

CURAPROX Enzycal.  
Scientific Background.



## Concerning Enzymes.

### ■ Lactoperoxidase in the prevention of plaque accumulation, gingivitis and dental caries (III)

Hugoson, A., Koch, G., Thilander, H., Hoogendoorn, H. (1974), *Odont. Revy*, 25, 69-80.

The existence of an antibacterial system in saliva and milk, consisting of the enzyme lactoperoxidase, a cofactor thiocyanate and hydrogen peroxide, has been recognised for many years. It had been shown that this system can be activated through hydrogen peroxide generation caused by addition of a combination of the enzymes amyloglucosidase and glucoseoxidase.

In this study, the effect of regular mouthrinses with amyloglucosidase and glucoseoxidase on plaque accumulation and the development of gingivitis and caries was analysed by using the model system of experimental gingivitis and caries in man. There was a testgroup using a mouthrinse containing amyloglucosidase and glucoseoxidase and a control group rinsing with a placebo solution. At the end of the experimental period a highly significant difference in caries distribution between the test and control groups was assessed, with a more pronounced aggravation of the caries lesions in the control group compared with the test group.

### ■ Clinical uses of an enzyme-containing dentifrice

Midda, M., Cooksey, M.W. (1986), *J Clin Periodontol*, 13, 950-956.

Previous studies have shown that the inclusion of certain enzymes in mouthrinses and dentifrices will reduce plaque and gingivitis scores. The enzymes that are most effective clinically have, as their active ingredients, amyloglucosidase and glucose oxidase. These produce hydrogen peroxide from dietary fermentable carbohydrates which in turn converts thiocyanate to hypothiocyanite in the presence of salivary lactoperoxidase. The resultant hypothiocyanite acts as a bacterial inhibitor by interfering with cell metabolism; thus, there is a reduction in plaque accumulation and therefore in gingival inflammation. Pilot studies have compared over a short period the action of the trial dentifrice with enzymes and fluoride at 1100 ppm, using as controls the paste without enzymes but with fluoride and a commercial fluoride paste. There was an expected reduction in all scores with all products due to the mechanical removal of plaque, but a significantly greater reduction in gingivitis was noted in the paste with enzymes.

This study is of longer duration with many more subjects. Baseline data include plaque and gingival indices and Periotron readings for crevicular fluid. The trial is of a double-blind non-crossover study design using a split-mouth technique. One side of the mouth is given a prophylaxis and the subject given one of the 3 test pastes to use. Readings were repeated every 2 weeks for 3 months. The results show a significant reduction in gingivitis scores in the enzyme-containing dentifrice group.

### ■ Enzymes in the acquired enamel pellicle

Hannig, C., Hannig, M., Attin, T. (2005), *Eur J Ora Sci*, 113, 2-13.

The acquired pellicle is a biofilm, free of bacteria, covering oral hard and soft tissues. It is composed of mucins, glycoproteins and proteins, among which are several enzymes. This review summarizes the present state of research on enzymes and their functions in the dental pellicle. Theoretically, all enzymes present in the oral cavity could be incorporated into the pellicle, but apparently enzymes are adsorbed selectively onto dental surfaces.

There is clear evidence that enzymes are structural elements of the pellicle. Thereby they exhibit antibacterial properties but also facilitate bacterial colonization of dental hard tissues. Moreover, the immobilized enzymes are involved in modification and in homeostasis of the salivary pellicle. It has been demonstrated that amylase, lysozyme, carbonic anhydrases, glucosyltransferases and fructosyltransferase are immobilized in an active conformation in the pellicle layer formed in vivo. Other enzymes, such as peroxidase or transglutaminase, have been investigated in experimental pellicles. Despite the depicted impact of enzymes on the formation and function of pellicle, broader knowledge on their properties in the in vivo-formed pellicle is required. This might be beneficial in the development of new preventive and diagnostic strategies.

### ■ Efficacy of enzymatic toothpastes for immobilisation of protective enzymes in the in situ pellicle

Hannig, C., Spitzmüller, B., Lux, H.C., Altenburger, M., Al-Ahmad, A., Hannig, M. (2010), *Arch Oral Biol*, 55, 463-469.

Different enzyme-containing toothpastes are available on the market. The aim of this in situ study was to investigate their efficacy for immobilisation of protective enzymes in the pellicle layer. Therefore three enzymatic toothpaste, enzymal, biotène and BioXtra, were tested in respect to their ability to enhance lysozyme, peroxidase and glucoseoxidase activity.

The results showed: Brushing with the toothpastes caused an extensive increase of glucoseoxidase activity in the pellicle. Peroxidase activity was enhanced considerably. Brushing without toothpaste had no effect on enzyme activities in the acquired pellicle. Conclusion: targeted immobilisation of enzymes in the in situ pellicle can be achieved with toothpastes.

## Concerning Sodium Lauryl Sulphate (SLS)<sup>1</sup>.

### ■ Toxicity of Sodium Dodecyl Sulphate and Other Detergents in Cultures of Human Oral Mucosa Epithelium

Arenholt-Bindslev, D., Bleeg, H.S., Richards, A. (1992), ATLA, 20, 28-38.

Up to 30% of the toothpaste applied to the toothbrush may be swallowed. This fact emphasizes the importance of the continuous assessment of possible long-term systemic effects of toothpaste ingredients. The aim of this study was to investigate the relative cytotoxic effects of the detergents sodium dodecyl sulphate, Triton X-100, sodium oleate, stearyl etoxylate, sodium cholate and sodium taurocholate. Sodium dodecyl sulphate and stearyl etoxylate are used as dentifrice ingredients. Cultures of human oral epithelial cells were exposed to dilutions of the detergents for five minutes. Acute cytomorphological changes and membrane damage were monitored.

Cytomorphological changes and cell proliferation were subsequently observed during the following week of recovery. Sodium dodecyl sulphate and Triton X-100 caused the most pronounced cytotoxic reactions, and it is concluded that more attention should be focused on the use of non-toxic detergents in oral hygiene products.

### ■ The effect of two toothpaste detergents on the frequency of recurrent aphthous ulcers

Herlofson, B.B., Barkvoll, P. (1996), Acta Odontol Scand, 54, 150-153.

The aim of the present clinical double-blind crossover study was to investigate the effect of two different toothpaste detergents, sodium lauryl sulfate (SLS) and cocoamidopropyl betaine (CAPB), as compared with a detergent-free paste, on 30 patients with frequent occurrences of recurrent aphthous ulcers. The study consisted of three 6-week periods during which the patients brushed twice daily with the different test toothpastes. The localization and number of new ulcers were assessed.

A significantly higher frequency of aphthous ulcers was demonstrated when the patients brushed with an SLS- than with a CAPB-containing or a detergent-free placebo paste. An SLS-free toothpaste may thus be recommended for patients with recurrent aphthous ulcers.

### ■ Increased human gingival blood flow induced by sodium lauryl sulfate

Herlofson, B.B., Brodin, P., Aars, H. (1996), J Clin Periodontol, 23, 1004-1007.

The aim of this study was to test the oral mucosal irritant potential of the toothpaste detergent SLS. Laser Doppler flowmetry was used in 14 subjects to investigate the effect of sodium lauryl sulfate (SLS) on gingival microcirculation. Gingival blood flow (GBF) was measured before and after application of 1.5% SLS for 90 s to the gingiva on one side. The contralateral side served as a control with water application only.

Relative changes in GBF were measured for 15 min on both sides. SLS increased the median GBF significantly between the 2nd and 10th min with a peak at 8 min. whereafter the flow decreased towards baseline. On the contralateral side, GBF initially declined before returning to baseline. 10 subjects felt a burning pain from the gingiva after SLS application and GBF increased in all of them. SLS increased the relative gingival blood flow presumably due to its penetrating and irritative properties, which resulted in vasodilatation. Laser Doppler flowmetry may be a useful non-invasive method for intraoral testing of different agents meant for oral use.

### ■ Irritation potential of seven dentifrices measured by the HET-CAM test

Kjaerheim, V., Rolla, G. (1996), J Dent Res, 75, 328 (Special Issue – abstract 2481).

The hen's egg chorioallantoic (HET-CAM) test has been introduced as an alternative method to the in vivo Draize rabbits eye test for irritation potential. The aim of this study was to find out if the test could serve as a model to examine a possible irritation potential of different substances to the oral mucosa. Seven common dentifrices were chosen to be tested: Denivit, Zendium, Colgate Total, Colgate Caries Control, Solidox G, Solidox F and Solidox Baking Soda. All of these brands, except Denivit and Zendium, contain the detergent sodium lauryl sulfate (SLS).

The results showed that all the SLS-containing dentifrices had high scores and therefore were categorized as strong irritants. Since these test results correspond well with those of many clinical studies it was concluded that the HET-CAM test proved a valid test to oral mucosal irritation potential.

<sup>1</sup> Also known as Sodium Dodecyl Sulphate (SDS).

## ■ Skin reactions and irritation potential of four commercial toothpastes.

Skaare, A., Kjaerheim, V., Barkvoll, P., Rolla, G. (1997), *Acta Odontol Scand*, 55, 133-136.

Skin reactions to 4 toothpastes were tested in 19 healthy dental students in a double-blind study. The hypothesis was that common toothpaste brands with and without sodium lauryl sulfate (SLS) and triclosan and with different additives/emulgators differ in irritation potential. An occlusion test system on human skin was used. The toothpastes tested were A) Zendium (non-ionic detergent), B) Solidox F (SLS/polyethylene glycol), C) Colgate Total (triclosan/copolymer/SLS/propylene glycol), and D) Solidox G (triclosan/zinc citrate/SLS/polyethylene glycol).

Toothpaste C was the greatest irritant, causing skin erythema in 16 of the 19 subjects, whereas toothpaste D gave no reactions. Toothpaste B provoked three reactions (two severe), whereas toothpaste A caused only one mild reaction. Although this study was carried out on skin and hence not directly applicable to the oral cavity, these and previous results may indicate that a toothpaste without propylene glycol and SLS may be preferred by susceptible persons.

## ■ The effects of two sodium lauryl sulphate-containing toothpastes with and without betaine on human oral mucosa in vivo

Rantanen, I., Jutila, K., Nicander, I., Tenovuo, J., Söderling, E. (2003), *Swed Dent J*, 27, 31-34.

The aim was to compare the effects of two sodium lauryl sulphate (SLS)-containing toothpaste formulations with and without betaine on human oral mucosa in vivo. The results are compared with the effect of a dry mouth toothpaste without SLS. Twenty subjects participated in the double blind, crossover study. The toothpastes with 1.2% SLS, 1.2% SLS and 4% betaine and with 4% betaine but not with SLS were placed on buccal mucosa in a test chamber and kept in place for 15 min. The condition of the mucosa was studied both visually and using electrical impedance (EI) for up to 45 min.

Both SLS-containing pastes had a similar, irritating effect on the mucosa as judged both by the appearance of the mucosa and the EI measurements. The dry mouth toothpaste (with betaine only) showed no significant irritation of the mucosa. Betaine did not reduce the mucosa-irritating effect of the SLS-containing toothpaste formulation. The surfactant-free toothpaste did thus not irritate the human oral mucosa in vivo while the SLS-containing pastes did.

## ■ Toothpaste detergents: a potential source of oral soft tissue damage?

Moore, C., Addy, M., Moran, J. (2008), *Int J Dent Hyg*, 6, 193-198.

Toothpastes are thought to be of benefit to cleaning teeth but may also have the potential for soft tissue damage at least on the cellular level by inclusion of detergents in their formulation. The aim of this study was to observe the in vitro response of oral mucosa like cells to toothpaste detergents. TERT-1 keratinocytes were exposed to varying concentrations of the detergents Adinol, Sodium Lauryl Sulphate, Tego Betain and Pluronic as well as PBS and culture medium. After 2-min exposure, cells were washed and incubated in fresh medium for 24 h. Cell death was then spectrophotometrically measured using an MTT assay.

SLS, Adonil and Tego Betain markedly reduced cell viability at all increasing concentrations when compared to the positive medium control. These in vitro data suggest that some detergents may have the potential to cause soft tissue damage in the mouth. Although in vivo, saliva may neutralize such effects.

## What is your opinion on CURAPROX Enzycal?

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Please let us know: [info@curaden.ch](mailto:info@curaden.ch)  
Thank you for sharing your experiences.

## curaden

Curaden International AG  
Amlehnstrasse 22  
CH-6010 Kriens  
T +41 (0)41 319 45 50  
F +41 (0)41 319 45 90  
info@curaden.ch

[www.curaprox.com](http://www.curaprox.com)