

Original Article

The effect of sugar-free and sugar chewing gums on plaque deposition

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ABSTRACT

Background: Chewing gum is a habit practiced regularly by a relatively high proportion of individuals in many countries including India, and its use has increased within the last decade. The aim of this study was to determine the effects of sugar-free and sugar chewing gums on plaque deposition.

Materials and Methods: The study is a double blind clinical trial involving 16 healthy volunteers (divided into 2 groups) in a 4-day plaque regrowth model. On day one, subjects received professional prophylaxis, suspended oral hygiene measures, and commenced chewing their allocated product. Gum chewing was one piece chewed for 30 minutes 3 times a day. On day 5, subjects were scored for plaque with the help of Silness and Loe Index.

Results: Results show sugar-free group have a lesser mean plaque score of 0.98 as compare to sugar group (1.23), though this difference was not statistically significant.

Conclusion: The sugar-free gums can be used as an adjunct to mechanical oral hygiene measures.

Key Words: Dental plaque, oral hygiene, sugar-free chewing gum

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INTRODUCTION

Chewing gum is a habit practiced regularly by a relatively high proportion of individuals in many countries including India, and its use has increased within the last decade. In 1999, available data suggested that some 374 billion pieces of chewing gum were sold worldwide, representing approximately U.S. \$5 billion.^[1] Besides the obvious pleasant taste imparted by flavors and sweetening agents in chewing gum, the practice has the potential to benefit oral and dental health.^[2]

The introduction of sugar-free or sorbitol-containing chewing gums renewed interest in this aspect of diet, and caries reduction with sugarless and sugar phosphate products was reported by Finn and Gimision.^[3] Short-

term plaque studies on the other hand demonstrated that sugar-free gums neither altered plaque accumulation nor removed established plaque.^[4,5]

Mechanical supragingival plaque control is the most rational and efficient method for the prevention of periodontal diseases.^[6] Daily removal of plaque by the patient is also of concern for a beneficial long-term treatment outcome.^[7,8] The majority of individuals find difficult or impossible to comply with a proper oral hygiene regimen. Moreover, even in those patients who do achieve high levels of oral cleanliness, plaque control deteriorates over time.^[9,10]

The effective use of mechanical devices to reduce dental plaque, in fact, is highly dependent on compliance with oral hygiene instructions given by dental professionals. Reasons for non-compliance are many and may include level of education, domestic circumstances, disposable income, beliefs and attitudes regarding personal and oral care, stressful life events, psychomotor skills, frequency of dental visit, and age.^[11,12] Thus, a need exists for adjunctive methods of mechanical plaque removal that are simple, inexpensive, and convenient for use by patients.

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In the last decade, sugar-free chewing gum has been claimed to provide oral health benefits, including caries reduction and plaque control.^[1] The caries preventive effects of these products have been well documented in many experimental and clinical investigations.^[1,3] The mechanical cleaning effects of chewing gum have also been studied, but the results on the antiplaque efficacy, particularly at the smooth (buccal and lingual) surfaces of the teeth, have been equivocal.^[1,2]

Indirect effect of chewing gums to oral health could be through salivary flow stimulation and mechanical tooth cleaning.^[2] Supragingival plaque is exposed to saliva and to the natural self-cleansing mechanisms existing in the oral cavity. The maintenance of an effective plaque control is the cornerstone of any attempt to prevent and control periodontal disease.^[10]

The aim of this study was to investigate the effects of sugar-free and sugar-containing gums on both plaque formation and established plaque over the whole surfaces of the teeth.

MATERIALS AND METHODS

A concurrent parallel double blind randomized control trial was designed involving 16 subjects (11 female and 5 male students) from a dental college, aged 20 to 25 years, who volunteered to participate in this 4-day plaque regrowth study. The subjects were selected on the basis of definite inclusion criteria of having 20 healthy natural teeth free from conservative restorations. Exclusion criteria included with no signs of periodontitis, temporomandibular joint disorder, malocclusion, or xerostomia and no medical or pharmacotherapy history that could affect the result of the study. The subjects who could not fulfill the set inclusion criteria were excluded from the final sample.

The total sample size of 16 was deliberately taken with the help of similar studies conducted around the world considering a total of 11 samples by Hanham and Addy,^[2] 12 samples by Pizzo *et al.*,^[14] 10 samples by Addy *et al.*,^[15] and 12 samples by Pizzo *et al.*^[16] Along with this, a pilot study was conducted on six samples (each $n = 3$); based on pilot study, sample size was calculated. Alpha level was set to the conventional 0.05. The study was powered (85%) to detect a difference in means of 2 units on the primary outcome variable using a 2-sided significance level *t*-test; therefore, a total of 16 subjects were recruited for the present study. The subjects who have given the consent and satisfied the

criteria of the study were given a through prophylaxis, polishing, and flossing in order to obtain zero baseline plaque, and randomly allocated into group A (sugar containing) and group B (sugar-free) of eight each.

Participating subjects were supplied with chewing gums which were similar in appearance and sufficient in quantity for the complete study period. The gums were provided in unmarked boxes, each coded with the subject's identity and the study period, along with verbal and written instructions on their use. The products tested are shown in Table 1, together with the active ingredients and the manufacturers. They were asked to chew one piece of chewing gum for 30 minutes 3 times a day after meal and to suspend all oral hygiene practices like brushing, mouth rinsing during the study period.

The subjects were also requested to maintain their customary dietary habits, but during the first hour after a chewing gum they avoided eating and drinking. On the 5th day, subjects were scored for plaque with the help of Silness and Loe Index.^[17]

The scoring criteria: (Silness and Loe – 1964).^[17]

0 – No plaque

1 – A film of plaque adhering to the free gingival margin and adjacent area of the tooth. The plaque may be seen *in situ* only after application of disclosing solution or by using the probe on the tooth surface.

2 – Moderate accumulation of soft deposits within the gingival pocket, or the tooth and gingival margin which can be seen with the naked eye.

3 – Abundance of soft matter within the gingival pocket and/or on the tooth and gingival margin.

The scores of the sugar and sugar-free chewing gum group were analyzed by using “Mann-Whitney U” test. A *P* value of less than 0.05 was considered statistically significant. All the data collected were tested for normality before entering for analysis using SPSS 11.0 version software.

The study design was approved by the local ethical committee and conformed to the requirements of the “Declaration of Helsinki” as adopted by the 18th World Medical Assembly in 1964 and subsequently revised.^[18]

RESULTS

Table 2 illustrates the mean PI scores in relation to upper and lower arch. There has been higher mean scores for upper and lower arch by sugar-containing

gums (1.39 and 1.05) when compared with sugar-free gums (0.98 and 0.96). And, similar results were found when the total mouth PI scores were compared between the two gums, i.e., 1.22 and 0.97, respectively. Result difference was statistically significant when tested among the sugar-containing and sugar-free gums of upper arch.

In Table 3, the mean PI scores among the anterior and posterior arches when tested for the sugar-containing and sugar-free gums revealed higher mean PI scores for sugar-containing gums, i.e., 1.10 and 1.32, among anterior and posterior arches, respectively.

In Table 4, the mean PI scores for upper and lower left quadrant were found to be lower in comparison to the upper and lower right quadrant. And, higher mean PI scores were reported in sugar-containing gums of all the four quadrants, i.e., 1.37, 1.42, 1.12, and 0.98, respectively. Significant difference has been shown for upper left quadrant between the sugar-free and sugar-containing gums.

In Table 5, the mean PI scores were found to be lower in upper lingual teeth (i.e., 0.65) in comparison with buccal and lingual surfaces of upper and lower arches.

DISCUSSION

The chewing gum is a common habit in many countries and belief exists amongst the general public that as with fibrous foods, chewing gum has cleansing effect on the teeth and gingiva. Some support for mechanical cleansing by chewing gum can be found in earlier reports.^[19,20]

Despite the lack of evidence for long-term benefits of chewing gum on dental health, some short-term advantages resulting from the mechanical removal of debris may be derived.^[15,20] With such objectives to test the efficacy of chewing gum containing sugar or sugar free in a 4-day double blind study was designed.

In the present study, the results showed that there is minimal difference between the sugar-free and sugar-containing gums. This indicates that sugar-free and sugar-containing gums do not have much effect on plaque accumulation. Similar results were reported by Addy *et al.*^[15] and Turesky and Bibby.^[20]

There was no significant reduction in plaque accumulation with sugar-containing chewing gums in the present study. Such results have been supported by other authors such as Bratthall and Ainamo

Table 1: Chewing gums, active ingredients, and manufacturers

Chewing gum	Active ingredients	Manufacturers
Chiclets	Sugar, Gumbase, Glucose Syrup (Dextrose, maltose), Glycerine, Lecithin, softner, Flavour.	Krafts Foods U.S
Orbit	Mannitol, Xylitol Soyabean Lecthin, Aspartme, Sweetner Acesulfame K, Glazing Agent, BHT (freshening agent)	Wrigley Private limited India

Table 2: Mean PI scores in relation to upper and lower quadrant in sugar containing and sugar-free gums (Mann-Whitney U test)

	Group	Mean	SD	Z-value	P value	S / NS
Total mouth	Sugar gums	1.22	0.28			
	Sugar free gums	0.97	0.30	-1.36	0.17	NS
Upper arch	Sugar gums	1.39	0.27			
	Sugar free gums	0.98	0.22	-2.41	0.01	S
Lower arch	Sugar gums	1.05	0.37			
	Sugar free gums	0.96	0.40	-0.42	0.67	NS

S: Significant, NS: Non Significant

Table 3: Comparison of Mean PI scores in anterior and posterior quadrant in relation to sugar containing and sugar-free gums (Mann-Whitney U test)

	Group	Mean	SD	Z-value	P value	S / NS
Anterior	Sugar gums	1.10	0.44			
	Sugar free gums	0.69	0.31	-1.83	0.06	NS
Posterior	Sugar gums	1.32	0.23			
	Sugar free gums	1.18	0.33	-0.84	0.40	NS

NS: Non Significant

Table 4: Comparison of Mean PI score in all four quadrants in relation to sugar containing and sugar-free gums (Mann-Whitney U test)

Quadrants	Group	Mean	SD	Z-value	P value	S / NS
Upper right	Sugar gums	1.37	0.37			
	Sugar free gums	1.01	0.25	-1.83	0.06	NS
Upper left	Sugar gums	1.42	0.22			
	Sugar free gums	0.96	0.27	-2.99	0.01	S
Lower right	Sugar gums	1.12	0.44			
	Sugar free gums	0.97	0.40	-0.36	0.71	NS
Lower Left	Sugar gums	0.98	0.33			
	Sugar free gums	0.95	0.46	-0.31	0.75	NS

S: Significant, NS: Non Significant

et al.^[4,5] The reduction in plaque reported may be due to the mechanical forces that little amount of

Table 5: Comparison of Mean PI scores buccal and lingual surfaces in relation to sugar containing and sugar-free gums (Mann-Whitney U test)

Group	Buccal surfaces				Lingual surfaces			
	Upper arch		Lower arch		Upper arch		Lower arch	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Sugar gums	3.30	0.42	2.46	0.67	1.17	0.06	1.26	0.36
Sugar-free gums	2.30	0.32	2.06	0.58	0.65	0.45	1.06	0.45
Z-value	-2.7831		-1.4703		-1.4703		-0.4726	
P value	0.0054		0.1415		0.1415		0.6365	
S / NS	S		NS		NS		NS	

S: Significant, NS: Non Significant

plaque is removed henceforth. Gum chewing elicits an increase in saliva flow rate which increase the buffering capacity of saliva and concurrently leads to an enhanced clearance of fermentable carbohydrates from the mouth.^[14]

The low scores recorded lingually on the lower teeth and palatally on the upper teeth in the present study would suggest that natural cleansing mechanisms of foods do alter plaque coverage of tooth surfaces and similar results were found in the another study.^[15,20]

Nevertheless, since no detrimental effects of chewing gum on the incidence of caries have been reported in the present study and since sugar-free chewing gum may actually reduce the incidence of caries, the chewing of gum cannot at this time be considered a hazard to dental health. However, it is still tempting to concur with the suggestions of Ainamo *et al.*^[5] that people who chew gum should be encouraged to use the now readily available sugar-free gums. Such preparations may also act as suitable replacements for other confectionary of known cariogenic potential.

Based on the available evidence, the chewing of sugar-free gum after meals has been recommended as a way to prevent caries, even if no mechanical oral hygiene can be performed.^[1,13]

Similar studies done on plaque control other than chewing gums employing fibrous food such as carrot have been undertaken by Lindhe and Wicen^[21] and Reece and Swallow.^[22]

CONCLUSION

It is concluded from these studies that chewing gum is capable of removing plaque deposits from the more

exposed aspects of tooth surfaces and will reduce the presence of salivary debris immediately after eating food.^[15,20]

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