Original Article

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COMPARATIVE EVALUATION OF THE EFFECT OF DIFFERENT TYPES OF CHEWING GUMS ON SALIVARY PH-AN INVIVO STUDY

Rani Somani, * Shipra Jaidka, ** Deepti Jawa Singh, *** Prabhav Chauhan †

* Professor & Head, Department of Pedodontics & Preventive Dentistry, DJ College of Dental Sciences & Research, Modinagar, Uttar Pradesh, India
** Professor, Department of Pedodontics & Preventive Dentistry, DJ College of Dental Sciences & Research, Modinagar, Uttar Pradesh, India
*** Reader, Department of Pedodontics & Preventive Dentistry, DJ College of Dental Sciences & Research, Modinagar, Uttar Pradesh , India
† Post Graduate Student, Department of Pedodontics & Preventive Dentistry, DJ College of Dental Sciences & Research, Modinagar, Uttar Pradesh, India

ABSTRACT

AIMS: The present study was done with the aims and objective to comparatively evaluate the effect of various chewing gums (sugarfree gum & sugared gum) on salivary pH. **METHOD:** The study was done on 90 children 6-12yrs of age. Subjects were divided equally into two groups-the experimental group and the control group. The experimental group was further divided into two –the one group chewing the sugarfree gum and the one group chewing the sugar containing gum. The pH of the saliva was noted with the help of pH meter before chewing, and subsequently after chewing at intervals of 5 minutes,10 minutes and 15 minutes after chewing gum respectively. **RESULTS:** The results showed that the there was significant difference in the oral cavity pH when compared between sugarfree and sugar containing gum. **CONCLUSION:** Thus it can be illustrated that the sugarfree gum is a food of choice in promoting salivary flow therby reducing the acidogenicity of oral cavity and resulting in reduction of caries.

KEYWORDS: Chewing gums; saliva, pH; dental caries

INTRODUCTION

An ounce of prevention is better than a pound of cure. The dental caries is once such disease which can be prevented if appropriately and timely diagnosed. It is the most common disease affecting children worldwide. The formation of dental caries is a process in which the mineral tissue of the teeth is dissolved by acid produced by microbes. It is not merely a simple demineralization; rather it is considered as a dynamic process including demineralization by the organic acids originated from microorganisms and further remineralization by saliva components.[1] A reduction in pH below critical pH i.e 5.5 is associated with demineralization and thus increase in pH above critical pH is usually associated with remineralization.[2] As seen after every meal there is a decrease in the pH of saliva and to overcome this decrease in pH certain substances have been introduced which when chewed increases the pH of saliva to a safe level.

There are number of food items that regulate salivary flow rate and effect the acidogenicity of saliva like some medicines, lollipops, toffees, acidic candies and more recently the chewing gums. Chewing gum is a food which is widely liked especially by children. Usually chewing gums contain high level of sugars which favours the process of demineralization. Apart from this chewing of gums repeatedly stimulate saliva production thus increasing its buffering action. Thus to overcome this negative effects of sugars in chewing gums, recently sugarfree chewing gums have been introduced to negate the effect of fermentable carbohydrates in the sugar containing gums.[2] Furthermore it has been well established that sugarfree chewing gum has an anticariogenic effect. Such effect is ascribed to the action of two factors, that are, saliva stimulation through the chewing process and integration of dietary polyols.[3] Xylitol is one such substance that has been used as a substitute for refined white sugar for more than 30 years. Xyltol has been approved by the food and drug administration since the 1960's and is safe for children. Since then it has been used as a sweetener in various food and food

Table 1: Mean percentage variation of salivary pH at different time intervals in various groups

GROUPS	BASELINE pH (Mean)	% INCREASE OF SALIVARY pH IMMEDIATELY AFTER CHEWING (Mean)	% INCREASE OF SALIVARY pH AFTER 5 MIN OF CHEWING (Mean)	% INCREASE OF SALIVARY pH AFTER 10 MIN OF CHEWING (Mean)	% INCREASEOF SALIVARY pH AFTER 15 MIN OF CHEWING (Mean)
Group A (Control)	7.22	9%	9%	7%	5%
Group B (Sugared Gum)	6.78	-3%	-5%	-1%	2%
Group C (Sugarfree Gum)	6.86	4%	16%	16%	14%

Table 2: Distribution of variance between the groups using Anova test

% Difference Of Salivary pH after chewing gum/ paraffin		Sum of Squares	df	Sig.
IMMEDIATELY	Between Groups	5543.362	2	.000
	Within Groups	12163.170	87	
	Total	17706.533	89	
FIVE MINUTES	Between Groups	6712.050	2	.000
	Within Groups	8623.785	87	
	Total	15335.835	89	
TEN MINUNTES	Between Groups	4999.044	2	.000
	Within Groups	4616.296	87	
	Total	9615.340	89	
FIFTEEN MINUTES	Between Groups	2125.065	2	.000
	Within Groups	6931.612	87	
	Total	9056.677	89	

products. Thus the aim of present study was to comparatively evaluate the effect of various chewing gums (sugarfree gum & sugared gum) on salivary pH.

MATERIALS & METHODS

The study was carried out in the department of Pedodontics and Preventive Dentistry in DJ College Of Dental Sciences and Research, Modinagar in collaboration with primary school i.e Saraswati Shishu Mandir, Gadana, Modinagar, UP. The school children were selected so that the procedure can be standardized and monitored appropriately. Prior Consent was taken from the parents of all children on whom the study was conducted.

SELECTION OF SAMPLES

A total of 130 students were screened out of which 90 children with DMFT/deft score zero were selected for the study. DMFT/deft scores were recorded according to WHO criteria. Subjects were divided into three groups, containing 30 children each.

Group A: Control group(paraffin)

Group B: Sugared gum group (Center Fresh Gum)

Group C: Sugarfree gum (Xylitol Gum)

COLLECTION OF UNSTIMULATED AND STIMULATED SALIVA

Collection of unstimulated saliva sample for all 90 subjects was done to get the baseline pH value. The children were advised to refrain from intake of any food or beverage (water exempted) one hour before the test session. The subjects were advised to rinse his or her mouth twice with deionized (distilled) water and then to relax for five minutes. The subjects were then instructed that during the collection they should make every effort to minimize movement, particularly movements of their mouth. They were then asked to swallow the saliva. Then keeping their head

Table 3: Intercomparison of mean percentage variation of salivary pH of different groups at various time intervals

Dunnett T3

Dependent Variable	(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.
% DIFF. OF SALIVARY pH IMMEDIATELY AFTER CHEWING OF GUM/PARAFFIN	Group A	Group B	11.67950*	3.59068	.008
		Group C	-7.38372*	1.43459	.000
	Group B	Group A	-11.67950*	3.59068	.008
		Group C	-19.06322*	3.60698	.000
	Group C	Group A	7.38372*	1.43459	.000
		Group B	19.06322*	3.60698	.000
% DIFF. OF SALIVARY pH FIVE MIN. AFTER CHEWING GUM/PARAFFIN	Group A	Group B	13.97272*	3.01065	.000
		Group C	-6.76773*	1.31699	.000
	Group B	Group A	-13.97272*	3.01065	.000
		Group C	-20.74044*	3.00438	.000
	Group C	Group A	6.76773*	1.31699	.000
		Group B	20.74044*	3.00438	.000
% DIFF. OF SALIVARY pH TEN MIN. AFTER CHEWING GUM /PARAFFIN	Group A	Group B	9.52458*	2.13681	.000
		Group C	-8.72526*	1.26613	.000
	Group B	Group A	-9.52458*	2.13681	.000
		Group C	-18.24984*	2.10788	.000
	Group C	Group A	8.72526*	1.26613	.000
		Group B	18.24984*	2.10788	.000
% DIFF. OF SALIVARY pH FIFTEEN MIN. AFTER CHEWING GUM/PARAFFIN	Group A	Group B	3.06225	2.65461	.581
		Group C	-8.42981*	1.39593	.000
	Group B	Group A	-3.06225	2.65461	.581
		Group C	-11.49206*	2.63423	.000
	Group C	Group B	8.42981*	1.39593	.000
		Group A	11.49206*	2.63423	.000

lean forward with mouth slightly open over the test tube and funnel, 10 ml of saliva was collected. While for the collection of stimulated saliva in various groups, all of 30 subjects in each group were first instructed to sit motionless. After that a chewing gum or a cylindrical block of paraffin of 1.5 cm height and 1cm diameter was given to them to simulate the size of chewing gum. They were asked to chew it for 2 minutes. After every one minute, subjects were asked to spit saliva into the tube without swallowing by keeping the head lean forward over the funnel. The subjects spitted out, kept chewing (after first minute), spitted out, kept chewing (after second minute). This procedure of saliva collection was stopped after 10ml of saliva was collected. Then subjects spitted out the chewing gum/paraffin and the collection of stimulated saliva was repeated for all the groups after 5 minutes, 10 minutes and at 15 minutes and salivary pH recorded with the help of digital pH meter (Fig. 1).

CALIBRATION OF THE pH METER

The pH meter was calibrated daily before the start of the study. For calibration, first the bulb of the electrode was dipped in a standard solution of pH buffered at 4. The reading obtained displayed were adjusted to pH 4. Then the bulb was dipped in a standard solution of pH buffered at 7 and

reading if required adjusted to pH 7. The bulb was again dipped in a solution of pH buffered at 4 to check if the reading displayed is correct, otherwise re calibration was done.

RECORDING OF SALIVARY PH

To record the pH of the saliva, the bulb of the electrode was dipped in the test tube containing the saliva and the pH obtained was displayed immediately as a digital reading on the body of the pH meter. Thus for various groups the salivary pH of unstimulated (baseline) and stimulated saliva was calculated (Fig. 2).

RESULTS

Collected data was tabulated & statistically analysed using Anova test and Dunnett test. It was found out that the mean percentage values of salivary pH increased in group A (control group) and Group C (sugarfree gum) and decreased in group B (sugared gum). It increased to a maximum of 1% in Group A (control group) and 5% in the Group C (sugarfree gum). While in group B it decreased to 1% (Table 1). When the intercomparison of various groups was done using Anova test. The mean percentage variation of salivary pH was compared between different groups. The mean pH between experimental and control groups was found to be significant at $p>0.05$ at all time intervals (Table 2). However when the intercomparison of groups was done using dunnett test. The intercomparison of mean percentage difference showed highly significant results in all the groups except when mean percentage difference of salivary pH post 15 minutes from baseline pH was compared between group A (control group) and group B (sugared gum) (Table 3).

DISCUSSION

Dental caries is a multifactorial disease that results from the interaction between the bacterial biofilm, the environment (e.g., diet, saliva composition and flow rate, fluoride exposure) and the tooth structure. Thus there are four Essential Factors in the etiology of dental caries (Keyes, 1960) which are, the presence of a susceptible host tissue i.e., the tooth, Microflora with a cariogenic potential, a suitable local substrate to meet the requirements of the pathogenic flora and presence of all these factors at a suitable period of Time.[4] So if we aim to reduce the occurrence of any one factor we would be able to reduce dental caries drastically. Oral cavity is a battle ground of demineralization and remineralization and saliva plays an important role in maintaining the equilibrium by its buffering action, from Ca & P ion present in it and flow rate etc. Salivary buffering capacity prevents reduction in pH by neutralizing acid in oral cavity after sugar intake This buffering equilibrium gets disturbed either positively or negatively during meal times, sleeping, by oral hygiene maintenance etc.[5] In terms of eating patterns, the work of Geddes and Glasgow has shown that if a “meal” includes an item which contains carbohydrate such as sucrose, glucose, or fructose that can be fermented rapidly by the acidogenic microorganisms in saliva, there will be rapid acid production and the salivary pH will fall. Moreover, if one sugary item is followed by another, the demineralizing potential may be enhanced. Other items eaten immediately before, during, or after the consumption of the sugary item can influence the salivary pH. If the non-sugary item stimulates salivary flow, it will have a pH- raising effect. Because the protective effects of saliva (including clearance) are increased greatly by stimulation, strategies for salivary stimulation should be considered as part of an overall preventive regime for an at-risk patient. These may include eating patterns which lead to saliva stimulation, as well as the use of stimulants e.g., toffees, lozenges, lollipops, chewing gums etc. However toffees, lozenges etc, increases the salivary flow but has more deleterious effect due to their sugar content and sticky nature. Chewing gum on the other hand not only stimulates salivary flow but also has a mechanical cleansing action and thereby augments its protective properties (e.g. buffering, pH, and supersaturation with minerals).[6] Chewing sugar-free gum is an important preventive oral health behaviour. As chewing of sugar-free gum elevates salivary pH and thus favours mineralisation. The inclusion of polyols such as xylitol into chewing gums improves the oral health benefits which can be gained by regular gum chewing. These polyols are unable to be fermented, and may directly inhibit plaque formation by biochemical effects on dental plaque microorganisms. It is important to stress that sugar (sucrose) containing gums must be avoided as these are less stimulatory to salivary flow than sugar-free gums. Sugar-containing gums do not

Fig. 1: Collection of unstimulated and stimulated saliva

Fig. 2: Recording of salivary pH

promote mineralisation but rather can be directly cariogenic through sustained release of sucrose.[7]

In the present study it was found that the mean percentage value of salivary pH increased in the sugarfree chewing gum group (14%) and control group (5%) from the measured baseline pH and decreased in sugared chewing gum group (1%) from measured baseline pH. This was observed because when patients chew sugarfree chewing gum, the increased volume and flow of saliva helps to dilute and clear plaque acids that can initiate the demineralization process. In addition, an increase in salivary flow rate buffers and raises salivary pH, thus reducing the potential time that demineralization of teeth can occur in an acidic environment. Moreover with sugarfree chewing gum the presence of fermentable carbohydrate is also not there and the sugar substitute such as xylitol is added which is non-fermentable and thus reducing the acid production and fall in pH. The increase in salivary volume and flow of saliva was also seen in control group, however there is less increase in bicarbonate ions as a consequence of its less stimulatory effect.[12] While with the sugared chewing gum this stimulatory effect is over rided by the simultaneous presence of the fermentable carbohydrates like sucrose which is easily metabolized by bacteria to form plaque acids, with unfavorable consequences on the salivary pH.[8] This is similar to the results seen in a study done by Shikhar Kumar *et al*., in which they compared the effect of sugarfree and sugared gum on the pH of saliva and found out that the chewing of sugarfree gum effectively raises the pH of saliva while the sugared gum decreased it. When intergroup comparisons between the experimental groups were made it was found out that the mean pH fall or rise was found to be significant at $p>0.05$ at all time intervals. This is because of the fact that sugarfree chewing gum raises the pH of saliva whereas the sugared chewing gum decreased it thus making the large difference in the values obtained.

CONCLUSION

Following conclusions were drawn from the study:

1. The acidogenic potential of sugared chewing gum was more as compared to sugarfree chewing gum.
2. Both sugarfree and sugared chewing gum affects the salivary pH significantly.
3. Chewing paraffin wax raises salivary pH but not as effectively as the sugarfree gum.
4. There was significant increase in the salivary pH on chewing sugarfree chewing gum from measured baseline value.
5. Significant decrease in the salivary pH was observed after chewing sugared chewing gum from measured baseline value.

Thus it is concluded that the sugarfree gums can be used as a caries preventive agent when used as an adjunct in the diet.

CONFLICT OF INTEREST & SOURCE OF FUNDING

The author declares that there is no source of funding and there is no conflict of interest among all authors.

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