

# Comparative Evaluation of the Effects of Xylitol Sugar Free Chewing Gum and Recaldent Sugar Free Chewing Gum on Salivary pH in Children

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## ABSTRACT

**Introduction:** There is a wide range of anticariogenic agents which serve to protect the tooth surface against caries development. This paper focuses on Xylitol and Recaldent™ chewing gums and their effect on the salivary pH of children. **Materials and methods:** For the study, sample size was 20 children and they were divided into two groups, and were given both types of chewing gums. **Results:** Although there was a significant increase in pH values of saliva after consumption of both Recaldent™ and Xylitol chewing gum, statistically it was not as significant. **Conclusion:** Xylitol shows anticariogenic potential together with salivary stimulation and antibacterial effect. To understand the effect of CPP-ACP on salivary pH, more studies with larger sample size need to be conducted so that it can be used as a preventive measure in control of dental caries.

**KEYWORDS:** chewing gum, pH, Recaldent™, Xylitol.

## INTRODUCTION

Dental caries, commonly known as tooth decay, is a multifactorial chronic condition; individuals are exposed to the risk factors that promote development of dental caries throughout their lives. Dental caries are formed due to a number of innate factors, like saliva, tooth surface morphology and external factors like general health, nutritional and hormonal status, diet and oral hygiene to name a few.

Saliva and its constituents affect the cariogenic bacteria and the subsequent development of dental caries. The lubricating and antimicrobial functions of saliva are maintained mainly by resting saliva. Saliva, being one of the most important protective factors against cariogenic agents, produces its effect by a kind of flushing mechanism which clears out noxious agents.<sup>1</sup>

Probably the most important caries-preventive functions of saliva are the flushing and neutralizing effects, commonly referred to as salivary clearance or oral clearance capacity. It has been well documented that the salivary flow rate is directly proportional to clearance mechanism. This high flow rate also leads to a higher buffer capacity.<sup>2</sup>

*Streptococcus mutans*, one of the major microbes implicated in the formation of dental caries, seems to be inhibited with the regular use of xylitol which is available

as sugar-free tablets, chewing gum, dentrifices and toothpaste. Its mechanism of action favours lactic acid production in dental plaque, and therefore causing a higher plaque pH which results in a difficult environment for caries formation. Keeping in mind the fact that a combination of mechanical cleaning and salivary stimulation gives further benefits compared to the anti bacterial effect alone of polyol, xylitol received further attention.<sup>2</sup>

Though human trials on the effects of CPP-ACP are pending, its effects have been demonstrated through animal and in situ caries models.<sup>3</sup>

Until the development of Recaldent (CPP-ACP), solutions of calcium phosphates had a low solubility and could not be readily incorporated into enamel. A new remineralisation technology has been developed, based on calcium and phosphate containing CPP-ACP, where it is claimed that CPP stabilizes high concentration of calcium and phosphate ions together with fluoride ions at the tooth surface.<sup>[4]</sup>

There aren't many studies pertaining to the effect of CPP-ACP on the pH of saliva, therefore this study was based on the salivary pH changes after consumption of CPP-ACP containing sugar-free chewing gum and then to compare it with sugar-free xylitol chewing gum.

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## MATERIALS AND METHODS

### Inclusion criteria:

- Age group 10 to 14 years
- Systemically healthy patients
- Dmft score less than 4.

### Materials:

- Salivary samples
- pH meter

**Methodology:** After ethical clearance from the institution, informed consent was obtained from parents prior to the start of the study. Twenty children within the age group of 10-14 years of age with dmft score less than 4 were selected were randomly and equally divided into two groups A & B. Baseline pH was obtained for all twenty children. At the start of the study, unstimulated saliva was collected from the children by asking them to expectorate the saliva (2ml) in a sterile test tube.

Children in group A were given Xylitol sugar-free chewing gum (Happydent protex Xylitol sugar free chewing gum), and Group B children were given Recaldent™ sugar-free chewing gum (GC Recaldent sugar-free chewing gum). They were asked to chew for 5 minutes, and the first sample of saliva was collected after 10 minutes. After 30 minutes collection of the second sample was done.

Results were obtained by assessing the salivary pH values with the help of a pH meter.

**Statistical Analysis:** The obtained data was analyzed using independent t-test and student paired t-test.

## RESULTS

An independent t-test was done to compare the mean values of baseline pH and values after 10 and 30 minutes of chewing gum in both Recaldent™ and Xylitol group and no statistically significant difference was seen (Table no. 1)

	Group	N	Mean	Std. Deviation	T	Df	P Value
Baseline Ph	Recaldent	10	7.425	0.38624	-0.083	18	0.935
	Xylitol	10	7.44	0.42206			
After 10 Mins	Recaldent	10	7.887	0.341209	-0.362	18	0.722
	Xylitol	10	7.953	0.465524			
After 30 Mins	Recaldent	10	7.79	0.276204	0.609	18	0.55
	Xylitol	10	7.714	0.282221			
Diff 10 Min Base	Recaldent	10	0.462	0.294988	-0.322	18	0.751
	Xylitol	10	0.513	0.404641			
Diff 30 Min Base	Recaldent	10	0.365	0.290259	0.637	18	0.532
	Xylitol	10	0.274	0.346256			
Diff 30 Min To 10 Min	Recaldent	10	-0.097	0.231855	1.186	18	0.251
	Xylitol	10	-0.239	0.299461			

Table no. 1. Independent T test. Shows mean values of baseline pH and values after 10 and 30 minutes of chewing gum in both the groups

According to the Students paired t-test (Table no. 2), there was a significant difference in Recaldent™ chewing

gum group between baseline pH and the pH values taken after 10 minutes and 30 minutes. No significant difference was found in the pH values taken after ten minutes and 30 minutes of chewing in this group (Fig 1). Xylitol chewing gum group had differences in between pH values taken after 10 minute and 30 minutes as well (Fig 1).

Grp	Pair		Mean	N	Std. Dev	Paired Differences		t	df	P Val
						Mean Dif	Std Dev			
Recaldent	Pair 1	Baseline Ph	7.425	10	0.38624	-0.462	0.294988	-4.953	9	0.001
		After 10 Minutes	7.887	10	0.341209					
	Pair 2	Baseline Ph	7.425	10	0.38624	-0.365	0.290259	-3.977	9	0.003
		After 30 Minutes	7.79	10	0.276204					
	Pair 3	After 10 Minutes	7.887	10	0.341209	0.097	0.231855	1.323	9	0.218
		After 30 Minutes	7.79	10	0.276204					
Xylitol	Pair 1	Baseline Ph	7.44	10	0.42206	-0.513	0.404641	-4.009	9	0.003
		After 10 Minutes	7.953	10	0.465524					
	Pair 2	Baseline Ph	7.44	10	0.42206	-0.274	0.346256	-2.502	9	0.034
		After 30 Minutes	7.714	10	0.282221					
	Pair 3	After 10 Minutes	7.953	10	0.465524	0.239	0.299461	2.524	9	0.033
		After 30 M	7.714	10	0.282221					

Table no. 2. Students paired t test. Shows significant difference in Recaldent™ chewing gum group between baseline PH and the pH values taken after 10 minutes and 30 minutes.

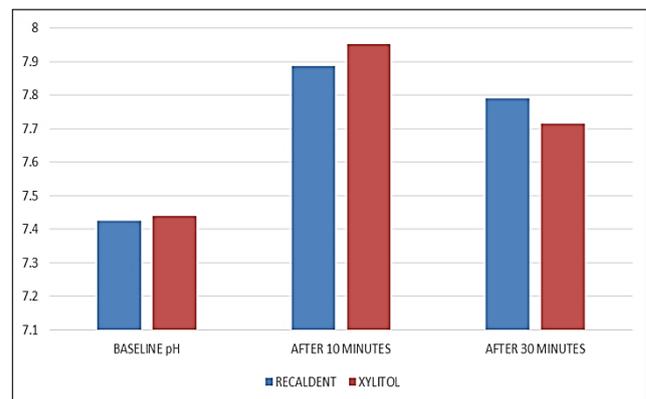


Fig.1. This graph here shows that the baseline pH for both Recaldent™ and Xylitol was around 7.45. And after 10 minutes of chewing pH increased to almost 7.9 in case of Recaldent™ and 7.95 in case of Xylitol. And after 30 minutes the pH decreased to 7.8 in case of Recaldent™ and 7.7 in case of Xylitol.

## DISCUSSION

The average baseline pH for all children participating in the study was 7.45 (Table no.1 & Fig 1). After checking the salivary samples taken after ten minutes of chewing xylitol chewing gum, it was seen that the saliva had become more basic. This finding is comparable to the pH values seen in the study conducted by Kumar et al. [1]

Irrespective of the type of chewing gum used, all stimulate saliva flow mainly owing to the chewing action. This aids in neutralization of reduction in plaque pH following a meal. Now it has to be noted that sugared gum is cariogenic, therefore chewing gums that are used for caries control purpose need to contain a non sugar sweetener. [5]

In a study done by Park et al, the authors compared the plaque pH effects of sugared and sugar-free chewing gums after an acidogenic challenge. The results of the study suggested that both types of chewing gums, when chewed for 20 minutes, reduced the fall in pH. However, the effect of sugar-free chewing gum was more effective.<sup>6</sup>

According to a study done by Dawes, the pH of unstimulated saliva was about 6.95. After chewing gum, the salivary pH decreased to 6.18 within the first minute of stimulation, and then rapidly increased to a level more than that of unstimulated saliva. When compared with lozenges both sucrose-containing and sucrose-free chewing gum, increased the pH instantly on stimulation, but after that the levels decreased slightly. These levels were significantly above the pH of unstimulated saliva.<sup>7</sup>

Cariogenic plaque bacteria do not have the ability to ferment xylitol. Therefore, plaque pH reduction does not occur. This means that enamel demineralization is prevented as the plaque bacteria don't have the ideal conditions to proliferate. This also means that the remineralisation process is enhanced. Growth of *mutans streptococcal* species is inhibited to a certain extent with regular use of xylitol chewing gum. Also, permanent reduction in the levels of oral *streptococcus mutans* bacteria is observed with this practice.<sup>5</sup>

In the present study, after chewing Recaldent™ chewing gum, an increase was seen in salivary pH values, and unlike the xylitol group, the pH values did not decrease in the samples taken after 30 minutes (Table no.2 & Fig 2).

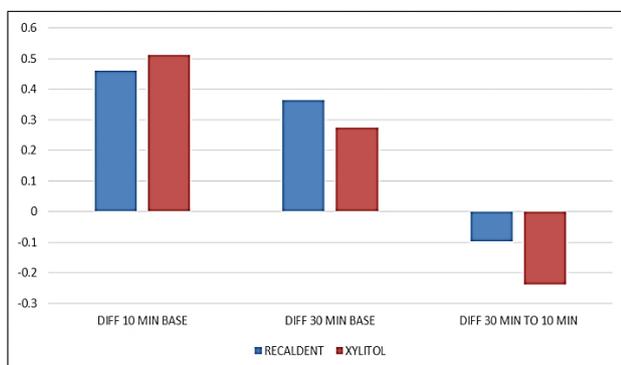


Fig.2.The differences in the pH are plotted in this graph.

Plaque enzymes such as phosphatases and peptidases partially degrade the cpp-ACP based products consequently increasing the pH due to production of ammonia. The basic process involved in tooth decay is due to the imbalance between the process of demineralization and remineralisation i.e., when the rate of demineralization exceeds the rate of rebuilding the enamel, it causes tooth decay. This process of remineralisation can be accelerated by the addition of amorphous calcium phosphate (ACP) by the addition of casein phosphopeptide (CPP).

Reynolds and Shen (2001) and Shen and Cai (2001) studied the ability of CPP-ACP sugar-free chewing gum to remineralize enamel subsurface lesions in human *in situ* model. They demonstrated that addition of CPP-ACP

to either Sorbitol-or Xylitol-based gum resulted in a dose-related increase in enamel remineralisation.<sup>[3]</sup>

CPP-ACP has been added to chewing gum in several, randomized, controlled, double-blind, *in situ* clinical studies. The sugar-free gums (control and CPP-ACP containing gums) were chewed for either 20 minutes periods, four times a day, or 5minute periods, seven times a day. Micro radiography and densitometry image analysis demonstrated that the CPP-ACP nano-complexes produced a dose-related mineralization of enamel subsurface lesions *in situ*, independent of gum type and chewing duration (e.g., 20 or 5 minutes).<sup>8</sup>

Yamanaka *et al.* (2003), evaluated the caries prevention potential of tooth mousse containing CPP-ACP and demonstrated its effect in preventing the enamel remineralisation *in vitro* and buffering capacity to acid produced by *S. mutans*.<sup>9</sup>

From extensive laboratory animal and human studies; it has been shown that casein phosphopeptide-amorphous calcium phosphate nano-complexes (CPP-ACP), have good anticariogenic potential, by localizing at the tooth surface and getting incorporated into dental plaque pH, depressing enamel demineralization, enhancing remineralisation, reducing the risk of caries development.<sup>10</sup>

When oral pH falls, the nanoclusters of ACP in CPP-ACP, release calcium and phosphate ions in form of CaHPO<sub>3</sub>, which is a unique soluble form. This is then transported into the tooth structure and it aids in enamel and dentin regeneration process. This, in turn, combined with other beneficial substances, can help fight tooth demineralization and thus restore the pH equilibrium of the mouth.<sup>9-10</sup>

## CONCLUSION

After chewing both Recaldent™ and Xylitol chewing gum, there was a significant increase in the pH of saliva. Also, chewing gum has the benefit of being easily accessible to the patients or users without need to consult a medical practitioner often.

This study, however, has not provided evidence on the long-term effect of Recaldent™ on the salivary pH. The results have also been affected by low sample size, level of oral hygiene, diet in the subjects from whom the salivary samples were taken.

Further studies need to be conducted to better understand the role of this molecule and its effect on the salivary pH so that it can be used as a preventive measure in control of dental caries.

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