Chewing maltitol or xylitol gums after an acidogenic challenge may induce similar benefits on remineralization

Author: Valerie MACIOCE
ROQUETTE
62080 Lestrem Cedex, France

Despite a decline in dental caries prevalence over the past 30 years, it remains unacceptably high in many developed countries (WHO, 2002).

Dental caries occur because of demineralization of enamel and dentine by acids produced by bacteria of the dental plaque, which are able to metabolize dietary carbohydrates (Arens, 1999). The remineralization process therefore plays a key role in the prevention of this disease. That is why a recent study conducted in Korea has evaluated the remineralization potential of sugars-free chewing gums containing either maltitol or xylitol (Lee *et al.*, 2009).

This 8-week randomized, double blind, controlled, cross-over clinical trial was conducted on 24 healthy adults (17 males, 7 females), aged 26 ± 2, according to a 4x4 latin square design as described in table 1. Every subject was instructed to chew for 7 days the allocated 2 gum pellets containing maltitol, xylitol or sugar (1.2 ± 0.1 g/piece) or gum base only, 7 times a day for 5 minutes between the regular meals. After each test week, there was a week of washout to stabilize the oral conditions.

Week	W1	W2	W3	W4	W5	W6	W7	W8
Group 1	GB		M		X		S	
Group 2	M	washout	X	washout	S	washout	GB	washout
Group 3	X		S		GB		M	
Group 4	S		GB		M		X	

GB=gum base, M=maltitol chewing gum, X=xylitol chewing gum, S=sugar chewing gum

Table 1: Study design and schedule

The subjects wore a removable appliance (figure 1) on which bovine enamel discs were positioned on the lingual side of the mandibular molars. Prior to be mounted on the appliance, the enamel specimens underwent an artificial lesion produced by a pH cycling procedure: this consisted in the immersion in a demineralizing solution followed by the immersion in a remineralizing one.

Figure 1: removable appliance

The demineralization and remineralization effects of chewing gums were evaluated following 3 methods :

Evaluation of microhardness through the measurement of the length of indentation made by a Vickers diamond.

A deep indentation (more negative value of ∆z) reflects a decrease in enamel microhardness. Figure 2 shows that compared to sugar gum, mastication of gum base, maltitol and xylitol gums lead to less deep indentations, that is to say to higher enamel microhardness, revealing a better mineralization.

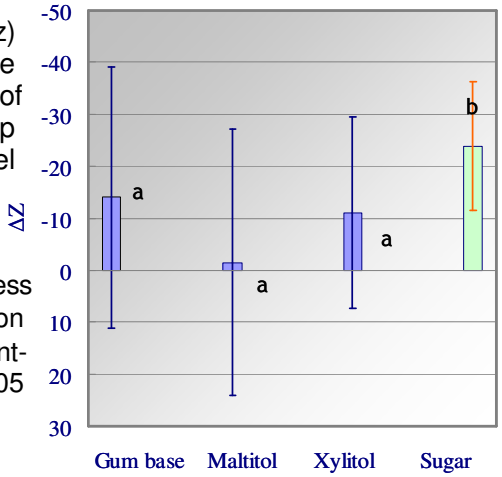

Figure 2: Mean value of microhardness
∆ Z: difference before/after gum mastication
a≠b means statistically different groups (Student-Newman-Keuls) with p<0.05

1. Evaluation of subsurface lesions by confocal microscopy

Confocal microscopy images gave a representation of enamel subsurface lesions. Surface analysis of these images allowed to measure the lesions' depth, as shown in figures 3 and 4.

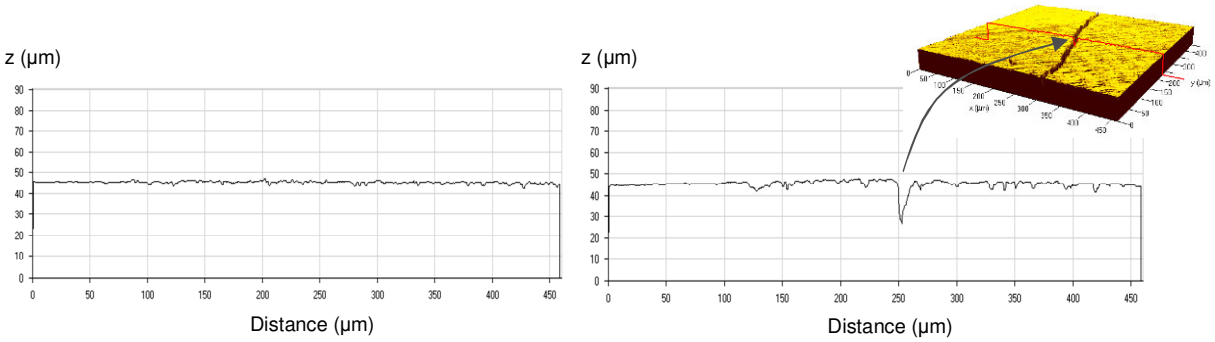

Figure 3 : enamel subsurface lesions before (left) and after (right) chewing **sugar gum**, evaluated by surface analysis of confocal microscopic images.

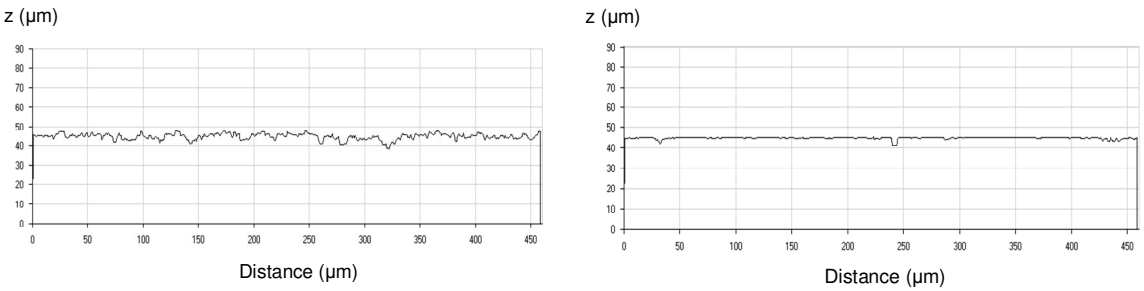

Figure 4: enamel subsurface lesions before (left) and after (right) chewing **maltitol gum**, evaluated by surface analysis of confocal microscopic images.

In the view of figures 3 and 4, it seems that subsurface lesions caused by the acidogenic challenge tend to be improved by chewing maltitol gum whereas chewing sugar gum tends to worsen them.

In each group, the mean value of z (enamel thickness) was measured before and after mastication and the difference between these two values (Δz) was displayed in figure 5. It showed that chewing maltitol, xylitol and gum base chewing gums lead to a better remineralization than chewing sugar gum.

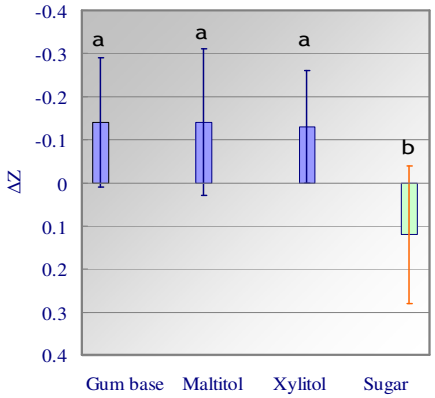

Figure 5: Mean values of confocal microscopy
ΔZ: difference between after gum mastication and before gum mastication
a≠b means statistically different groups (Student-Newman-Keuls) with p<0.05

2. Observation of the enamel subsurface lesions by images of Scanning Electronic Microscopy (SEM)

The images of SEM showed surface remineralization by coverage of dissolved enamel prism cores (figure 6). After chewing gums containing maltitol, xylitol or gum base, most of the enamel prism cores were covered, which indicates surface remineralization. However, the sugar gum group showed an enlargement of enamel prism core spaces.

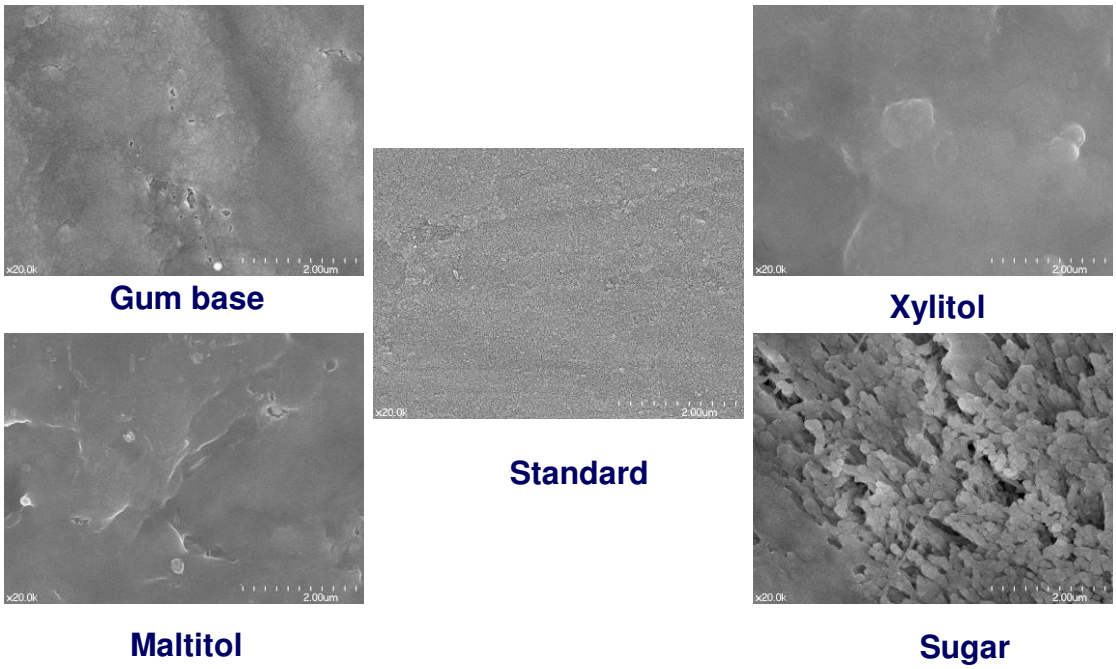

Figure 6: Observation of the enamel subsurface lesions by images of Scanning Electronic Microscopy

Conclusion

This study showed that the use of sugar-free chewing gum after an acidogenic challenge can enhance the remineralizing potential of the mouth. This is likely to be a result of increased plaque buffering by the stimulated saliva. Rapid restoration of plaque pH tends to restore remineralization.

This trial suggests that the effectiveness of maltitol or xylitol chewing gums could be similar in remineralization. Thus, both polyols may be useful as sugar substitutes in the context of dental caries prevention. It should be noted that recent studies have not only confirmed the similar effects of maltitol and xylitol but have also demonstrated that both polyols chewing-gums induced higher benefits than gum base on dental caries biomarkers (Thabuis *et al.*, 2010; Macioce *et al.*, 2010).

References

Arens U, ed. *Oral health – diet and other factors: the Report of the British Nutrition Foundation's Task Force.* Amsterdam, Elsevier Science Publishing Company, 1999.

Lee EJ, Jin BH, Paik DI, Hwang IK, 2009. Preventive effect of sugar-free chewing gum containing maltitol on dental caries *in situ*. *Food Sci Biotechnol* 18(2):432-435

Macioce V, Thabuis C, Zhong B, Wang X, Lefranc-Millot C, Berard M, Wils D, Guérin-Deremaux L (2010). Effect of maltitol or xylitol sugar-free chewing-gums on salivary parameters related to dental caries development. 57th ORCA Congress. *Caries Res* 44 *(in press).*

Thabuis C, Macioce V, Zhong B, Wang X, Lefranc-Millot C, Berard M, Wils D, Guérin-Deremaux L (2010). Effect of maltitol or xylitol sugar-free chewing-gums on plaque parameters related to dental caries development. 57th ORCA Congress. *Caries Res* 44 *(in press).*

WHO. Diet, nutrition and the prevention of chronic diseases. Report of a WHO Consultation. Geneva, World Health Organization, 2000 (WHO Technical Report Series, No. 916, p105-128).