SWEETENERS AND DENTAL HEALTH

Stevia as an Innovative Oral Health Solution

Can steviol glycosides effectively suppress the growth and activity of oral pathogens linked to caries and gum diseases?

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B iofilm control is fundamental to oral health. Fermentable carbohydrates are implicated in the etiology of biofilm and associated diseases, such as gingival inflammation and dental decay. Therefore, sugar substitutes – sole sweeteners or mixtures with carbohydrates, were introduced into preventive dental care, to replace sucrose.

The cariostatic potential of sweeteners is highly accepted in dentistry. However, due to problems in food formulation, their use is limited. Sugar mixtures including sweeteners may also have a potential to affect growth and pH-decline of complex oral biofilm communities. Similarly, steviol glycosides as natural high intense sweeteners, are stated to have non-cariogenic effects. Beyond that, the addition of steviol glycosides to carbohydrate sources may suppress biofilm formation.

The definite relationship between dietary consumption of sugars and the incidence of dental caries is evidence based in dentistry. Added sugar has found its way into almost all food.

Effective Strategies

Oral health care could show that the prevention of caries decay and periodontal diseases may be highly effective, if sugar consumption decreases and biofilm management is performed. Different aspects may influence biofilm activity in the oral cavity:

• Mechanical and chemical removal of the dental plaque.
• Application of fluorides.
• Antimicrobial drugs.
• Reduction of dietary consumption of fermentable carbohydrates.
• Suppression of plaque growth.

Because fermentable carbohydrates are significantly implicated in the etiology of dental caries, sugar substitutes are in addition to plaque removal and fluoride applications, the most promising tools in preventive dentistry. Oral health conditions affect billions worldwide and have a significant negative impact on people’s health. The evidence of oral health care can be demonstrated by the actual expenses of health insurance systems (e.g. more than €18.7 billion in 2012 for dental care in Germany). Moreover, dental health presents an important health concern for European consumers, leading to a potential benefit perception of consumer products which have a positive impact on dental health (BfR). Nevertheless, despite this general positive attitude, little is known in terms of how consumers perceive different health promoting ingredients, as well as their combination with different product carriers. Microbial biofilms on oral surfaces usually exist in dynamic equilibria with host defenses, and are compatible with the maintenance of the integrity of target tissues (table 1).

Oral Microbial Biofilms

A balanced oral microflora seems to be a key to maintaining good oral health. A predominant microflora exists on different sites. Although saliva contains up to 10^6 microorganisms/mL, it is not expected to have a negative impact on oral health. The normal swallowing process prevents the bacteria from including pathogenic effects. In contrast, the microbial community associated with teeth (biofilm/dental plaque) is composed differently, due to the special local environmental conditions on a tooth surface and has a pathogenic impact. The formation of biofilms is central to the initiation and progression of all oral diseases. Dental caries and periodontal disease should be considered as consequences of ecologically driven imbalances of oral microbial biofilms. These ecologically driven changes result in increases in the proportions of pathogenic microorganisms, which possess enzymatic and structural determinants that may render them more virulent than organisms associated with oral health (figure 1). The transition from health to disease is associated with compositional and metabolic changes in populations of bacteria that form the biofilms colonizing the hard and soft tissues of the mouth.

Plaque Acidification

Dental caries development is directly correlated with repeated cycles of plaque acidification, which encourage the emergence of aciduric bacteria at the expense of bacteria that are less acidogenic and acid tolerant. Acid production in dental plaque from the fermentation of dietary carbohydrate leads to the demineralization of underlying enamel and dentine. Fermentable carbohydrates are highly implicated in the etiology of biofilm associated oral diseases. Therefore, artificial and natural sweeteners were introduced into preventive dental care to replace sucrose. These “toothfriendly” properties
are, for example, determined in standardized plaque-pH tests.

Steviol Glycosides

Steviol glycosides are intense natural sweeteners that might support oral health. In current dental literature only a few reports were published dealing with possible dental health care effects of steviosides. The cariostatic effects of stevial glycosides were only investigated in 3 international publications (Berry et al. 1981 and Das et al. 1992; Brambilla et al., 2014). It could be shown that stevia extracts can cause a reduction in growth of _S. mutans_ and decrease of acid production. A reduction of caries in rats colonized with _S. sobrinus_ could also be proved.

Biofilm Suppressing Effects

Besides dietary aspects (zero-calorie sweetener), the aim of current investigations was the evaluation of the biofilm suppressing effects of stevia. This would represent a positive approach to e.g. using antiseptic mouth washes and appears as more natural, targeted and gentle to maintain a positive microflora balance.

Recently, this topic was presented in Berlin by the “stevia”-task force of the University of Bonn, Germany, at the 6th World Convention on Stevia (June 2014). To evaluate the preventive potential of stevial glycosides in presence of carbohydrate sources, the growth pH-levels, fermentation of nutrients, and especially the biofilm formation was examined in mono- and mixed cultures of oral cariogenic streptococci ( _S. mutans, S. salivarius, S. sanguinis, S. sobrinus_ ). All bacteria were cultured under optimized growth conditions, with or without the addition of two stevia sweeteners (“VitaNatura”, Vita Natura, Bonn, Germany; “SteSweet,” Stevia Germany, Essen, Germany). Mixed cultures of oral streptococci showed a delay in growing when steviosides were added to carbohydrate sources. The addition of steviosides to a glucose source repressed the fermentation of glucose in mixed cultures. Furthermore, the biofilm formation was limited. The actual data indicates not only a cariostatic, but also a suppressive effect of steviosides on biofilms when added to a carbohydrate source.

Further supporting data was published at the 8th symposium of the European Stevia Association (EUSTAS) in Bonn in January 2015. The benefit of a sugar mixture including stevia extracts in food and beverage formulations may be a highly significant approach in preventive dental care. The caries preventing aspects of stevia would enhance acceptance as an oral health care product and open new marketing strategies. Not only are dairy products a healthy alternative to carb- or sugar-filled snacks, they also may be considered as a preventive measure against cavities. ©

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