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Cambio del pH salival por ingesta de edulcorantes no calóricos en la erosión dental

Change in salivary pH due to ingestion of non-caloric sweeteners in dental erosion

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Palabras claves:
Erosión dental, lesiones no cariosas, edulcorantes no calóricos, pH salival.

Resumen

Introducción. Los edulcorantes no calóricos son una tendencia como sustitutos del azúcar de caña que genera en los productos de consumo masivo el uso de palabras como “Light” “Bajo en azúcar” “Cero” entre otras para referirse al uso de estos compuestos químicos como un aditivo en alimentos para tener una similitud a los productos originales, pero con una presentación más saludable. La epidemia mundial de obesidad y diabetes ha llevado a una preocupación por el consumo. de azúcar y su impacto en la salud. Como resultado, se han desarrollado edulcorantes no calóricos como alternativas al azúcar para reducir el consumo calórico. Estos edulcorantes son ampliamente utilizados en todo el mundo en alimentos y bebidas para diabéticos, productos dietéticos y productos bajos en calorías. Sin embargo, la posible asociación entre el consumo de edulcorantes no calóricos y la salud oral ha sido objeto de debate. **Objetivo.** El objetivo de esta investigación es evaluar los efectos de los edulcorantes no calóricos en la salud oral, incluyendo su relación con la formación de placa, la caries dental, erosión dental y la salud periodontal. Se espera que los resultados de esta proporcionen información valiosa sobre la seguridad y eficacia de los edulcorantes no calóricos como alternativas al azúcar y su impacto en la salud oral. **Metodología.** El proyecto de investigación sistemática se desarrolló bajo las indicaciones PRISMA *(Preferred Reporting Items for Systemic Reviews and Meta-Analysis*). Por otro lado, este proyecto investigativo se elaboró a través de una revisión del contenido literario de artículos científicos en el área de la salud, particularmente en odontología, dichos artículos han sido difundidos en las principales revistas indexadas. Se obtendrán por medio de bases de datos científicas como *PubMed, Google Scholar* dentro de las más destacadas. Estos se encuentran publicados dentro de los últimos 10 años. Además, se desarrolló de forma organizada con el fin de resolver las variables dependientes (cambio de pH por ingesta de edulcorantes no calóricos) y variable independiente (erosión dental). **Resultados.** La disolución del esmalte está fuertemente influenciada por la concentración de Ca, el pH y la acidez titulable de la sustancia y está directamente relacionada con la concentración de la forma no

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disociada del ácido en una sustancia determinada. Por lo tanto, los valores más altos de acidez titulable son fuertes indicadores de concentraciones más altas de las especies no disociadas del ácido, lo que, a su vez, conduce a una mayor erosión del esmalte. **Conclusión.** La erosión es un problema significativo que puede estar influenciado por la ingesta de edulcorantes no calóricos, lo que destaca la importancia de un enfoque preventivo en la atención dental y la necesidad de educar a la población sobre la elección de alimentos y bebidas que no comprometan la salud bucal. Además, se observaron cambios en el pH salival que respaldan la importancia de la monitorización continua de este parámetro como un indicador clave de la salud bucal. **Área de estudio general:** odontología. **Área de estudio específica:** odontología general, salud, nutrición. **Tipo de estudio:** Artículos originales.

Keywords:
Dental erosion, non-carious lesions, non-caloric sweeteners, salivary ph.

Abstract

Introduction. Non-caloric sweeteners are a trend as substitutes for cane sugar that generates the use of words in mass consumption products such as “Light,” “Low in sugar,” “Zero” among others to refer to the use of these chemical compounds as an additive. in foods to have a similarity to the original products, but with a healthier presentation. The global epidemic of obesity and diabetes has led to concern about consumption of sugar and its impact on health. As a result, non-caloric sweeteners have been developed as alternatives to sugar to reduce caloric intake. These sweeteners are widely used around the world in diabetic foods and beverages, diet products, and low-calorie products. However, the possible association between the consumption of non-caloric sweeteners and oral health has been the subject of debate. objective. The objective of this research is to evaluate the effects of non-caloric sweeteners on oral health, including their relationship with plaque formation, dental caries, dental erosion, and periodontal health. The results are expected to provide valuable information on the safety and effectiveness of non-caloric sweeteners as alternatives to sugar and their impact on oral health. Methodology. The systematic research project was developed under PRISMA (Preferred Reporting Items for Systemic Reviews and Meta-Analysis) guidelines. On the other

hand, this research project was developed through a review of the literary content of scientific articles around health, particularly in dentistry, said articles have been disseminated in the main indexed journals. They will be obtained through scientific databases such as PubMed, Google Scholar, among the most prominent. These are published within the last 10 years. Furthermore, it was developed in an organized manner to resolve the dependent variables (change in pH due to ingestion of non-caloric sweeteners) and independent variable (dental erosion). Results. Enamel dissolution is strongly influenced by the Ca concentration, pH, and titratable acidity of the substance and is related to the concentration of the undissociated form of the acid in each substance. Therefore, higher values of titratable acidity are strong indicators of higher concentrations of the undissociated species of the acid, which, in turn, leads to further enamel erosion. Conclusion. Erosion is a significant problem that can be influenced by the intake of non-caloric sweeteners, highlighting the importance of a preventive approach in dental care and the need to educate the population on the choice of foods and beverages that do not compromise the oral health. Furthermore, changes in salivary pH were observed that support the importance of continuous monitoring of this parameter as a key indicator of oral health.

Introduction

Non-caloric sweeteners are a trend as substitutes for cane sugar that generates in mass consumption products the use of words such as "Light" "Low in sugar" "Zero" among others to refer to the use of these chemical compounds as an additive in foods to have a similarity to the original products, but with a healthier presentation.(1)(2).

The global epidemic of obesity and diabetes has led to a concern about sugar consumption and its impact on health. As a result, non-caloric sweeteners have been developed as alternatives to sugar to reduce caloric intake. These sweeteners are widely used worldwide in diabetic foods and beverages, diet products and low-calorie products. However, the possible association between non-caloric sweetener consumption and oral health has been the subject of debate.(2).

The Food and Drug Administration or as it is called in English FDA approved the use of non-caloric sweeteners classifying them as not bad for health and mentions that 37 studies

done on animals and humans designed to identify possible toxic effects have been analyzed, resulting in certain non-caloric sweeteners such as aspartame and advantame, being a compound similar to the first, have a problem by not being metabolized by people who suffer from phenylketonuria, which is a rare genetic disorder.(3).

Non-caloric sweeteners have different mechanisms of action and health effects. Some sweeteners, such as aspartame and saccharin, are noncariogenic and do not promote dental caries. Other sweeteners, such as sorbitol and xylitol, have a beneficial effect on dental health due to their ability to inhibit plaque formation and prevent dental caries. However, other sweeteners, such as sucralose and acesulfame-K, may have negative effects on oral health.(4).

The objective of this research was to evaluate the effects of non-caloric sweeteners on oral health, including their relationship with plaque formation, dental caries, dental erosion and periodontal health. The results of this research are expected to provide valuable information on the safety and efficacy of non-caloric sweeteners as alternatives to sugar and their impact on oral health.(5).

Methodology

The systematic research project was developed under the PRISMA (Preferred Reporting Items for Systemic Reviews and Meta-Analysis) guidelines. The peak question (population, intervention, comparison, outcomes) used was: What was the effect of pH change due to non-caloric sweetener intake on dental erosion? The elements of this peak question included: “P” (population); dental erosion, “I” (intervention); salivary pH changes, “C” (comparison); non-caloric sweetener intake “O” (outcomes); effect of pH change due to non-caloric sweetener intake on dental erosion.A total of 24 articles were eligible for full text reading and 7 articles were subsequently eliminated for not meeting the inclusion criteria: type of restoration, permanent teeth. Finally, 17 studies were chosen for qualitative and quantitative analysis.

On the other hand, this research project was developed through a review of the literary content of scientific articles in the health area, particularly in dentistry. These articles have been published in the main indexed journals. They will be obtained through scientific databases such as PubMed and Google Scholar, among the most prominent ones. These have been published within the last 10 years. In addition, it was developed in an organized way in order to resolve the dependent variables (pH change due to the intake of non-caloric sweeteners) and independent variable (dental erosion). A total of 61 scientific articles were collected, distributed in 12 in Spanish and 49 in English.

Inclusion criteria

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- Scientific articles were selected whose content included important information on pH changes, the use of non-caloric sweeteners, and dental erosion.
- Scientific articles were obtained from randomized studies, clinical interventions, systematic reviews, case studies and meta-analyses that have been published in the last 10 years.
- Scientific articles will be taken into account if the SJR (Scimago Journal Ranking) impact factor and the ACC (Average Count Citation) citation count exceed the established minimum, values that guarantee the quality of the literary content of each of the scientific articles.
- Free scientific articles in Spanish and English.

Exclusion criteria

- Scientific articles outside the annual interval established for the development of research between 2013-2023.
- Grey literature
- Articles from scientific databases that do not provide relevant and outstanding information on the topic raised in this research.

Table 1. Peak question

Component 1		Component 2
P	Population	Dental erosion
Yo	Intervention	Changes in salivary pH
C	Comparison	Intake of non-caloric sweeteners
EITHER	Outcomes	Effect of pH change due to ingestion of non-caloric sweeteners on dental erosion

Table 2. Search terms and extraction of use in the databases

Fountain	Search equation
PubMed (PMC)	Sweeteners Dental erosion Salivary pH Visual diagnosis Demineralization
Google Scholar	Sweeteners Dental erosion Oral cavity salivary pH Dental demineralization

Table 3.*Study selection criteria*

Study components	Criteria
Type of study	Literature review Descriptive studies Experimental studies Observational studies Case studies
Population	61 high-impact scientific articles Dental erosion Non-caloric sweeteners salivary pH
Language of publication	Spanish and English
Availability of text	Full and free texts
Publication time	Last 10 years: 2013-2023

Instruments used

- High-impact scientific articles
- Matrix for performing meta-analysis
- Checklist

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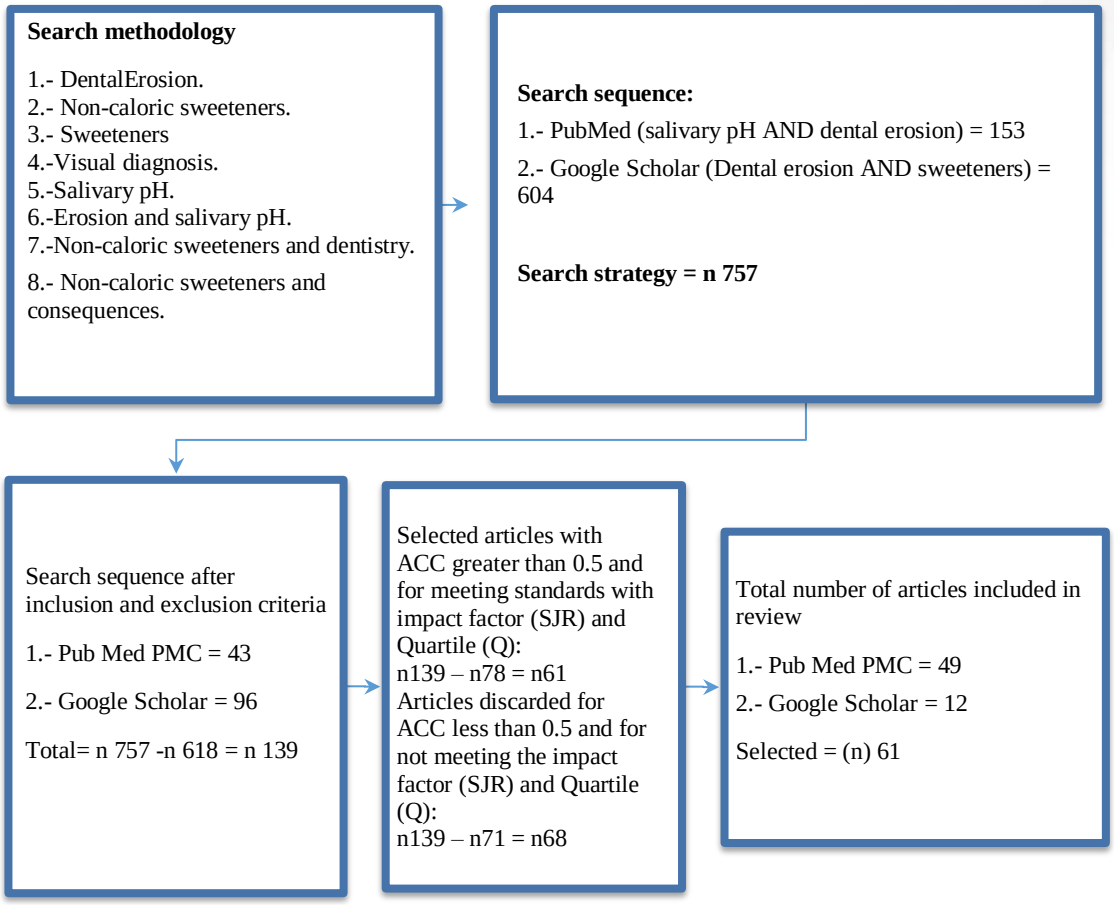

Figure 1. Methodology with scale and search algorithm

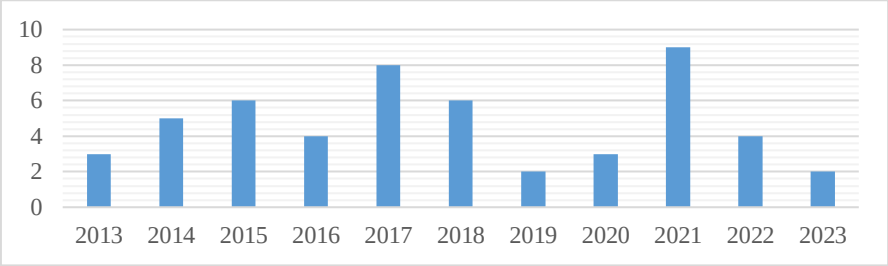

Figure 2. Publications by impact factor and year of publication

Analyzing Figure 2, we can see the average impact factor resulting from each year of publication of the studies used that were collected from the selected scientific databases, showing that almost all of them exceed the minimum recognized average of 1.5, which guarantees the quality of the bibliographic sources, where the year 2021 stands out with the highest average.

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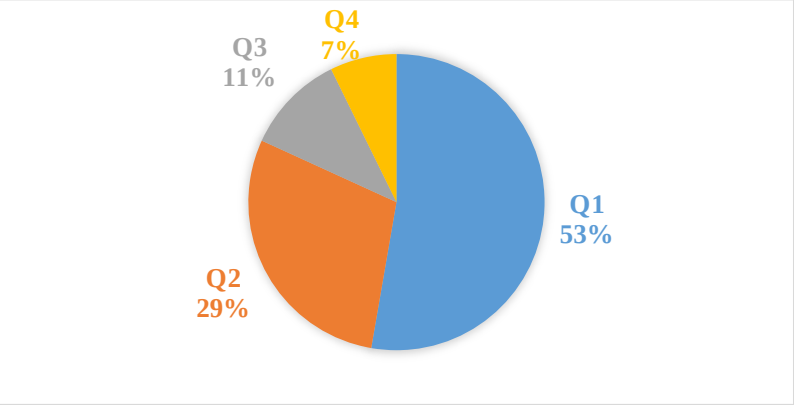

Figure 3. Publications by quartile

The table shows the distribution of bibliographic sources in their respective quartiles, highlighting the articles located in quartile 1 (Q1), as these reach more than 50%, guaranteeing the bibliographic quality with which the research was developed. Where this classification by quartiles establishes the degree of impact factor of the literary sources, where Q1 is the one with the highest impact and Q4 the lowest. In addition, a fragmentation of scientific articles is observed in the missing quartiles (Q2, Q3, and Q4).

Results

Excessive consumption of acidic foods and beverages has been the main focus of research on enamel erosion. Enamel dissolution is significantly associated with chemical parameters: pH, buffer capacity, titratable acidity, viscosity, as well as with calcium, phosphate and fluoride concentrations in foods and beverages.(1).

Erosive substances, such as Coca-Cola, Pepsi, Red Rivella, Kiwi and Gatorade, have a high phosphoric acid content and, consequently, high concentrations of Pi. The concentration does not play a major role in the erosive dissolution of enamel. Therefore, enamel dissolution is strongly influenced by the Ca concentration, pH and titratable acidity of the substance.(2). Titratable acidity is a measure of the buffering of a solution and is directly related to the concentration of the undissociated form of the acid in a given substance. Therefore, higher titratable acidity values are strong indicators of higher concentrations of the undissociated species of the acid, which, in turn, leads to increased enamel erosion.(3)(4).

Regarding enamel demineralization, all tested sweeteners showed a lower percentage of SHL compared to the positive control for caries. Fructose, however, induced higher demineralization than the other sweeteners. When biofilm properties were analyzed, only the saccharin-treated samples showed significantly lower biomass than the rest of the experimental products, although there was a tendency to induce less biomass for Stevia and sucralose. Stevia, sucralose, and saccharin recovered significantly fewer viable cells

from biofilms compared to the other sweeteners, with similar counts to the negative control. Likewise, polysaccharide analysis indicated that, except for fructose, all sweeteners induced lower IEPS production than sucrose.(5).

As enamel erosion progresses, the yellow-colored dentin becomes visible upon inspection and solitary dental restorations with no border of dentin and enamel can be seen. The effects of chemically induced erosion are most evident on the inner (palatal-facing) surfaces of the maxillary anterior and mandibular posterior teeth, as well as on the biting surfaces of all teeth, which appear concave or cupped (6).(7)(8).

Therefore, the abuse of carbonated acidic substances leads to an increased possibility of dental erosion with the consequent structural disintegration and reduction of the physical and mechanical properties of the enamel. Therefore, there is greater bacterial adhesion on rougher surfaces, determined by the erosive process, and therefore a greater risk of caries. The pH of most carbonated drinks on the market is lower than the critical pH for enamel demineralization. The pH of carbonated drinks and the duration of exposure have different harmful effects on enamel.(9).

In recent decades, increasing concerns about health and quality of life have encouraged people to avoid consuming foods high in sugar, salt or fat. With increasing consumer interest in reducing sugar intake, food products containing calorie-free alternatives (non-nutritive sweeteners; NNS) have become increasingly popular. NNS are generally hundreds to thousands of times sweeter than sucrose. Most of them contain no calories, while some NNS (e.g. aspartame) contain very few. Each sweetener has specific characteristics of sweetness intensity, sweet taste persistence, tooth coating and aftertaste effect.(10).

Discussion

Dental erosion is a degradation of the dentin tissue caused by several factors, one of which is the acidic pH of the saliva, which is influenced by the patient's usual diet.(1)(4)(11)(12). That is why the authors(1)(6)(7)(13)In conclusion, the decrease in the salivary medium generates a demineralization of the tooth enamel.

Non-caloric sweeteners are substances used to sweeten foods and beverages without adding calories. Some non-caloric sweeteners, such as sucralose and Stevia, are acidic. Ingestion of acidic non-caloric sweeteners can reduce salivary pH, which may increase the risk of dental erosion, the authors also note.(2)(5)(8)(14), agree that a low salivary pH indicates that the saliva is acidic. Acidic saliva can demineralize tooth enamel, which can lead to tooth erosion. Some authors claim that the intake of acidic non-caloric sweeteners can reduce salivary pH and increase the risk of tooth erosion.

Critically assess the results of the study, taking as a reference works published by the authors themselves or by other researchers. Explain the scope and limitations of the results.

The authors(15)(16)(17)(18), point out that the consumption of low-calorie carbonated drinks, medications and industrialized fruit drinks contain several components derived from non-nutritive sweeteners that are currently in mass consumption used mainly by people with eating disorders, obesity, diabetes and fans of low-calorie diets, however, the authors(13)(19)(20), they point out that when used they can generate a decrease in salivary pH, going from neutral to an acidic environment of the oral cavity, being more prone to demineralizing lesions of dental tissues, since one of the effects of salivary imbalance leads to problems such as caries, periodontal disease and dental erosion. Although the authors(21)(22)(23)(24), disagree based on their studies determining that the results do not have any significant effect on the acidification of pH in saliva, the data do not show that not all non-caloric sweeteners generate changes in pH although there are some adverse effects on the most commonly used sweeteners such as saccharin and aspartame.

Conclusions

- Through an analysis of the scientific literature, it is concluded that the information obtained on dental erosion has shown that it is a significant problem that can be influenced by the intake of non-caloric sweeteners, highlighting the importance of a preventive approach in dental care and the need to educate the population on the choice of foods and beverages that do not compromise oral health. In addition, changes in salivary pH were observed, supporting the importance of continuous monitoring of this parameter as a key indicator of oral health.
- Likewise, thanks to the exploration of scientific literature and the analysis of experimental data, we have been able to identify the key characteristics of dental erosion, including its risk factors and clinical manifestations. In addition, we have examined the consumption habits of non-caloric sweeteners and their potential impact on dental erosion and salivary pH. These findings provide a deeper understanding of the interaction between these factors and suggest the need for greater public awareness, knowledge of the risks of some foods and preventive measures to preserve oral health.
- We also find the relationship in the formation of dental erosion caused by changes in salivary pH, the drop in the salivary medium influenced by various factors that affect both the quantity and quality of saliva are fundamental factors in promoting an oral environment susceptible to demineralization of dentin tissues, systemically the body in reaction to eating habits lowers salivary pH levels and is directly proportional to the risk of dentin erosion, several factors influence the risk of this

loss of dental structure but changes in the acidity of saliva are the most important intrinsic factor and as a consequence an unhealthy and aesthetic appearance of the teeth.

- When comparing the cross-sectional and individual parameters on the changes in salivary pH generated by the excessive consumption of drinks, medications, foods containing non-caloric sweeteners, we found that they are related to non-carious lesions, mainly dental erosion, since different studies show that the consumption of certain types of food generates an imbalance in the oral environment, the normal drop in salivary pH from 6.8 to 7.2 as normal to a drop of up to 5.5, which is an environment conducive to erosion and dental caries. Thus, we conclude that a low-calorie diet using non-caloric sweeteners is a primary factor in the development of dental erosion.

Conflict of interest

The authors declare no conflict of interest in relation to the submitted article.

Authors' contribution statement

All authors contributed to writing, reviewing and editing the article. Primary author and the person who developed the systematic review. NRLM, collaboration and verification of results AJQC, DACZ and GXOP. All authors have read and accept the written version of the manuscript.

The authors who publish in «Change in salivary pH due to the ingestion of non-caloric sweeteners in dental erosion» know and accept the following conditions:

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