

ARTIFICIAL SWEETENERS AND THEIR ANTI CARIOGENICITY

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Abstract

Sugar substitutes can play an important role in shifting the caries process in favor of maintaining dental health, and they should be recommended as part of an overall preventive treatment plan for patients at high risk of developing caries. The role of sucrose and other fermentable carbohydrates in the etiology of dental caries has been well established. Since it is known that sugared chewing gums may increase the risk of dental caries, it has been proposed that the replacement of sucrose in chewing gum or candies with a sugar substitute such as xylitol, may contribute to caries prevention.

INTRODUCTION

A sugar substitute is a food additive that duplicates the effect of sugar in taste, but usually has less food energy. Some sugar substitutes are natural and some are synthetic. Those that are not natural are, in general, referred to as artificial sweeteners.

An important class of sugar substitutes is known as high-intensity sweeteners. These are compounds with sweetness that is many times that of sucrose, common table sugar. As a result, much less sweetener is required, and the energy contribution often negligible. The sensation of sweetness caused by these compounds (the "sweetness profile") is sometimes notably different from sucrose, so they are often used in complex mixtures that achieve the most natural sweet sensation.¹

If the sucrose (or other sugar) replaced has contributed to the texture of the product, then a bulking agent is often needed. This may be seen in soft drinks labeled as "diet" or "light," which contain artificial sweeteners and often have notably different mouth feel, or in table sugar replacements that mix maltodextrins with an intense sweetener to achieve satisfactory texture sensation.

In the United States, six intensely-sweet sugar substitutes have been approved for use. They are saccharin, aspartame, sucralose, neotame, acesulfame potassium, and stevia. Apart from that xylitol, sorbitol, & mannitol are some natural sugar substitutes.²

SYNTHETIC SUGAR SUBSTITUTE

Aspartame

Aspartame was first approved in 1981. It is 200 times sweeter than sugar, with a caloric value similar to sugar (4

kcal/gram). However, since small amount is used in food it is considered essentially free of calories. In the mid-1990's, a researcher raised concern that a rise in brain cancer incidence was linked to Aspartame use. However, after intense testing both in animals and humans, there has been found no link between aspartame and cancer. There has also been no evidence to support any other side effects connected to the sweeteners. Widely used in chewing gums, it is a potential anti cariogenic agent³

Sucralose

Sucralose is a zero-calorie sugar substitute artificial sweetener known under the E number. Sucralose is approximately 600 times as sweet as sucrose (table sugar) & twice as sweet as Saccharin and 3.3 times as sweet as Aspartame. Unlike Aspartame, it is stable under heat and over a broad range of pH conditions. Therefore, it can be used in baking or in products that require a longer shelf life. The commercial success of sucralose-based products stems from its favorable comparison to other low-calorie sweeteners in terms of taste, stability, and safety. It has been shown to be non cariogenic in rats.³

Neotame and Tagatose

The newest of the low-calorie sweeteners which was approved by the FDA in 2002 as a general purpose sweetener. It is approximately 7000 times sweeter than sugar. Prior to its approval, Neotame was subjected to well over 100 scientific studies. These studies found no link to disease and use of the product. Tagatose was recently approved in 2001. It is a low-calorie sweetener derived from lactose, a carbohydrate found in many dairy products. Neotame and Tagatose are also helpful in caries prevention. Further research is being carried out.³

Acesulfame-K

Acesulfame-K is 200 times sweeter than sugar, with no calories. It was first approved by the FDA in 1988 for specific uses including as a tabletop sweetener. In 1998, it was then approved for use in beverages. It is not broken down by the body and is eliminated unchanged by the kidneys. Therefore diabetic patients may safely use the product without it affecting their blood glucose levels. Although it is remarkable in caries prevention, its use is limited because of potential carcinogenicity in children.³

Stevia

There is also a herbal supplement, Stevia, used as a sweetener. Controversy surrounds lack of research on Stevia's safety and there is a battle over its approval as a sugar substitute. Triratna et. al compared the effects of commercially available Xylitol and Stevia extract on caries-inducing properties of *Streptococcus sobrinus* and found that Stevia extract had inhibitory effect on the caries inducing properties of *S. sobrinus* and could be useful for caries prevention.⁵

NATURAL SUGAR SUBSTITUTE

Sorbitol & Xylitol

The majority of sugar substitutes approved for food use are artificially-synthesized compounds. However, some bulk natural sugar substitutes are known, including Sorbitol and Xylitol, which are found in berries, fruit, vegetables, and mushrooms. It is not commercially viable to extract these products from fruits and vegetables, so they are produced by catalytic hydrogenation of the appropriate reducing sugar. For example, xylose is converted to xylitol, lactose to lactitol, and glucose to sorbitol.⁴ Still other natural substitutes are known, but are yet to gain official approval for food use. Sorbitol and Xylitol both are not fermented by oral bacteria. Studies have shown that Sorbitol-sweetened gum does not cause a fall in plaque pH and Xylitol sweetened gum has an anticariogenic effect, because Xylitol has a chemistry of 5 carbon atom which are unlike glucose a 6 Carbon atom molecule. Hence oral bacteria are unable to metabolize it to acids, though these claims need further study. There also is good evidence that when mothers of infants and young children chew xylitol-sweetened gum, it blocks transmission of mutans streptococci from mother to child⁶.

Studies enrolling a total of almost 4,000 people, mostly children, have found that xylitol flavoured gum, candy, or toothpaste can help prevent cavities.⁷⁻¹²

A double-blind, placebo-controlled study of 1,677 children compared a standard fluoride toothpaste with a similar toothpaste that also contained 10% xylitol.¹² over the 3-year study period, children given the xylitol-enriched toothpaste developed significantly fewer cavities than those in the fluoride-only group.

In another trial, a 40-month, double-blind study of 1,277 children, researchers studied gum products containing various concentrations of xylitol and/or sorbitol.⁸ The gum with the highest xylitol concentration proved most effective at reducing cavities.

Another series of studies suggests that children acquire cavity-causing bacteria from their mothers; regular use of xylitol by a mother of a newborn child may provide some

protection to the child, as well¹³⁻¹⁵

Conclusions

The caries-preventive efficacy of sweeteners and sugar substitutes is not clearly established on an epidemiological scale. A review of cariogenicity assessments in vitro and in vivo as well as of human clinical caries trials, however, clearly demonstrates that the replacement of sugar by such products has a caries-preventive effect. The clinical relevance of some bacteriostatic and/or cariostatic properties ascribed to sorbitol, stevia, and xylitol remains to be corroborated. Although artificial sweeteners have anti cariogenic properties, there is no sufficient evidence to recommend them as a first line anti caries strategy in light of the large body of evidence on the effectiveness of topical fluoride and dental sealants

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