International Journal of Research in Health and Allied Sciences
Journal home page: www.ijrhas.com
Official Publication of "Society for Scientific Research and Studies" [Regd.]
ISSN: 2455-7803

REVIEW ARTICLE

Effect of Sugar and Sugar Free Substitutes on Dental Caries

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ABSTRACT:
Dental caries (tooth decay) is a major oral health problem in most industrialised countries, affecting 60–90% of schoolchildren and the vast majority of adults. The early manifestation of the caries process is a small patch of demineralised (softened) enamel at the tooth surface, often hidden from sight in the fissures (grooves) of teeth or in between the teeth. The destruction spreads into the softer, sensitive part of the tooth beneath the enamel (dentine). The weakened enamel then collapses to form a cavity and the tooth is progressively destroyed. Caries can also attack the roots of teeth should they become exposed by gum recession. This is more common in older adults. Dental caries is caused by the action of acids on the enamel surface. The acid is produced when sugars (mainly sucrose) in foods or drinks react with bacteria present in the dental biofilm (plaque) on the tooth surface. The acid produced leads to a loss of calcium and phosphate from the enamel; this process is called demineralisation. This paper reviews the role of sugar and sugar substitutes in dental caries.
Key words- Dental Caries, Sugar Free, Dental Health.

Received: 14 February, 2019 Revised: 24 February, 2019 Accepted: 27 February, 2019

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This article may be cited as: Nain JK, Kaur S, Kaur M. Effect of Sugar and Sugar Free Substitutes on Dental Caries. Int J Res Health Allied Sci 2019; 5(2):27-32.

INTRODUCTION-
Dental caries, which is also referred to as tooth decay or cavities, is one of the most common and widespread persistent diseases today and is also one of the most preventable. (2,3)When you eat certain foods, the bacteria on your teeth breaks them down and produces acids that have the ability to seriously damage the hard tissues of your tooth. The result is the formation of dental caries (cavities).Many factors can contribute to the development of dental caries (both dietary and non-dietary factors). These include the presence of plaqueproducing bacteria, susceptibility of tooth surfaces, frequency of eating, oral hygiene practices, fluoride availability, and s alivary flow. Of all these factors, diet plays an important role and within diet, sugars are the major cause of dental caries .(4-9) Sugars that we consume can be readily metabolized by many bacteria involved in dental biofilm formation, generating acid by-products that lead to demineralization of the tooth structure and ultimately, dental caries. Also, low levels of saliva (causing dry mouth) may worsen the process of demineralisation leading to dental caries. This may occur especially during night time or may also occur due to taking some medications (e.g. anti-depressants) or even extreme stress. Sugars that we consume can be readily metabolized by many bacteria involved in dental biofilm formation, generating acid by-products that lead to demineralization of the tooth structure and ultimately, dental caries.(10-14) Also, low levels of saliva (causing dry mouth) may worsen the process of demineralisation leading to dental caries. This may occur especially during night time or may also occur due to taking some medications (e.g. anti-depressants) or even extreme stress development.
Those scientists at the University of Melbourne found that sugar-free drinks can actually soften dental enamel by 30 to

50 percent. After testing 23 different types of sports and soft drinks, they found that beverages that have low pH levels and contain acidic additives cause significant damage to enamel. All but 2 of the 8 sports drinks that were tested were found to cause dental erosion. (The 2 that didn't cause dental enamel loss contained higher calcium content).“Many people are not aware that while reducing your sugar intake does reduce your risk of dental decay, the chemical mix of acids in some foods and drinks can cause the equally damaging condition of dental erosion,” says Professor Eric Reynolds. “Dental erosion occurs when acid dissolves the hard tissues of the tooth. In its early stages erosion strips away the surface layers of tooth enamel.(15,16) If it progresses to an advanced stage it can expose the soft pulp inside the tooth.” Teeth are more susceptible to tooth decay when tooth enamel is eroded because it's more prone to bacterial growth.The issue is that artificial sweeteners don't protect your teeth from the damage caused by real sugar: acid. Although artificial sweeteners aren't fueling the bacteria in your mouth to produce acids the way sugar does, sugar substitutes are often found in beverages and candies that contain potentially harmful acidic ingredients. The researchers at Melbourne found that citric acid and phosphoric acid play big roles in tooth erosion. They are often found in sugar-free candies and colas for added tanginess, which tastes good, but harms your teeth. Reynolds warns that consumers should be aware of what kind of acidic ingredients are in candies and drinks and stay educated about how they can be detrimental to your oral health. (17-26)

Sugar vs. Artificial Sweeteners

Sugar-The logic behind consuming artificial sweeteners rather than sugar make sense. Because some types of oral bacteria feed on sugar, exposing your teeth to high amounts of sugar can lead to tooth decay. (27,28)The bacterial microorganisms break down sugar and release acids that weaken the enamel of your teeth, which is the hard, outer coating. The bacteria, acids, food debris and saliva combine to form a plaque that sticks to the surface of your teeth. The acids in the plaque dissolve the enamel (called dentin erosion), creating shallow holes called cavities. They can grow deeper over time as the decay spreads down to the pulp of the tooth.Obviously, consuming excessive amounts of sugary food and beverages isn't good for the teeth.

Artificial Sweeteners-

Unfortunately, it would appear that sugar substitutes can cause damage to tooth enamel, too. A recent study in Australia has found that diet soda and sports drinks that use artificial sweeteners often do as much damage to teeth as those that have real sugar. Researchers in the study were quoted saying:“There was no significant difference between the erosive potential of sugared and non-sugared soft drink.”Those scientists at the University of Melbourne found that sugar-free drinks can actually soften dental enamel by 30 to 50 percent. After testing 23 different types of sports and soft drinks, they found that beverages that have low pH levels and contain acidic additives cause significant damage to enamel. All but 2 of the 8 sports drinks that were tested were found to cause dental erosion. (The 2 that didn't cause dental enamel loss contained higher calcium content).(25)“Many people are not aware that while reducing your sugar intake does reduce your risk of dental decay, the chemical mix of acids in some foods and drinks can cause the equally damaging condition of dental erosion,” says Professor Eric Reynolds.“Dental erosion occurs when acid dissolves the hard tissues of the tooth. In its early stages erosion strips away the surface layers of tooth enamel. If it progresses to an advanced stage it can expose the soft pulp inside the tooth.” Teeth are more susceptible to tooth decay when tooth enamel is eroded because it's more prone to bacterial growth.The issue is that artificial sweeteners don't protect your teeth from the damage caused by real sugar: acid. Although artificial sweeteners aren't fueling the bacteria in your mouth to produce acids the way sugar does, sugar substitutes are often found in beverages and candies that contain potentially harmful acidic ingredients.(23,24)The researchers at Melbourne found that citric acid and phosphoric acid play big roles in tooth erosion. They are often found in sugar-free candies and colas for added tanginess, which tastes good, but harms your teeth. Reynolds warns that consumers should be aware of what kind of acidic ingredients are in candies and drinks and stay educated about how they can be detrimental to your oral health.

Effect of Sugar Free On Dental Health

Sugar-free gum, sweets and soft drinks, marketed as healthy alternatives to sugary products, can damage teeth, cause gastric problems and are unlikely to promote weight loss, research claims.(18,19) A study review in the British Dental Journal (BDJ) found that sugar-free foods and drinks contain acidic additives that may cause dental problems by eroding the enamel on consumers' teeth.Disclosure of what the authors call a "hidden risk" could affect sales of sugar-free products, especially given what the paper describes as consumers' blind confidence in such products as a good thing.(17)The paper, Are sugar-free confections really beneficial for dental health?, examined the role of sugar substitutes used in products to reduce the risk of tooth decay. While one commonly used group of substitutes, called sugar alcohols, or polyols, do lessen the risk of cavities, they can cause acidity in the mouth that then leads to erosion of teeth enamel, says the paper.(16)These substitutes include xylitol, which the European commission has allowed to market itself as a "tooth friendly" ingredient in chewing gum. Xylitol is widely-used in sugar-free products sold in the UK, but not in soft drinks [see footnote].(8,9)The literature review, by academics from the universities of Boston, Helsinki and

Southern Nevada, concludes: "As the use of sorbitol and xylitol containing products increases, the public should be educated on the hidden risk of dental erosion due to acidic additives, as well as the adverse effects of gastric disturbance and osmotic diarrhoea. Especially in sugar-free products, these adverse effects may be more insidious because the public has blind confidence that they are oral health friendly." "Although the presence of acidic flavourings and preservatives in sugar-free products has received less attention, these additives may have adverse dental health effects, such as dental erosion. Furthermore, the term sugar-free may generate false security because people may automatically believe that sugar-free products are safe on teeth.(6.7)"The review raises the wider question of what health-related claims made on behalf of products can be trusted, said Stephen Hancocks, the BDJ's editor-in-chief. (3,4)"The claim might well mean what it says and be suitably backed-up by research evidence, but does it fully say what it means, or alternatively, what is it not saying? Sugar-free may seem to indicate that a sweet or other product is tooth friendly, but this is not automatically the case," he wrote in a commentary on the findings.Given sugar-free products' role in erosion of dental enamel, and doubts over perceptions of them as helping users to consume fewer calories, he continued, "the result is a minefield of confusion for the patient who is trying his or her very best to comply with healthy choices and a complex labyrinth of communication for the professional in attempting to convey practical advice."Professor Damien Walmsley, scientific adviser to the British Dental Association, which represents dentists, said excess use of sugar-free products containing fruit flavourings could rot the enamel covering the dentine in teeth and ultimately cause teeth to dissolve. This footnote was added on 24 November 2011. The sweeteners xylitol and sorbitol, which the study looked at, are used in sugar-free gum, sweets and soft drinks in the US, but are not permitted in soft drinks in the European Union.(16)

Dental caries –sorbitol and xylitol

The prevalent use of chewing gum has prompted interest in its dental effects. Important defining aspects are the ability to use sugar substitutes in gum manufacture and the prolonged stimulation of a protective flow of saliva. The main sugar substitutes used are sorbitol and xylitol. Because it is not fermented by oral bacteria, xylitol is considered to be non-cariogenic, and while sorbitol in solution can be fermented slowly by mutants streptococci, chewing sorbitol-sweetened gum does not cause a fall in plaque pH. (1,2)Effects of chewing sugar-free gum on the ability of plaque to form acid from sucrose are equivocal, although the tendency is for the plaque acidogenicity to be reduced with the use of xylitol gum for 2-3 weeks, due to its inhibitory effects on mutants streptococci. Gum-chewing also stimulates a protective salivary flow when used after an acidogenic stimulus, and may enhance salivary function, especially in subjects with low flow rates. Sorbitol and xylitol gums have similar beneficial effects in promoting enamel remineralisation in short-term in-situ experiments. Clinical trials indicate that xylitol gum has a useful anticaries role, superior to the effects of sorbitol gum. In conclusion, both sorbitol and xylitol chewing gums are non-cariogenic in contrast to sugared gum, and exhibit beneficial anticaries properties through salivary stimulation. In addition, xylitol's antibacterial properties seem likely to lead to caries reductions superior to the more modest reductions with sorbitol gum.(17) In recent years, the use of chewing gum after meals has gained popularity as it prevents the formation of dental caries by stimulating salivary flow. The increase in flow enhances the buffering capacity of saliva, which effectively neutralizes the drop in plaque pH that occurs after eating.[6] Increased levels of calcium and phosphate in gum-stimulated saliva also limit demineralization and enhance remineralization.[7,8]

The most common dietary polyols used in sugar-free chewing gums are xylitol and sorbitol.[3,9] Most oral bacteria do not metabolize xylitol and sorbitol to form acid. Xylitol is a sugar alcohol derived from pentose sugar xylose and sorbitol is a sugar alcohol derived from glucose. Both stimulate a gustatory reflex that together with the chewing process, enhances saliva stimulation.[3] Thus, sugar substitution and salivary stimulation could be equally responsible for the non-cariogenicity of sugar-free chewing gum.[8] Sorbitol is metabolized not at all by most microorganisms, it can be fermented at a slow rate by all of the mutans streptococci including Streptococcus mutans while xylitol is considered to be non-acidogenic.[9] Xylitol is a caloric sugar substitute that is not readily fermented by oral microorganisms[1] and also actively protective against tooth decay through reduction in S. mutans and levels of lactic acid produced by these bacteria.[10]There are various reports that evaluated the effect of polyol gums on the remineralization of denimeralized enamel.[11,12,13,14] There are contradictory findings regarding the effects of polyols' types in chewing gums on caries lesions. In an in situ study, comparing the remineralizing effect of gums containing sorbitol and a mixture of sorbitol/xylitol on caries-like enamel lesions, no differences were observed between the gums.[15] On the other hand, the use of xylitol sweetened gum has been found to be more effective on rehardening of dentinal lesions than sorbitol sweetened gums.[16] A recent systematic review of clinical trials investigating the effects of xylitol challenged the greater caries reduction claimed for gums containing xylitol compared with other sugar alcohol.[17]In the literature, it is a matter of controversy whether the main effect of polyols in gums is attributed to the sugar substitute per se or saliva stimulation.[4,9,18].In a systematic review it has been reported that the caries-reducing effect was not due to the therapeutic action of polyol, but rather to the chewing process itself and subsequent saliva stimulation.[19]Therefore, this in

situ study was aimed to compare the effect of three chewing gums: Gum containing sorbitol (Trident Splash), xylitol (First Ice) and a mixture of sorbitol and xylitol (Vivident Xylit) and paraffin on the demineralization and the hardness of demineralized enamel.

EFFECTS OF DIET COKE ON DENTAL HEALTH:

A study conducted by a team of Australian dental researchers from the University of Melbourne suggests that sugar-free beverages, including diet sodas and sports drinks, can erode tooth enamel, eventually leading to decay. Erosion can show up on tooth surfaces as chalkiness, pitting, or opacity and can also cause sensitivity. Acidic additives used to flavor sugar-free soft drinks are responsible for the enamel erosion. The worst of these is citric acid used in lime and lemon drinks. Phosphoric acid used in colas is almost as damaging. Drinks containing sugar have similarly bad effects – the sugar is fermented by bacteria in dental plaque on tooth surfaces forming acid that erodes enamel and leads to decay.

The researchers tested 15 soft drinks including Coca-Cola on healthy molars that had been extracted and saw that all of them led to enamel erosion. Whether the drinks contained sugar or were sugar-free made no difference. When they compared soft drinks to sports drinks, they found that the soft drink effects were worse, although of the 8 sports drink brands tested, all but two significantly damaged enamel. The best of all the tested beverages for teeth was water – it actually hardened enamel. The researchers had some tooth-care hints for those who consume sugar-free drinks and candies (which they also studied):Rinse your mouth afterward, but wait at least an hour before brushing your teeth. Brushing sooner could remove the softened layer of enamel. If you eat sugar-free candies, avoid fruit flavors, particularly lemon. Mint or menthol flavors are safest for the teeth. Limit your intake of soft drinks, fruit juices, sports drinks and diet drinks. Tooth decay is a very big problem in this country as well as in Australia. According to the National Institutes of Health, 21 percent of youngsters between the ages of 6 and 11 have had cavities in their permanent teeth. That number rises to 58 percent among teens age 12 to 19. Adults are in even worse shape – 92 percent between ages 20 and 64 have had cavities and surprisingly, decay is more prevalent among white adults, those living in large families and those with higher incomes and more education. Your teeth aren't the only worry if you drink sugar-free beverages. In March of 2015, researchers at the University of Texas Health Sciences Center published findings showing that in people age 65 and older, regular consumption of diet soda is associated with increased abdominal obesity. Better known as belly fat, abdominal obesity is associated with a higher risk of diabetes, cardiovascular disease, some types of cancer and premature death.

What Happens to body after Drinking Diet Coke, Coke Zero & Any Other Similar Diet Soda

The phosphoric acid attacks the enamel in your teeth, while the artificial sweeteners like aspartame hit your system. Aspartame may trigger taste receptors and trick your body into thinking it has just processed sugar. The evidence: Research, including studies from Switchers and colleagues, shows that frequent consumption of high-intensity sweeteners may have the opposite effect by confusing the body's natural ability to manage calories based on tasting something sweet. According to a report published in the March / April edition of General Dentistry, phosphoric acid in soda causes tooth enamel erosion, even with minimal exposure.(27)Like regular Coke this can trigger insulin, which sends your body into fat storage mode.The evidence: Artificial sweeteners, and sugar alcohols (another type of low-calorie sweetener) present in diet colas can all interfere negatively with natural gut bacteria that is part of your immune and digestive system, according to Amanda Payne of Switzerland's Institute of Food, Nutrition and Health. Data from a number of studies, including the Nurses' Health Study and the Health Professionals Follow-up Study also reported greater risk of type 2 diabetes, high blood pressure, heart disease and metabolic syndrome, which is related to diabetes and cardiovascular problems, for consumers of artificially sweetened beverages. Some data indicated that those who consumed artificially sweetened beverages had double the risk of metabolic syndrome compared to non-consumers. (23,24)The potentially deadly combination of caffeine and aspartame creates a short addictive high similar in the way cocaine works. Excitotoxins are released which may exhaust your brain by over stimulating it's neuroreceptors, especially if consumed on a regular basis. (8,9)The evidence:Excitotoxins are shown to freely penetrate certain brain regions and rapidly destroy neurons by hyper activating the NMDA subtype of Glue receptor in studies. Cravings for more coke are explained by the release of two neurotransmitters in the brain, dopamine and glutamate. Caffeine and aspartame increases dopamine levels as shown in various studies. Aspartic acid taken in its free form (unbound to proteins), significantly raises the blood plasma level of aspartame and glutamate.(4,6) Researchers say glutamate is more essential to addiction than dopamine. Source: Phenotype Offers New Perception on Cocaine The Scientist Date: 21 Jan 2002(28)Unlike the small amount of satisfaction you get from regular coke your body may still crave sweets. (5,7)This makes you likely to reach for another soda, or worse, some other junk food you consider to be safe and the cycle continues. A can of diet coke provides no nourishment and would replace a more nutritious drink you could have drunk while potentially depleting your body of essential minerals. It will never quench your thirst as it dehydrates rather than hydrates your body.(23,22) A lack of vital water can lead to brain fog, poor concentration, fatigue and feeling irritable. The evidence:"Some of the

connection to metabolic disease could be related to how people behave by saying to themselves, 'I'm having a diet soda, so this cheeseburger is OK.' says Swithers Marisa Peer rated by Men's Health as Britain's Best Therapist, a behavioral psychologist and a world renowned expert in eating disorders confirms this, "It is very common to see clients who are overweight who drink diet coke who then eat a plate of chips or reach for the cake. This is because drinking a 'diet drink' like diet coke makes them feel it is now ok to eat whatever they want. '(4,7)The Big Problem With 'Zero' Calories Marisa has over 20+ years as a weight loss therapist with her method proven to be the only one to work by the famous UK TV series Super Size Super Skinny that tested every method available and claimed only hers to work. She has this to say about diet sodas and weight gain: 'Artificial sweeteners are associated with a drop in the appetite-regulating hormone lepton.(28,29) Lepton is the hormone that inhibits hunger so diet drinks like diet coke actually make you hungry and less satisfied with normal amounts of food, and finally when you eat or drink a lot of chemicals that your body simply cannot break down, your body makes more and more internal fat to wrap the chemicals in keeping those harmful chemicals away from your vital organs. (30,23)As diet coke has no calories and no recognized ingredients we know it is a cocktail of chemicals that encourage your body to gain and store weight especially on your legs and bottom away from your organs. diet drinks are not good for your body your health or even as it turns out for dieting.'

CONCLUSION-

Sugar-free gum, sweets and soft drinks, marketed as healthy alternatives to sugary products, can damage teeth. 'sugar free' may generate a false sense of security because people may automatically believe that sugar-free products are safe for teeth.

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