated [9,10].

After three days debris index was recorded, the surface area of teeth in upper and lower arch covered by debris is estimated by running the side of the explorer along the tooth surface being examined. Criteria for classifying debris were as follows:

- Score 0. No debris or stain present.
- Score 1. Soft debris covering not more than one-third of the tooth surface, or presence of extrinsic stains without other debris regardless of surface area covered.
- Score 2. Soft debris covering more than one-third, but not more than two-thirds, of the exposed tooth surface.
- Score 3. Soft debris covering more than two-thirds of the exposed tooth surface.

All data were collected, tabulated, and statically analyzed via SPSS version 20 using. The normality test showed up-normal numerical distribution therefore Kruskal Wallis test was used to compare the three tested groups, and pairwise comparisons between every 2 groups were done using Post Hoc Test (Dunn's for multiple comparisons test),and comparison between the three studied groups according to debris index score by using Chi square test.

RESULTS

The results of comparison between the three studied groups according to counting *S. mutans* and *lactobacilli*. Before and after chewing gum, there was a statistically significant difference between groups ($p<0.001$) by using the Kruskal Wallis test. The pairwise comparison test showed a statistically significant difference in-between the groups ($p<0.05$) at different time intervals. Xylitol chewing gum (Group B) showed a lower counting with the higher percentage (%) reduction in *S. mutans* and *lactobacilli* count when compared to chiclets and mastic chewing gum (group C and A) (Table 1 and 2).

TABLE (1): Descriptive statistics of counting *S. mutans* and *lactobacilli* in each studied group.

Groups	Time	Counting *S. mutans*	Counting *Lactobacilli*	*P*-value
		Mean ± SD	Mean ± SD	
Mastic gum (n = 20)	Before	419.0 ± 224.0	24.88 ± 32.61	<0.001*
	After 1 day	232.3 ± 122.2	16.68 ± 21.94	
	After 2 days	209.0 ± 112.7	15.62 ± 20.49	
	After 3 days	146.9 ± 78.37	14.31 ± 18.95	
Xylitol gum (n = 20)	Before	212.4 ± 94.83	20.73 ± 10.60	<0.001*
	After 1 day	65.75 ± 21.72	11.87 ± 6.07	
	After 2 days	63.68 ± 28.40	10.37 ± 5.30	
	After 3 days	44.45 ± 20.06	9.23 ± 4.82	
Chiclets gum (n = 20)	Before	296.9 ± 146.6	31.83 ± 38.80	<0.001*
	After 1 day	197.2 ± 96.38	23.67 ± 28.67	
	After 2 days	179.7 ± 96.68	22.19 ± 27.09	
	After 3 days	163.9 ± 80.19	19.89 ± 26.20	

TABLE (2): Comparison between the three studied groups according to the percentage of reduction in counting *S. mutans and lactobacilli* in each period.

Microorganis	Percentage of reduction	Mastic gum (n = 20)	Xylitol gum (n = 20)	Chiclets gum (n = 20)
S. mutans	After 1 day	44.28 ± 2.60	66.57 ± 7.05	33.38 ± 2.0
			p_1<0.001*, p_2=0.001*, p_3<0.001*	
	After 2 days	50.32 ± 1.73	70.02 ± 0.13	40.57 ± 11.51
			p_1<0.001*, p_2=0.002*, p_3<0.001*	
	After 3 days	64.92 ± 0.18	79.09 ± 2.92	44.69 ± 1.44
			p_1<0.001*, p_2<0.001*, p_3<0.001*	
Lactobacilli	After 1 day	33.06 ± 1.51	42.43 ± 2.41	25.33 ± 1.23
			p_1=0.001*, p_2<0.001*, p_3<0.001*	
	After 2 days .	37.20 ± 1.72	50.0 ± 0.0	30.36 ± 1.24
			p_1<0.001*, p_2<0.001*, p_3<0.001*	
	After 3 days	43.16 ± 3.70	56.23 ± 2.79	36.26 ± 26.05
			p_1=0.001*, p_2=0.007*, p_3<0.001*	

p: p-value for comparing between the studied groups

p_1: p-value for comparing between Group I and Group II.

p_2: p-value for comparing between Group I and Group III.

p_3: p-value for comparing between Group II and Group III.

**: Statistically significant at $p \leq 0.05$.*

DISCUSSION

The process of chewing playing a significant role in the stimulation of saliva and increase of SFR and hence decreasing the rate of caries [10]. The chewing of food that did not contain sucrose could be able to inhibit the metabolization of the colonized bacteria and the production of acid [2,11].

The sweetened chewing gum usually contributes to the incidence of dental caries [2]. However, the manufacturer recently introduces chewing gum with sugar-free or sugar-less to reduce the risk of caries incidence associated with the sweetened chewing gum [9-11]. Usually, sugar-free chewing gum is sweetened with sugar substitutes such as xylitol, mannitol, sorbitol, and maltitol [11].

In this study, saliva was chosen as an oral sample for testing the *S. mutans* and *Lactobacilli* oral pathogens. As it is considered an easy and non-invasive way to obtain oral material that containing pathogens from different locations including supra and sub-gingival plaque as well as mucosal surfaces[12]. Additionally, salivary microorganisms have been stated as a diagnostic marker for tooth caries[13].

In the present study saliva samples were collected by spitting, because of that, the spitting method in saliva collection could be performed by the children easily [2]. Moreover, in the present study we selected unstimulated saliva to detect the oral pathogens this may be because unstimulated saliva samples were preferred because it is easier and it reflects accurately the caries risk in every individual [14]. Also, children aged between 6-12 years were chosen for this study, since the chewing gum habit is a practice that is well adopted among preadolescent individuals [15].

According to the results of this study, the use of all types of chewing gums has a significant reduction in *S. mutans* and *Lactobacilli* count in the collected saliva. Moreover, the use of chewing gum resulted in a gradual reduction in these bacteria from baseline to day three of use. This may be because the stimulation of saliva during chewing resulted in an increase in SFR which acts as a washing bath that prevents the accumulation of food debris and disturb microbial colonization [16]. Moreover, this may be due to the increased buffer capacity of the stimulated saliva via its tribble buffering system namely; bicarbonate, phosphate, and protein buffer systems [17].

Also, the results of this study exhibited that the use of sugar-free chewing gum (xylitol) significantly decreases the count of *S. mutans and Lactobacilli* in saliva when compared to the sugar-less and sugar-containing chewing gum at the different tested time intervals. This may be due to the presence of sucrose (the simplest phase of polysaccharide) in chiclets chewing gum which play an important role in the metabolization of bacterial and hence its growth [2,9,11]. And in mastic gum it may be inappropriate to use it with children and young people due to the unpalatability of the taste, while the sugar-free chewing gum has non-fermentable sugar substitutes as a sweetened agent, have a palatable taste and hence inhibits bacterial metabolization [18].

CONCLUSION

From the results of this study, it was concluded that the use of chewing gum significantly reduces the count of *S. mutans and Lactobacilli*.

Xylitol gum is the most effective in decreasing Streptococcus Mutas and lactobacilli count in saliva compared to Chiclets gum and Mastic gum.

However, the use of sugar-free chewing gum significantly reduces these bacteria when compared to sugar-less or sugar-containing chewing gum.

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