

Use of LCS in Dental Caries

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Abstract

Dental caries (Decay) is an oral disease, caused by the interaction of bacteria, mainly *Streptococcus mutans*, and sugary foods on tooth enamel. Dental Caries (DC) is increased when the consumption of sugar is frequent and unhealthy eating habits are practiced. They can begin early in life, progress rapidly in those who are at high risk, and often goes untreated. Dental caries has multifactorial aetiology in which microorganisms have a significant role to play by altering the pH of saliva caused due to fermentation of carbohydrate. The impact of low-calorie sweeteners contrary to sugar is non-cariogenic, as they do not participate in the fermentation processes by the microorganisms that are naturally present in our mouth. Low calorie sweeteners can help in decreasing the tooth demineralization if they are consumed instead of sugars by maintaining the salivary pH. This paper reviews the role of low-calorie sweeteners in dental caries.

Keywords: Dental Caries, Children, Low Calorie Sweetener (LCS), Tooth Decay, Sugar Consumption, Stevia, Sucralose

Abbreviations: LCS: Low Calorie Sweetener; DC: Dental Caries; WHO: World health organization

Introduction

Dental caries (DC) is one of the most prevalent oral diseases observed in children [1]. It is a multifactorial disease caused due to formation of microbial growth in the dental plaque (biofilm) due to bacterial fermentation of carbohydrates on tooth surface after meals and snacks, causing demineralization of the enamel [2]. Caries is majorly caused by foods rich in dietary sugars, other factors being salivary flow, exposure to fluoride and preventive behaviors [3]. *Streptococcus mutans* and *Streptococcus sobrinus* are the main bacteria found in early childhood caries [4,5]. These acid producing pathogens inhabiting the mouth cause damage by dissolving tooth structures in the presence of fermentable carbohydrates such as sucrose, fructose, and glucose and produce lactic acid [6,7]. This acid lowers the intraoral pH and causes demineralization of tooth enamel. Prolonged demineralization eventually leads to corrosion of dentin and cavitation [8]. Caries risk is greatest/increases if sugars are consumed at high frequency and are in a form that is retained in the mouth for long periods [9]. Sucrose is a poten-

tial cariogenic substrate compared to other forms of sugar, due to formation of large amount of acid because of fermentation in oral cavity [10].

In children, the surface of the newly developed teeth easily gets stained and are difficult to clean due to their surface texture. In addition, the tooth substrates are not fully matured. For these reasons, they are susceptible to caries. If caries in milk teeth is left untreated, it can affect the alignment of the permanent teeth. Milk teeth have the important role of securing space for permanent teeth, and if a milk tooth is badly affected by caries or is lost at an early stage, it may cause the teeth alignment to become crooked or cause a shortage of space in which permanent teeth can erupt.

Children prefer to eat sweet and sugary products like chocolate and often do not rinse after eating, once consumed it takes less than 60 seconds for the bacteria on your teeth to combine with the sugar and get converted into acid. pH of saliva for healthy oral is normally between 6 to 7, cavity is observed to develop when the pH reduces

below 5.5 [11]. Thus, it is very important to establish healthy eating habits from an early age, to prevent the impact on overall growth of the body and the oral health by self-care. Besides recommendations to reduce sugar intake and to limit the frequency of food and/or drink intake with sugars and fermentable carbohydrates to four to five times per day, also the use of tooth friendly sugar alternatives can help to achieve this goal. Low calorie sweeteners can contribute to good dental health when used in place of sugar. As they are not fermentable ingredients, – which means bacteria in our mouth do not break them down – low calorie sweeteners do not contribute to tooth decay and that is why they have the benefit of being tooth-friendly ingredients [12].

Low calorie sweetener and oral health

The beneficial role of low-calorie sweeteners in dental health is well-established [12]. Low calories sweeteners are non-cariogenic as they do not contribute to the development of dental caries or tooth decay as compared to sugars and other fermentable sugars. Dental caries, also known as dental cavities or tooth decay, is a global health challenge as it is one of the widespread chronic diseases worldwide. Though it is a common disease in children or younger population, data suggests that it affects people of all ages across the lifespan [13]. Dental caries or decay happens when plaque is formed, and the bacteria present in your mouth breaks down the sugars in the food leading to acid production. The acid produced can cause serious damage to the hard tissues of your tooth and manifest as dental caries or cavities. Tooth decay or cavity is a progressive disease and is a result of lifelong exposure to dietary factors like sugars. Contrary to earlier belief that it's a condition more likely to affect children and cavity free childhood means no caries in later life, evidence suggests the occurrence is more in adults now. Therefore, a slight reduction in risk factors of dental caries in early life is significant for adulthood [14].

Sugar and dental caries

Dietary sugar intake and frequency of consumption are important risk factors in the development of dental caries. World health organization (WHO) recommends reducing intake of free sugars to less than 10% of the total energy throughout the life stages [15]. These recommendations were informed by a systemic review of prevalence and impact of dental caries. The review suggests that there is reasonable evidence to support that the amount of free sugars intake is related to development of dental caries across age groups [14]. Additionally, another study showed that higher frequency of sugar consumption and the form of sugar that stays in the mouth for a longer duration possess greater risk of dental caries [16].

All approved LCS are sweet tasting food additives with zero to low calories. LCS have no cariogenic effect, as they cannot be fermented by oral microorganism contrary to sugars which act as substrate for these microorganisms. Hence, LCS does not contribute to tooth decay [17,18]. In the 1970s [19], the first evidence regarding the dental health benefits of LCS was published and after-

wards multiple number of reviews and studies have confirmed the non-cariogenic nature of LCS [12,20-24]. The important factors to consider when assessing a non-sugar sweetener in relation to dental caries are potential for metabolism by oral bacteria and dental plaque formation, the influence on cariogenic microorganisms on consumption and risk related to microbial adaptation to the sweetener. A literature review was conducted in 2013, to examine the impact of sugars and LCS on dental health. It was found that LCS such as aspartame, acesulfame-K, cyclamate, saccharin, sucralose and steviol glycosides among others are not metabolized by oral organisms to produce acid and therefore cannot cause dental caries [12]. As per FDI (FDI World Dental Federation) in most cases, there is nothing inevitable and certainly dental caries is greatly preventable and avoidable [13].

Stevia for Dental Caries

Steviol glycosides are one of the natural plants based LCS. They are stable at high temperatures (up to 200°C), varying pH from acidic to alkaline range [2]. *In vivo* testing for carcinogenicity, they have been found to be non-cariogenic [25]. A study conducted for carcinogenicity with four different groups of rats that were given Stevioside, Rebaudioside A, Sucrose, and no additive in their diet. There were no differences observed between groups that had stevioside or rebaudioside A and groups without additives in their diet, however significant difference was observed for group that had sucrose in the diet. This study supports the claim that stevioside rebaudioside A are non-cariogenic [25]. Similar other studies conducted also supported reduction in microbial load preventing growth of bacteria in the mouth [26] showing reduction in plaque accumulation [27]. Due to observed antimicrobial activity [28] stevia was shown to be a strong alternative to sucrose for DC [29].

Sugar alcohols (polyols) like maltitol, sorbitol and xylitol are widely used in place of sucrose in confectionaries, helping in calorie reduction and are considered as "safe for teeth" [30]. Maltitol is used as sugar substitute as it is almost as sweet as sucrose (approximately 90%) and its calorific value is 2-2.4 kcal/g [31,32]. Because of rising incidence of dental caries and high consumption of chocolates by both adults and children [33], we aimed to conduct an open-label study on healthy human subjects to evaluate the safety and efficacy of maltitol-based sugar free chocolates on salivary pH, through measurement of salivary pH and growth of *S. mutans* [34]. No adverse effect was reported in this study, supporting low calorie sweeteners i.e maltitol-based sugar-free chocolates containing maltitol are safe to consume and do not promote DC.

Conclusion

LCS are non-cariogenic tooth friendly ingredient that has replaced sugar in many products such as toothpaste, chocolates, medications, and other beverages. Replacing sugar by LCS provides dental benefits by eliminating pH lowering due to non-fermentation, thus being non-cariogenic and non-erosive thereby maintaining the mineralization and tooth surface texture. From the children's perspective reduction in frequency and amount of

sugar consumption will help in preventing the dental caries and products with LCS will help in managing the sugar intake without compromising on the sweet taste thus supporting the healthy tooth.

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