

CARIES, DENTAL EROSION AND CARIOGENIC FOODS: A REVIEW OF CURRENT SCIENTIFIC LITERATURE

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Abstract: Caries and dental erosion are very common dental diseases today, with the etiology of both pathologies mentioned having a multifactorial origin, with diet as one of the main factors in the development of these diseases. **OBJECTIVE:** To evaluate, through a literature review, topics such as pathophysiology, etiology and influence of nutrition on both caries and dental erosion in light of current data. **METHODOLOGY:** Literature review using the main internet databases to select articles. **CONCLUSIONS:** This work highlights the importance of understanding cariogenic nutrition for oral health. Certain foods contribute to tooth decay, requiring preventative measures. A cariogenic diet is characterized by foods rich in sugar and starch, which feed the oral bacteria responsible for the demineralization of tooth enamel. The frequency and form of consumption also influence cavities. Education and access to accurate information are essential to changing eating habits and ensuring lifelong oral health. Health professionals, especially dentists, must provide clear guidance on cariogenic nutrition. This way, we can reduce cavities and promote healthy, long-lasting smiles.

Keywords: Dental Caries, Dental Erosion, Dental Diseases, Cariogenic Diet.

INTRODUCTION

Dental caries is considered a disease of multifactorial origin and is considered a public health problem, and can be acquired at any stage of a person's life, but children still end up being the main target of this pathology (1). In this scenario, according to PITTS et al. (2017), it is extremely important that the dentist identifies any type of development of this disease as soon as possible. Because, according to the same authors, caries in advanced stages can trigger intense local pain, reaching disabling levels for the individual, in addition to general and/or systemic infections,

dental erosion, loss of dental structures, such as crown, root and the infected tooth itself. In extreme cases, death may occur associated with dental treatment due to complications from anesthesia, for example (2).

Among the main factors that lead to the development of caries are the presence of a cariogenic diet, which is rich in fermentable sugars, inadequate oral hygiene followed by low use of products containing fluoride, dysregulation of the oral microbiota (oral dysbiosis) and dysfunctions. linked with saliva production (2,3). Dental erosion, which is wear on the tooth structure, can be one of the consequences of cavities if not treated properly due to dental demineralization, but this is just one of several risk factors for this situation, being the main factor for the development of cavities. Dental erosion is still food, where acidic foods tend to cause corrosion of the tooth structure (4).

Tooth decay is a chronic disease that affects millions of people around the world and is one of the leading causes of tooth loss in adults and children. Cavities are caused by the interaction of three main factors: bacteria, cariogenic foods and time (5). According to the authors MARTINS et al. (2021), fermentable sugars are considered the main risk factors for the development of cavities, as bacteria present in the oral cavity use these sugars to produce acids that erode tooth enamel (6).

This literature review sought to understand and point out the relationship between cariogenic foods, fermentable sugars and tooth decay, aiming to develop strategies for preventing and treating this pathology. Furthermore, research can provide relevant information for the population and oral health professionals, increasing awareness about the harmful effects of cariogenic foods and fermentable sugars on oral health and encouraging healthier eating habits.

CARIOGENIC FOODS AND THEIR RELATIONSHIP WITH CARIES

Dental caries is a multifactorial disease, and it is not new that the relationship between the appearance of this disease and the high consumption of dietary sugars is known, especially when we talk about sugars with fermentable capabilities, such as sucrose, glucose, fructose and starch. This occurs since these are the main carbohydrates present in Western food and/or added by industries to food products (7). Figure 1 shows the favorable factors for the emergence of cavities, such as the consumption of sugar and other cariogenic foods, as well as the favorable factors against the development of cavities.

Within the food industry, the use of starches and their derivatives (syrups), together with the famous “added sugars”, is very common. This occurs since these ingredients can confer several characteristics to the product to which they are added, such as film formation, adhesiveness, texture, clarity and shine of the gel, reduction of syneresis, retrogradation, gelation, thermal stability and cooking properties. Furthermore, due to the great demand for foods that are healthy, functional and gustatory attractive, starch is used mainly in its form called “resistant starch” to improve the digestive properties of these foods, since in this form the starch acts in a similar to dietary fiber (8,9).

Going deeper into the oral cavity, according to recent studies, it is possible to find around 700 to 1000 species of commensal bacteria in the oral cavity that form our oral microbiota. This way, it is possible to find two states of this microbiota in an individual: the eubiotic state (eubiosis), considered a state of balance and health between the host and its microbiota; The other state is dysbiotic (dysbiosis), which is related to imbalance and diseases, so it is in the state of oral dysbiosis that a person acquires related pathologies, such

as periodontitis, gingivitis, cancer, cavities, among others (CHOWDHRY et al., 2023; MADEIRA, 2020).

According to the context, when there is an increase in the consumption of fermentable sugars or foods that contain these carbohydrates, together with the lack of adequate oral hygiene and the absence of the use of toothpastes with fluoride, the bacteria present in the dental biofilm multiply (12).

Streptococcus mutans, *Veillonella* spp. and *Lactobacillus* spp. are examples of this; they ferment and convert sugars into acids, especially lactic acid, which, over time, can erode tooth enamel and cause tooth decay to form. If not treated immediately, decay can reach the level of the dentin and then the pulp, requiring root canal treatment or perhaps causing the loss of the affected tooth (GOMES, 2022; MARTINS et al., 2021).

ORAL HYGIENE AND CARIES PREVENTION

Along with diet and composition of the oral microbiota, we also have poor oral hygiene as a direct risk factor for the formation and appearance of dental cavities and other oral diseases (14).

It is established in the literature (15) that poor oral hygiene can cause the appearance of cavities due to the fact that through basic hygiene actions such as brushing your teeth daily, daily use of dental floss and fluoridated toothpastes that can be removed correctly dental biofilm and thus reduce/eliminate aciduric bacteria that in the future could cause demineralization of dental tissues

Still in the same line of thought, Martignon and collaborators (16) describe in their work that poor oral hygiene leads to the accumulation of food debris on the teeth, which leads to the growth of both beneficial and harmful bacteria, which can generate a condition of gingivitis, a disease that can

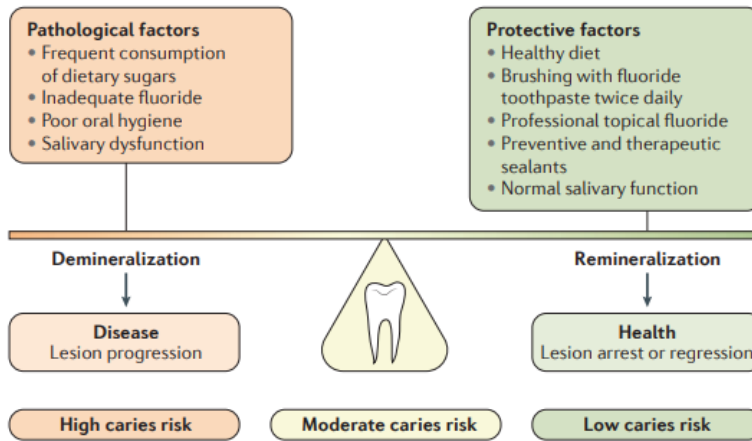


Figure 1: Factors that contribute to the emergence of tooth decay and factors that protect against it (PITTS et al., 2017).

worsen the condition of teeth, favoring the appearance and development of cavities

One factor that directly affects an individual's oral hygiene is socioeconomic status. Santos (17) carried out a literature review to identify the prevalence factors for cavities in low-income children and the impact of the disease on the quality of life of these children. With this, it was possible to conclude that children from families of low socioeconomic status have a higher prevalence of dental cavities due to a series of issues, such as: lack of access to dental services, misinformation, low education of caregivers/guardians, poor distribution income, unemployment and poor oral hygiene habits. In this context, it is the state's obligation to promote and implement policies, laws and programs that are focused on oral health, but also addressing other socioeconomic determinants that contribute to other divergences.

Finally, fluorine is an electronegative and reactive chemical element that can be found in nature. This element has action both in the treatment and prevention of dental caries, as it provides greater resistance to dental enamel through the formation of fluorapatite (more acid-resistant than calcium hydroxyapatite), thereby reducing demineralization, increasing remineralization and inhibiting bacterial

metabolism. In general, fluoride ends up strengthening teeth and making them more resistant against the action of acids generated by bacterial metabolism, in addition to promoting tooth remineralization. (18)

Due to its high effectiveness in treating and preventing tooth decay, fluoride can be easily found in dentifrices such as toothpastes and mouthwashes, supplements, dental offices and waters (19). The fact that there is fluoride in water is because cancer is still considered a major public health problem around the world. Johnston and Strobel (20) state that since 1930 water has been fluoridated in some countries, including Brazil, in an attempt to reduce the number of cases of this serious disease. Due to its high effectiveness in treating and preventing dental cavities, fluoride can be easily found in dentifrices such as toothpastes and mouthwashes, supplements, dental offices and in water (19). The fact of finding fluoride in water is due to the fact that tooth decay is still considered a major public health problem, therefore, according to Johnston and Strobel (20), since 1930 water fluoridation has been taking place in several countries, including Brazil, with the aim of reduction in cases of this chronic disease.

REGULAR VISITS TO THE DENTIST: PREVENTION AND EARLY DETECTION OF DISEASES

Since the beginning of time, it is possible to notice the presence of dentistry in history. There are records of this science as early as 3,500 BC, in the Mesopotamia region, with reports of cases of toothaches and gum wounds or those caused by parasites, as mentioned by L. S. Braga (21) in his book "National Research and Innovations in Health Sciences and Biological". Furthermore, there are records of dentistry in the Neolithic era and ancient Egypt (22). As a result of the presentation of these data and studies, it is possible to notice a common point: both medicine and dentistry were created from the moment when the first human beings had pain and problems related to both systemic health and oral health (21)

Given the historical data presented, it is discernible that, from the past to the present day, the position of dental surgeon is still seen and viewed as something negative. Magdaleno (23) showed in his study that people avoid going to the dentist for several reasons, highlighting here, among these, the fear of the unknown, bad past experiences, misinformation about oral hygiene, anxiety and, especially, the fear of feeling pain or even more pain.

All of this results in what is known as odontophobia/dentophobia, or the fear of dentists. Therefore, it is necessary to develop strategies that can reduce dental anxiety, such as promoting public awareness of the latest anesthetic techniques that make dental procedures virtually painless; highlight the importance of maintaining oral hygiene from an early age; and, most importantly, disseminate a more welcoming, pleasant and relaxing environment, whether in healthcare units or private practices. The goal is to reduce symptoms such as anxiety and fear, which will consequently reduce the likelihood of having a more difficult dental experience, both now

and in the future.

The importance of understanding odontophobia is essential when talking about the appearance of oral pathologies and conditions, as people no longer have an adequate diagnosis and prognosis due to this phobia. The dentist, contrary to what many people think, must be integrated into a multidisciplinary team, since many systemic pathologies can present oral manifestations, such as Diabetes Mellitus, systemic arterial hypertension (SAH) and cancer (24)

Include oral health in an individual's systemic health through regular visits to the dentist (at least every six months); Just as the basic care notebook, number 17 made available by the Ministry of Health, aims to not only help detect oral diseases, but also help identify signs, symptoms and stages of systemic conditions. Therefore, overcoming odontophobia and promoting routine dental visits are crucial steps in the prevention and early detection of diseases, which will ultimately lead to a better overall health status (25,26).

STEM CELLS IN CARIES TREATMENT

According to Suarez Rodrigues, biotechnology can be defined as "the application of science and technology to biological systems and living organisms, as well as to parts, products and models thereof, with the objective of creating or modifying materials, whether living or not, and processes, and to provide understanding, goods, and processes" (27). This way, it is possible to say that biomaterials are substances of natural origin or artificially created that come into contact with biological systems with the purpose of repairing or replacing tissues, organs or body functions, aiming to improve or preserve the individual's quality of life (28). In this context, it becomes evident that biomaterials play a crucial role in

the search for better treatments and practices within dentistry.

Stem cells have emerged as a valuable resource in dentistry, offering a wide range of applications as biomaterials. These cells, which have the ability to self-renew and transform into different types of tissues, including dental tissues, are being explored to regenerate damaged oral tissues. Silva and collaborators (2021) carried out a bibliographical review on the use of mesenchymal stem cells (MSC) removed from the dental pulp, in this sense, several applicability of MSC within dentistry was observed as advantages compared to current prosthetic methodologies, giving and maintaining vitality, elasticity and hydration of dental tissues and their regeneration, in the treatment of pathologies and in tissue bioengineering (29).

Guo and colleagues (30) implanted stem cells from exfoliated human primary teeth (SHED) into pigs without dental pulp. The results showed that the implantation of SHED in the samples managed to regenerate the lost pulp tissue, restore and promote root development. Furthermore, stem cells from exfoliated human primary teeth were able to generate/express gene markers linked to osteogenesis, adipogenesis, and angiogenesis (30). Another factor considered promising regarding MSC (Mesenchymal Stem Cells) removed from dental pulp is that their collection is minimally invasive, as they are taken from exfoliated deciduous teeth (SHED) or third molars (DPSC - dental pulp stem cells from teeth permanent), and in the latter case anesthetics are used, making the procedure practically painless. Furthermore, collection is easily accessible and can be carried out in a common dental office. However, there must be correct transport and storage of the extracted element, as these two factors directly influence the integrity and survival of stem cells (31).

Thus, the application of biotechnology

in dentistry through the integration of biomaterials and stem cells represents a field of research and practice with great transformative potential. By embracing these innovations, dentistry is positioned to offer more effective and less invasive treatments, improving patients' lives and paving the way for a more personalized and efficient approach to restoring oral health.

PROBIOTICS AND ORAL HEALTH

According to what is described in the literature and by bodies related to global health (FAO and World Health Organization), probiotics can be defined as "live microorganisms that, when administered in adequate quantities, confer benefits to the health of the host" (32). When administered correctly, probiotics have the ability to modulate the human microbiota appropriately, which indirectly affects the systemic health of an individual and acts to control and proliferate other pathogenic microorganisms (33).

Within probiotic therapy, the choice of strain to be used will depend on the individual's clinical case. For example, in situations of low immunity, cancer prevention, treatment and control of symptoms related to inflammatory bowel diseases (IBD), liver diseases, control of symptoms related to the treatment of *H. pylori*, obesity, increased performance, malabsorption of lactose, among other clinical conditions. It is important to highlight that, for each clinical case, it may be necessary to use a single strain or a combination of specific strains, in the correct/recommended quantities for each situation (34–36).

In dentistry, the use of probiotics has been considered as an alternative due to their potential benefits for oral health in several aspects. In their literature review on the use of probiotics in the treatment of cavities, Sivamaruthi and colleagues (37)

found two studies that demonstrated that supplementation with *Lactobacillus rhamnosus* GG (5-10 x 10⁵ CFU/ml) for approximately 7 months, administered through protein milk or juice, was able to reduce the incidence of cavities in children. Furthermore, in the same literature review, it was observed that the consumption of approximately 200g of probiotic yogurt containing strains of *Bifidobacterium* DN-173010 in adults significantly reduced mutans streptococcus counts in adults after 2 weeks of daily intake. This indicates that supplementation with *Bifidobacterium* DN-173010 can help reduce cariogenic bacteria in adult saliva.

Souza Santos and collaborators (38), through their literature review, compiled the benefits of using probiotics based on the selected studies. Among the benefits found in these studies, it was possible to verify advantages related to oral health, such as preventing cavities, helping to treat oral candidiasis, promoting oral health and improving cases of halitosis. In addition, several other benefits of probiotics in relation to systemic health were also cited, including the prevention of reproductive tract infections, the treatment of dermatological diseases in general, the reduction of respiratory infections, the relief of allergic manifestations and the prevention of infections of the reproductive tract.

An important point that must be mentioned before a professional prescribes any probiotic is that, for a long time, priority was given only to studying microorganisms and their effects on an individual's health. However, if these bacteria are not implanted in a suitable vehicle (capsules, gums, rinses, juices and gels) that can allow adequate fixation of the microorganisms in the oral cavity, both their proliferation and their effects/benefits for the individual will not be possible. will be effective, this was demonstrated in the study carried out by How and Yeo (39).

In summary, probiotic therapy can be considered an option of choice when it comes to prevention or adjuvant treatment in dental cases and other pathologies. However, more studies are needed to prove its true effectiveness, as well as the standardization of the form of administration and ideal dosages to obtain consistent clinical results. It is important that healthcare professionals and researchers continue to investigate probiotic therapy to understand its full potential and how it can be incorporated, especially in the clinical practice of the dental surgeon.

CONCLUSION

This study highlighted the immediate connection between the consumption of foods containing fermentable sugars and the development of cariogenic bacteria, such as *Streptococcus mutans*, emphasizing the need to make healthy food choices and maintain adequate oral hygiene habits. Through this research, it was possible to recognize the complex interactions between cariogenic foods and tooth decay, highlighting the importance of dietary control, oral hygiene and routine dental visits, since these factors directly contribute to the prevention and treatment of tooth decay. Considering technological advances, dentistry is increasingly developing in terms of treatment options, such as the use of stem cells and probiotics. This way, the importance of nutrition, oral hygiene, fluoride, frequent dental visits, biotechnology and diagnostic tests was highlighted. This emphasizes the importance of oral health for people's overall well-being and the need for multidisciplinary approaches to promote systemic health.

THANKS

The authors thank: ``Centro Universitário das Faculdades Integradas de Ourinhos`` (Unifio), Ourinhos, SP, Brazil.

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