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CURRENT FAILURES IN THE CONSUMPTION OF SUGAR IN THE PRODUCTION OF DENTAL CARIES

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Keywords: *dental caries, sugars, biofilm, sucrose, natural sweeteners, fluoride*

Abstract: *Inadequate dietary intake as well as increased intake of sugar and carbohydrates are among the etiological factors of dental caries. The aim of the study is to synthesize current research on the effect of sugar-rich nutrition on dental tissues. An electronic search in Science Direct and PubMed databases was conducted with search words such as dental caries, sugars, biofilm, sucrose, and natural sweeteners, a total of 362 articles were found, of which 59 items met the inclusion criteria. Following the evaluation, we can say that the contact between sucrose and oral biofilm determines its use as a substrate in order to generate increased amounts of organic acids, thus inducing a marked decrease in pH, sucrose and monosaccharides have a cariogenic effect. Natural sweeteners alter the microbiome of the oral cavity and are involved in preventing the transmission of Streptococcus Mutans in early childhood, fluoride has a safe and scientifically proven prophylactic effect, which through local and general administration contributes to the prophylaxis of dental caries.*

INTRODUCTION

Poor diet and increased sugar and carbohydrates are among the etiological factors of tooth decay.(1,2)

Maintaining the health of the oral cavity at optimal parameters is achieved by its microflora because of a balanced dietary intake. A high-CARB diet containing several kinds of sugars influences both inhibition and bacterial plaque formation.(3) The oral cavity is a complex, dynamic system. It houses over 700 distinguished bacterial species that normally live in symbiosis.(4) Dental caries is considered one of the most common health problems recorded globally, with a multifactorial etiology (5,6,7), which can be prevented, is irreversible, and does not present an increased severity. Untreated dental caries causes a number of complications that can lead to an alteration or a decrease in the quality of life.(3,8)

AIM

The aim of the study is to synthesize current research on the effect of a high-sugar diet on dental tissues.

MATERIALS AND METHODS

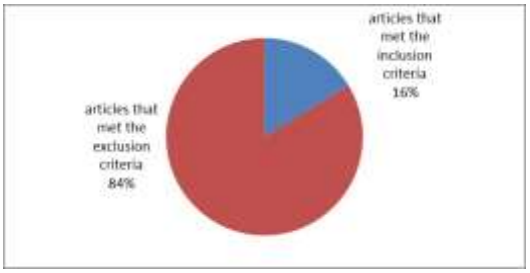
We researched literature data on the effects of sugar consumption on oral health using Science Direct and PubMed databases. We also consulted exclusively English publications, published in the period 1975-2022, using keywords such as dental caries, sugars, biofilm, sucrose, natural sweeteners, and fluoride. We have selected from the Science Direct and PubMed databases only original articles that correspond to search keywords and provide solid evidence of the research on the effects of sugar consumption on oral health.

Articles that were selected based on keywords by the database search engine and which we only had access to the summary and conference summaries and letters to the editor were excluded.

RESULTS

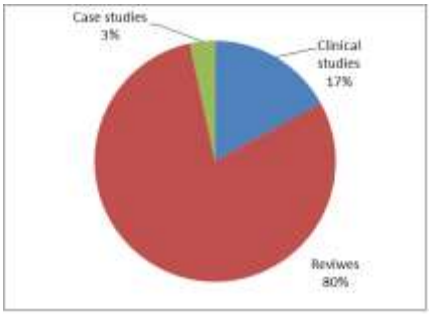
We examined 362 articles of which, 59 articles (16%) met the inclusion criteria, 303(84%) met the exclusion criteria (figure no. 1).

Figure no. 1. Distribution of the articles through the basis of inclusion and exclusion



Of the total number of articles that met the inclusion criteria: 3% were case studies, 17% clinical studies and 80% reviews (figure no. 2).

Figure no. 2. Distribution of articles according to the inclusion criteria



Out of the total of 59 articles examined, 32 articles

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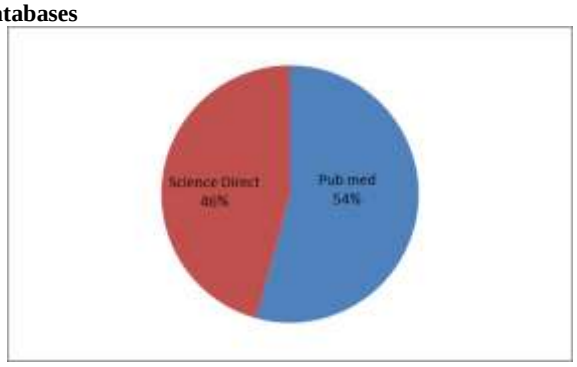
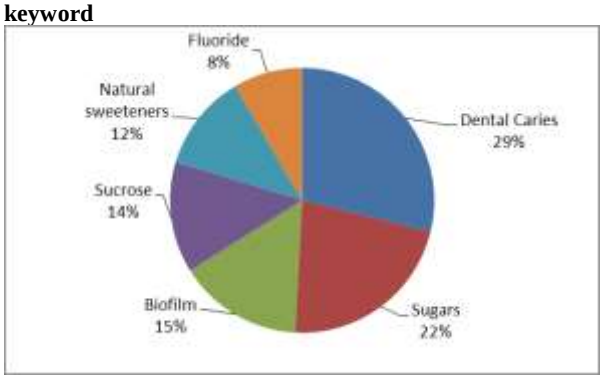
(54%) were selected from the Pub Med database, 27 articles (46) from the Science Direct database (figure no. 3).

Figure no. 3. Distribution of articles according to selected databases



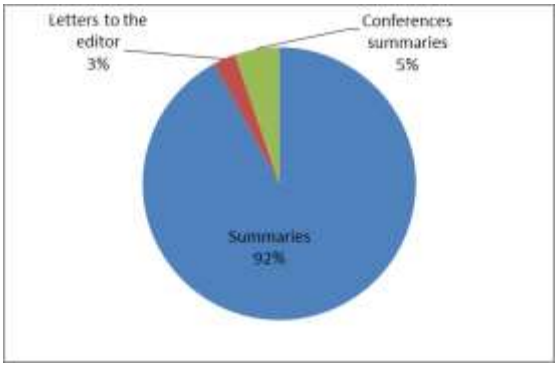
Using keywords in the search engine of the Science Direct and Pub Med databases such as dental caries, sugars, biofilm, sucrose, natural sweeteners, and fluoride we identified a number of relevant articles by the keyword used, namely: 29% of the total articles using the dental caries word, 13% using the word sugars, 15% using the word biofilm, 14% using the word sucrose, 12% using the word natural sweeteners and 8% using the word fluorine (figure no. 4).

Figure no. 4. Distribution of articles according to the search keyword



Of the 303 articles that met the exclusion criteria, 92% were summaries, 5% were conference summaries, and 3% were letters to the editor (figure no. 5).

Figure no. 5. Distribution of articles on the basis of exclusion criteria



DISCUSSIONS

It is estimated that around 80% of adult people with permanent teeth will have dental caries by the age of 34.(8)
Dental caries is a set of dynamic and complex demineralization and remineralisation processes that take place at the level of dental structures. The main etiological factor of dental caries is considered to be the consumption of sugars in different forms. Ingestion of carbohydrates or sugars causes the flora of the oral cavity to continuously produce acids via the glycolytic pathway, with the stimulation of the long-term demineralization of enamel and the appearance of dental caries.(3) Dental caries results from the repeated demineralisation of the inorganic portion of the enamel and the alteration of its organic portion with the appearance of cavity and eventually tooth decay.(9,10) The resulting amplitude of the generated cariogenesis is influenced by the efficiency with which carbohydrates or sugars ingested by food intake by the oral flora are processed and metabolized.(10)

In the current context and following studies conducted over time, current oral prevention programmes are directed at Streptococcus Mutans, considered to be the most notable bacteria with cariogenicpotential.(11,12,13,14,15) Streptococcus mutans are considered responsible for producing carious processes at the substance level.(16) Bacterial involvement in the production of dental caries multiple and involves in addition to Streptococcus Mutans other bacterial species such as the Streptococcus Sobrinus and lactobacilli. Oral bacteria with high cariogenic potential are therefore represented by Streptococcus Mutans and Streptococcus Sobrinus.(17)

There is the question of a window of infectivity in children aged 2-4 years, with temporary dentition, which shows most colonization of Streptococcus Mutans considered the primary etiological agent of dental carious processes.(18)

The increased cariogenesis of Streptococcus Mutans is due to the fact that it rapidly ferments sucrose in order to produce acids that in turn alter the mineral substances present in hard dental tissues, generating extracellular polysaccharides that increase the adhesion of bacterial species to the teeth and decrease the permeability of the bacterial plaque.(19,20) The adhesion, as well as the accumulation of Streptococcus Mutans, is due to the matrix composed mainly of insoluble glucans.(21)

As seen through molecular studies of the human microbiome, the oral ecosystem is composed of immeasurable bacterial species. It has also been found that oral pathogenic bacterial species can be found even in healthy people, who do not show carious processes.(22)

The frequency of occurrence of carious processes depends on the type of dietary carbohydrate consumed, the amount as well as the frequency of consumption.(23,24) A daily dietary intake rich in sucrose, ingested at least 3 times a day is associated with a 179% increase in the occurrence of carious processes.(25)

The World Health Organization for dental caries prevention recommends that sugar consumption should account for 5, a maximum 10% of daily caloric intake.(26,27)

A sugar intake of less than 10% of daily caloric intake is associated with low cariogenesis but does not exclude the formation of carious processes. The cariogenic risk decreases as the intake of sugars decreases.(28,29)

A decrease in sucrose intake below 15–20 kg/person/year or 40–55 g/day causes a reduction in the risk of developing carious processes.(30) The contact between sucrose and oral biofilm determined the use of sucrose as a substrate in order to generate increased amounts of organic acids, thus inducing a marked decrease in pH, (31,32) with demineralisation of dental tissue and change in the composition and virulence of oral biofilm.(31,33,34) Also, alterations in the bacterial composition of supragingival dental tartar are considered to be responsible by some authors for initiating carious processes. In this context, a transformation of the composition of oral biofilm takes place, incorporating more and more bacterial species when continuous and systematized deposition of microbes and bacteria occurs on dental

surfaces.(35,36)

Biofilm is the extracellular matrix of polymeric substances made up of commensal and pathogenic micro-organisms in the form of colloidal dispersion which protects bacteria present in the oral cavity from the external environment and allows them to grow and become multi involved.(37) In order to obtain a mature dental biofilm, it is necessary the adhesion of the bacteria to the hard dental tissues.(38)

Dental plaque can be compared to a biofilm because like the biofilm it contains a very large number of bacteria in the form of a polymer matrix (39,40) but unlike the biofilm which is less susceptible to antimicrobial agents, dental plaque exhibits improved pathogenicity.(41)

Carbohydrates, the fuels necessary for the functioning of the human body, are consumed frequently. They are chemically classified into polyhydroxy aldehydes, ketones, alcohols, or acids, and can be found in the form of sugars, oligosaccharides, or polysaccharides with acetyl bonds.(42)

Of all these types of carbohydrates, sucrose holds the highest cariogenic potential due to the structural changes it induces in the oral biofilm, making the oral biofilm thinner, porous and more adherent to hard dental surfaces when is present as a sublayer. The association of sucrose with other carbohydrates causes an increase in its cariogenic potential.(43)

A dietary intake rich in sucrose and monosaccharides has an increased cariogenic potential because it causes a rapid decrease in salivary ph. (44,45,46,47,48,49) Numerous studies on the effects of high-CARB diets on oral health describe fructose and glucose as carbohydrates with a lower cariogenic potential than sucrose.(50)

As for the use of natural sweeteners over sugars, xylitol, which comes from the hydrogenation of xylose, is preferred among them and possesses about 95% of the sweetness of sucrose, being also a natural compound present in many fruits and vegetables (51) and erythritol. Both sweeteners alter the microbiome of the oral cavity are involved in preventing the transmission of Mutans streptococcal in early childhood, possessing both oral and systemic benefits.(52)

Primary prevention of dental caries is achieved by excluding at least one of the etiological factors, fluoride having a special place. The administration of fluoride and the use of food sweeteners are effective means of achieving widespread prevention of carious processes.(53) *In situ* studies have highlighted the quality of the fluoride to mitigate the consequences of dietary intake rich in sucrose.(54)

Although fluoride administration is an effective method of preventing dental caries when the intake of sucrose is high and frequent, the prophylactic effect of fluoride decreases considerably.(55)

Over time, multiple measures to prevent dental caries have been tested. To date there are the balanced diet, administration of fluoride, and sealing of the grooves and fosetss of permanent teeth.(56,57)

Dental brushing and flossing are mechanical means used to remove plaque in order to remove potentially cariogenic bacterial species present in the oral cavity.(58,59)

CONCLUSIONS

Dental caries is a set of dynamic and complex demineralization and remineralisation processes that take place at the level of dental structures. The main etiological factor of dental caries is considered to be the consumption of sugars in various forms. The contact between sucrose and oral biofilm causes it to be used as a substrate in order to generate increased amounts of organic acids, thus inducing a marked decrease in pH. Sucrose and monosaccharides have an increased cariogenic effect. Natural sweeteners alter the microbiome of the oral cavity and are involved in preventing the transmission of Streptococcus Mutans inearly childhood. Fluoride has a safe and scientifically proven prophylactic effect, which through local and general administration contributes to the prophylaxis of dental caries.

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