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Sweeteners: Classification, Properties, Uses, and Health Effects

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Abstract

Sweeteners constitute a diverse group of compounds widely used in the food, pharmaceutical, and nutritional industries for their ability to provide sweetness with varying energy content and functional properties. The objective of this review article was to critically analyze recent scientific evidence (2020–2026) on the classification, chemical structure, physicochemical properties, metabolism, applications, and health effects of the main sweeteners, including sugars, intense sweeteners, and polyols. The methodology involved searching for open-access articles in databases such as PubMed, SciELO, and ScienceDirect in Spanish and English. The results show that each type of sweetener has specific characteristics that determine its technological and physiological behavior, highlighting the multifunctionality of sucrose compared to high-intensity substitutes. Furthermore, the study identifies advantages such as reduced caloric intake, as well as limitations related to gastrointestinal effects or controversies regarding long-term safety. It concludes that the selection of sweeteners should be based on the context of consumption, dosage, and individual needs, promoting a balanced and informed approach.

Keywords: sweeteners; sucrose; sucralose; polyols; metabolism

1 Introduction

Sweeteners have become increasingly important in food science and nutrition due to their role in formulating lower-calorie products and preventing metabolic diseases. Traditionally, sucrose has been the primary sweetening agent in human food, not only for its sweetness but also for its functional properties related to texture, preservation, and stability. However, the rise in consumption of added sugars and their association with health issues such as obesity, type 2 diabetes mellitus, and cardiovascular diseases has driven the search for alternatives (Morio & Guy-Grand, 2021).

In this context, non-caloric and low-energy sweeteners have emerged as key tools in food reformulation. These compounds include intense sweeteners, such as sucralose, aspartame, and saccharin, as well as polyols such as erythritol and xylitol. Each possesses unique structural, metabolic, and functional characteristics that influence their behavior in the body and their industrial applications (Campos et al., 2025; Urrialde et al., 2023).

Despite their potential benefits, the use of sweeteners has also sparked controversy regarding their safety, metabolic effects, and possible impact on the gut microbiota. Furthermore, scientific evidence suggests that completely replacing sugar does not always yield the expected effects on weight control or metabolic improvement, highlighting the importance of a comprehensive analysis (Plaza-Diaz et al., 2020; Kossiva et al., 2024).

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2 Materials and Methods

A descriptive-analytical narrative review of sweeteners was conducted to synthesize and discuss the scientific evidence on their classification, chemical and physicochemical characteristics, metabolism, applications, health effects, safety, and regulation.

To this end, a literature search was conducted in PubMed, ScienceDirect, and SciELO, using combinations of terms related to sweeteners, sugar substitutes, non-nutritive sweeteners, polyols, metabolism, gut microbiota, toxicity, safety, and regulation. Priority was given to scientific articles published between 2020 and 2026. Original articles, scientific reviews, and book chapters relevant to the objective were included. Official documents from international organizations and regulatory agencies—including the WHO, EFSA, FDA, and JECFA—were also considered, particularly those related to safety assessment, exposure, and regulation.

The selected literature was reviewed using a qualitative synthesis. It was organized into thematic categories: classification, chemical structure, molecular mechanisms, metabolism, applications, health effects, gut microbiota, emerging sweeteners, sweetener blends, and regulation. Study results were compared by sweetener type, dose or exposure, experimental model, study population, exposure duration, and primary outcomes. Special attention was paid to consistent and conflicting results, as well as to the methodological limitations of the studies. Experimental and clinical evidence was compared with information from regulatory agencies and international organizations. The objective was to distinguish between hazard evidence, risk assessment, dietary exposure, acceptable daily intake, and public health recommendations.

3 Results and Discussion

3.1 Regulatory frameworks of the WHO, the FDA, and the EU

Sweeteners are consumed daily by hundreds of millions of people and are found in a wide range of foods, beverages, and pharmaceutical products. Historically, the assumption that these substances have minimal interaction with the body has been based on animal toxicology and human intake modeling, but this assumption is now being questioned. These sweeteners undergo toxicological evaluation by the Joint FAO/WHO Expert Committee on Food Additives (JECFA) and other authorized bodies to establish safe intake levels (i.e., acceptable daily intake [ADI]; see Table 1) (Chudasama, 2026). New fundamental studies have examined potential links between low-calorie and non-caloric sweeteners (LNCS) and metabolic outcomes, cardiovascular and cognitive health, microbiome composition, endocrine development, and possible signs of cancer risk.

Table 1: Acceptable Daily Intake (ADI) for low-calorie sweeteners, as established by the FAO/WHO JECFA

Low-calorie/calorie-free sweetener	**ADI (mg/kg)**
Acesulfame-K (INS 950)	0–15
Aspartame (INS 951)	0–40
Cyclamate (INS 952)	0–11
Saccharin (INS 954)	0–5
Sucralose (INS 955)	0–15
Thaumatin (INS 957)	Not specified (an "unspecified" ADI means that thaumatin may be used in accordance with good manufacturing practices
Steviol glycosides	0–4 (expressed as steviol)
Neotame (INS 961)	0–2
Advantame (INS 969)	0–5

Note: The "INS" reference for each additive refers to the Codex Alimentarius International Numbering System

The approval and authorization of food additives begins with safety assessments by the Joint FAO/WHO Expert Committee on Food Additives (JECFA) and is subsequently carried out—either in parallel or, in some cases, even first—by national food safety authorities or agencies, such as: the European Food Safety Authority, the U.S. Food and Drug Administration (FDA), the Food Standards Agency of Australia and

New Zealand, the Food Standards Agency of the United Kingdom, the Norwegian Food Safety Authority, the Icelandic Food and Veterinary Authority, the Federal Food Safety and Veterinary Office of Switzerland, the Federal Commission for the Assessment of Health Risks of Mexico, the Canadian Institute of Food Safety, and the Food Safety Commission of Japan, to name a few (Urrialde et al., 2023).

Sweeteners, like other ingredients added to foods in the U.S., must be safe for consumption. Companies that wish to market a new food additive or use an already-approved one in a different way must first apply for approval from the U.S. Food and Drug Administration (FDA). The FDA determines whether the ingredient is safe for its intended use based on the most recent scientific studies available. In the case of aspartame, the scientific evidence continues to support its safety for the general population when used under appropriate conditions (Food & Administration, 2023).

EFSA provides scientific advice to support the European Commission's (EC) food additive authorization processes. Its main tasks regarding food additives include: assessing the safety of new food additives or modifications, reevaluating safety, and responding to new ad hoc requests from the EC (Association, 2026).

The WHO presents evidence and recommendations on the use of non-sugar sweeteners (NSS) and recommends that they not be used to control weight or reduce the risk of noncommunicable diseases (Organization, 2023).

3.2 The Current Importance of Research on Sugars and Sweeteners

Sweeteners play a fundamental role in the modern diet due to the growing demand for lower-calorie products. Their use has increased significantly in response to public health concerns about excessive sugar consumption (Hedrick et al., 2023; Witkowski et al., 2023).

Furthermore, scientific interest in these compounds has grown in recent years due to their potential relationship with appetite regulation, energy metabolism, and cardiometabolic health, which has generated both expectations and controversy regarding their use (Khan et al., 2023; Rogers & Appleton, 2021). In this context, the reduction in added sugar consumption has driven the development and use of low- or zero-calorie substitutes that maintain the sensory acceptability of foods (Morio & Guy-Grand, 2021).

From a nutritional and physiological perspective, it is essential to understand the differences between sugars and sweeteners, as they undergo distinct metabolic pathways and can elicit diverse biological responses, including effects on the gut microbiota, energy metabolism, and appetite regulation (Plaza-Diaz et al., 2020; Kossiva et al., 2024). Therefore, a comprehensive study of these compounds is essential in both clinical settings and the food industry.

3.3 Classification of Sweeteners and Major Representative Compounds

The classification of sweeteners is essential for understanding their functional, metabolic, and technological differences. In the scientific literature, these compounds are primarily grouped into three categories: nutritive sugars, intense sweeteners, and polyols. This classification is based not only on their origin or chemical structure, but also on their physiological behavior, energy content, and interaction with biological systems. (Campos et al., 2025; Urrialde et al., 2023)

Nutritive sugars include monosaccharides and disaccharides, such as glucose, fructose, and sucrose, which are the most traditional forms of sweeteners in the human diet. These compounds provide approximately 4 kcal per gram and are completely metabolized by the body, making them a direct source of energy. Sucrose, in particular, consists of one glucose molecule and one fructose molecule linked by a glycosidic bond, which gives it specific physicochemical properties that influence its behavior in foods (Preinfalk et al., 2024).

In addition to their function as sweeteners, dietary sugars play a key role in the structure and stability of food products. Sucrose, for example, contributes to texture, volume, moisture retention, and shelf life by reducing water activity.

These functional properties are difficult to replicate with other sweeteners, which explains their continued use in the food industry (Salar et al., 2022).

However, excessive consumption has been linked to adverse health effects, including the development of metabolic diseases. Despite this, recent studies suggest that its effects depend largely on the amount consumed and the overall dietary context, rather than on its chemical nature per se (Zhang et al., 2022). Therefore, sucrose should not be viewed exclusively as a negative component, but rather as an ingredient whose impact depends on consumption patterns.

Intensive sweeteners, also known as non-nutritive or high-intensity sweeteners, are characterized by a significantly higher sweetness than sucrose, allowing them to be used in very low concentrations. This group includes compounds such as saccharin, aspartame, sucralose, acesulfame-K, and steviol glycosides. Their main advantage lies in their low or zero caloric content, which makes them attractive for low-calorie diets and products intended for people with diabetes (S et al., 2024).

From a chemical standpoint, these compounds have diverse structures, ranging from sulfonated derivatives (saccharin) to halogenated molecules (sucralose) or modified peptides (aspartame). These structural differences determine their interaction with sweet taste receptors, as well as their thermal stability and behavior under different processing conditions (Shil et al., 2025).

Despite their advantages, intense sweeteners have certain limitations. Some can produce undesirable aftertastes, such as bitter or metallic notes, which makes it necessary to combine them with other compounds to improve their sensory profile. Furthermore, although most have been deemed safe within acceptable daily intake limits, scientific debates persist regarding their long-term effects, particularly in relation to gut microbiota and appetite regulation (Kossiva et al., 2024). These controversies highlight the importance of continuing to investigate their impact on health.

Polyols, or sugar alcohols, form an intermediate group between dietary sugars and intense sweeteners. Among the most commonly used are sorbitol, xylitol, and erythritol. These compounds have a sweetening power that is lower than or similar to that of sucrose, but they provide fewer calories because they are only partially absorbed in the small intestine (Poka et al., 2023).

From a chemical standpoint, polyols are characterized by the presence of multiple hydroxyl groups, which give them high solubility and hygroscopic properties. These characteristics make them particularly useful in the food industry, as they help retain moisture, improve texture, and extend the shelf life of products. In addition, they have a low glycemic index, making them a viable alternative for people with diabetes (Kaur et al., 2024).

However, consuming them in large quantities can cause adverse effects, primarily gastrointestinal, due to the fermentation of the unabsorbed portion in the colon. This effect may manifest as abdominal bloating, flatulence, or diarrhea, which limits their use in certain populations (Campos et al., 2025). Despite these limitations, polyols continue to be widely used because of their versatility and functional benefits.

From a comprehensive perspective, this categorization allows us to analyze how each group influences the perception of sweetness, the metabolic response, and functionality in food matrices. Furthermore, it facilitates the appropriate selection of sweeteners based on specific objectives, such as calorie reduction, glycemic control, or technological stability. In this regard, it is important to note that the choice of a sweetener depends not only on its sweetening capacity but also on factors such as its stability, its compatibility with other ingredients, and its short- and long-term physiological effects (Xue et al., 2025).

3.4 Chemical Structure and Determinants of Sweet Taste

The chemical structure of sweeteners is one of the most decisive factors in the perception of sweetness (see Figure 1), as well as in their physicochemical properties, stability, and metabolic behavior. At the molecular level, sweetness depends on interaction with T1R2/T1R3 receptors, which is influenced by molecular struc-

ture. Sweetening compounds interact with heterodimeric receptors located in the taste cells of the tongue. This interaction depends on the spatial conformation of the molecule, the presence of specific functional groups, and its ability to form intermolecular bonds with the receptor's active site (Shil et al., 2025).

Various theoretical models, such as the AH-B (proton acceptor-donor) model, have been used to explain the structure–activity relationship of sweet compounds. According to this model, the presence of a proton donor (AH) and an acceptor (B) at an appropriate distance within the molecule allows for the activation of the sweet receptor. However, more recent research has shown that this model is an oversimplification, since the perception of sweetness also depends on molecular flexibility, hydrophobicity, and interaction with multiple sites on the receptor; see Figure 2 (Shil et al., 2025).

In the case of sugars such as sucrose, their disaccharide structure consists of glucose and fructose linked by a glycosidic bond, which gives them a balanced sensory profile, no aftertaste, and efficient interaction with taste receptors. This characteristic explains why sucrose is considered the benchmark for evaluating the sweetening power of other compounds (Preinfalk et al., 2024).

On the other hand, intense sweeteners have highly diverse chemical structures. Sucralose, for example, is a chlorinated derivative of sucrose in which three hydroxyl groups have been replaced by chlorine atoms, which significantly increases its sweetening power and reduces its metabolism. In contrast, aspartame is a dipeptide composed of aspartic acid and phenylalanine; its structure allows it to interact effectively with sweet taste receptors, but also makes it susceptible to thermal degradation and extreme pH conditions (S et al., 2024).

Polyols, such as erythritol and xylitol, have linear or cyclic structures with multiple hydroxyl groups, which give them high water solubility and a characteristic cooling sensation when consumed. This sensation is due to an endothermic effect that occurs during dissolution, which distinguishes them sensorially from sugars and intense sweeteners (Poka et al., 2023).

In addition to influencing the perception of sweetness, their chemical structure determines key physicochemical properties relevant to their application in food and pharmaceutical products. Among these properties are:

- Thermal stability: Some sweeteners, such as sucralose and steviol glycosides, are highly heat-resistant, making them suitable for processes such as baking or pasteurization. In contrast, aspartame degrades at high temperatures, which limits its use in processed products (da Silva Santana et al., 2025).

- Solubility: The ability to dissolve in water is essential for incorporation into beverages and solutions. Polyols and sugars are highly soluble, while some high-intensity sweeteners require specific formulations.

- pH stability: Certain sweeteners can degrade under acidic or alkaline conditions, which affects their use in carbonated beverages or fermented products.

From a metabolic standpoint, the chemical structure also determines the fate of the sweetener in the body. While sucrose is hydrolyzed in the small intestine into glucose and fructose, other compounds, such as sucralose, are poorly absorbed and are excreted unchanged, which explains their zero caloric content (S et al., 2024; Xue et al., 2025). Polyols, on the other hand, are partially absorbed and undergo colonic fermentation, which can lead to specific physiological effects.

Overall, scientific evidence shows that chemical structure determines not only the sweetness but also the technological functionality, stability, and metabolic impact of sweeteners. Furthermore, studies suggest that artificial sweeteners may have varying effects among individuals due to genetic factors and taste sensitivity, which influence caloric intake and food preferences (Preinfalk et al., 2024). On the other hand, some sweeteners may alter the gut microbiota, although the results remain inconsistent and depend on dosage and dietary context, which has sparked a debate regarding their long-term use. (Richardson & Frese, 2022; Suez et al.,

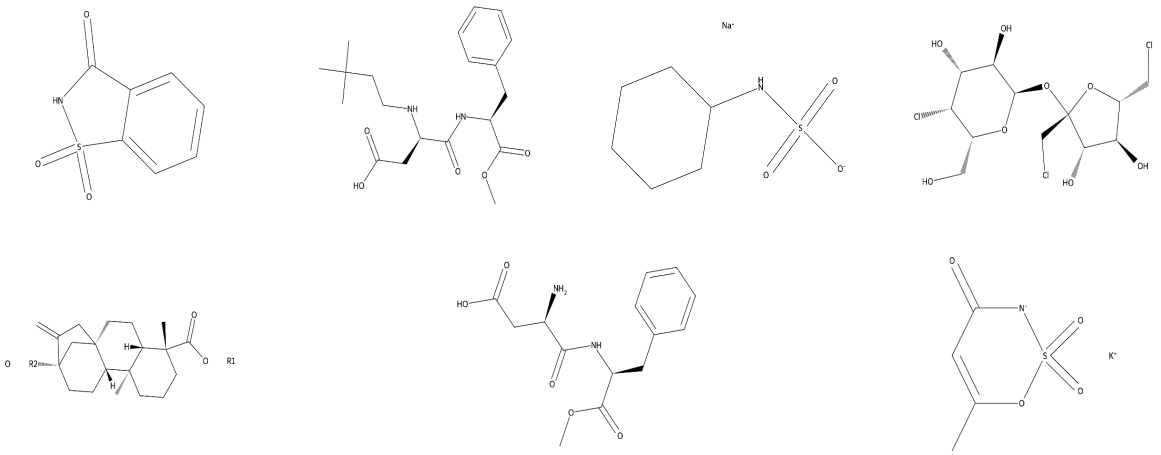


Figure 1: Structure of the sweeteners redrawn by the authors based on structural information available in PubChem (Kim et al., 2025).

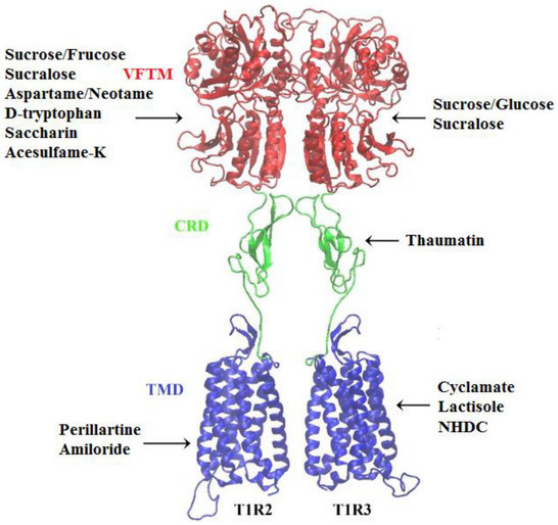


Figure 2: Graphic representation of the modeled structure of the human sweet taste receptor T1R2/T1R3 and its binding sites for different sweeteners. The extracellular VFTM (Venus flytrap module), CRD (cysteine-rich domain), and TMD (transmembrane domain) are colored in red, light green, and blue, respectively (Wang et al., 2022).

2022). This knowledge is essential for the design of new compounds and the appropriate selection of sweeteners based on their applications and health effects.

3.5 Physicochemical Properties, Absorption, and Physiological Effects

Some sugars, such as sucrose, are hydrolyzed into glucose and fructose, which are completely metabolized and absorbed for use as an energy source. However, some studies suggest that sucrose has certain effects on the gut microbiota (Suez et al., 2022; Zhang et al., 2022). In contrast, intense sweeteners are absorbed only partially or not at all, which reduces their caloric impact.

Polyols are partially absorbed, and the unabsorbed fraction is fermented in the colon, which can cause gastrointestinal effects at high intake levels (Campos et al., 2025; Goveas, 2025).

Furthermore, experimental studies have shown that different levels of sucrose consumption can elicit distinct physiological responses, suggesting that its effects depend on dose and dietary pattern; see Table 2 (Zhang et al., 2022).

3.6 Food, Pharmaceutical, and Clinical Applications

Sweeteners have a wide range of applications across various sectors, particularly in the food, pharmaceutical, and clinical-nutritional industries, where their selection depends on their

Table 2: Metabolic and functional comparison of sweeteners

Compound	Type	Absorption	Metabolism	Glycemic impact	Notes
Sucrose	Sugar	Complete	Glucose + fructose	High	Immediate energy
Sucralose	Intensive	Minimal	Not significant	None	Non-caloric
Aspartame	Intensive	Complete	Amino acids	None	Heat-sensitive
Saccharin	Intensive	Partial	Excretion	None	High potency
Erythritol	Polyols	Partial	Renal elimination	Very low	High tolerance
Xylitol	Polyols	Partial	Slow metabolism	Low	Laxative effect in excess

(Campos et al., 2025; de Cock, 2020; Kaur et al., 2024; Poka et al., 2023; S et al., 2024).

physicochemical properties, stability, sensory profile, and metabolic behavior. Their use is driven not only by the need to provide sweetness but also by specific technological and therapeutic functions (Salar et al., 2022; Londoño & Polo, 2024).

In the food industry, sweeteners are primarily used to reduce the caloric content of products without compromising sensory acceptability. Sucrose remains the benchmark ingredient due to its ability to provide not only sweetness but also structure, volume, viscosity, and stability in various food systems, making it difficult to replace entirely (Muñoz-Labrador et al., 2024). Furthermore, it participates in important chemical reactions, such as caramelization and the Maillard reactions, which contribute to the characteristic color, aroma, and flavor of many processed foods. These properties make its complete replacement challenging, as most alternative sweeteners lack these integral technological functions (Salar et al., 2022).

On the other hand, intense sweeteners such as sucralose, saccharin, and aspartame are widely used in beverages, "light" or "sugar-free" products, and functional foods. Their high sweetening power allows them to be used in very low concentrations, which significantly reduces energy intake. However, since they do not contribute volume or texture, they are often combined with other ingredients or bulking agents to achieve characteristics similar to those of traditional products (Kossiva et al., 2024). Furthermore, their thermal stability and pH determine their specific application; for example, sucralose is suitable for baked goods, while aspartame is limited to products that do not require high temperatures (da Silva Santana et al., 2025).

In the case of polyols, their use in foods is associated with chewing gum, candy, and baked goods. These compounds provide moderate sweetness, help retain moisture, and create a refreshing sensation in the mouth, which is desirable in certain applications. Furthermore, their low glycemic index makes them suitable for foods intended for populations with specific dietary requirements, such as people with diabetes (de Cock, 2020; Poka et al., 2023).

In the pharmaceutical field, sweeteners play a key role in improving the palatability of medications, especially in liquid formulations, syrups, chewable tablets, and pediatric products. The addition of sweeteners helps mask the bitter or unpleasant tastes of active ingredients, promoting acceptance of the medication and, consequently, treatment adherence. In this context, the selection of a sweetener depends on its chemical stability, its compatibility with other excipients, and the absence of adverse reactions, all of which promote treatment adherence (Londoño & Polo, 2024).

In addition, some sweeteners, such as polyols, are used as functional excipients because of their ability to act as bulking agents, humectants, or stabilizers. This is particularly relevant in the development of modern pharmaceutical formulations, where the goal is to optimize both therapeutic efficacy and the patient experience

(de Cock, 2020).

In clinical and nutritional contexts, sweeteners are used as tools in the management of metabolic diseases, particularly in the control of diabetes mellitus and in strategies for weight loss. Non-nutritive sweeteners make it possible to reduce the intake of simple sugars without completely eliminating sweetness from the diet, which can facilitate adherence to restrictive dietary regimens (Campos et al., 2025). However, their use must be carefully evaluated, as some studies suggest that they may influence appetite regulation or the perception of sweetness in the long term.

Similarly, in clinical nutrition, sucrose may continue to be used in certain contexts, particularly when a rapid source of energy is required or in specific formulations where its technological properties are indispensable. This reinforces the idea that there is no universally superior sweetener; rather, the choice of sweetener should be based on the intended use and the characteristics of the patient or the product.

Furthermore, some sweeteners, such as polyols, are used as functional excipients due to their ability to act as bulking agents, humectants, or stabilizers. This is particularly relevant in the development of modern pharmaceutical formulations, where the goal is to optimize both therapeutic efficacy and the patient experience.

Overall, the applications of sweeteners reflect their versatility and importance in many areas, underscoring the need for a comprehensive approach that considers both their functional properties and their health implications (Xue et al., 2025).

Overall, the applications of sweeteners reflect their versatility and relevance across multiple areas, highlighting the need for a comprehensive approach that considers both their functional properties and their health implications.

3.7 Advantages and Disadvantages of Using Sweeteners

The use of sweeteners—both nutritive and non-nutritive—has sparked extensive debate in the scientific literature due to the complexity of their effects on health, metabolism, and eating behavior. They cannot be evaluated in a generalized manner, as the advantages and disadvantages depend on the type of sweetener, the dose consumed, the frequency of intake, and the dietary context in which they are incorporated (Campos et al., 2025; Urrialde et al., 2023). Therefore, their consumption must be evaluated on an individual basis, taking into account the dietary context and the specific needs of each population (Khan et al., 2023). Some studies have identified associations between the consumption of artificial sweeteners and metabolic abnormalities, although the results are not conclusive (Hedrick et al., 2023; Khan et al., 2023).

Among the main advantages is the ability to adjust the energy content of the diet. High-intensity sweeteners such as sucralose, saccharin, and aspartame provide sweetness without a significant increase in caloric intake, making them useful tools for weight management and obesity prevention (S et al., 2024). In this regard, several studies have shown that partially replacing sugars with non-nutritive sweeteners can help reduce total energy intake, especially in populations with high consumption of sugar-sweetened beverages.

Another important advantage is their use in glycemic control, particularly in people with diabetes mellitus. Unlike sucrose and other simple sugars, many sweeteners do not cause significant increases in blood glucose levels, allowing for their inclusion in specific diets. Furthermore, polyols have a low glycemic index and are only partially absorbed, which also makes them viable alternatives in these types of dietary regimens (Kaur et al., 2024).

From a technological standpoint, some sweeteners have specific functional properties. For example, polyols contribute to moisture retention and product stability, while sucrose remains irreplaceable in many applications due to its ability to provide texture, volume, and color (through Maillard reactions), in addition to contributing to preservation. This highlights that, far from being completely replaced, sucrose continues to play a fundamental role in the food industry (Salar et al., 2022).

However, the use of sweeteners also presents disadvantages and limitations that must be considered. In the case of polyols, consuming them in high quantities can cause gastrointestinal ef-

fects such as abdominal bloating, flatulence, and diarrhea, due to their fermentation in the colon. This dose-dependent effect may limit their tolerance in certain individuals (Poka et al., 2023).

As for intense sweeteners, one of the main concerns is their potential impact on the gut microbiota and metabolic regulation. Some studies have suggested that certain sweeteners may alter the composition of the microbiota or influence insulin response, although the results remain inconsistent and depend on multiple experimental factors (Zhang et al., 2022). These uncertainties have kept the scientific debate open regarding their long-term effects; see Figure 3.

Another significant drawback is sensory perception, as some high-intensity sweeteners may have bitter or metallic aftertastes, which affects consumer acceptance. This has led to the development of sweetener blends to improve the organoleptic profile, although this can increase the complexity of formulations (Kossiva et al., 2024).

As an example of a disadvantage, we have sucralose, which was shown to be chemically stable in the body during the 1980s and 1990s. Based on this evidence, ADI values were established, Schiffman et al. (2023) studied sucralose and sucralose-6-acetate (S6A), an acetylated product identified as a metabolite and impurity of sucralose. One of the main findings is that S6A exhibited genotoxic activity, inflammation, oxidative stress, and cancer-associated processes. Given this information, it is proposed that the safety of sucralose should be assessed through a reevaluation of the original compound and its byproducts in humans.

Similarly, studies were conducted on erythrol and erythronate, which found that participants had elevated concentrations, were older, had a higher body mass index, and had a higher prevalence of diabetes, hypertension, hyperlipidemia, and kidney dysfunction, as well as higher concentrations of cardiac and inflammatory biomarkers (Witkowski et al., 2023). Another sweetener that is frequently singled out is sucrose, due to its link to metabolic diseases when consumed in excess. In moderate amounts and as part of a balanced diet, its consumption does not pose a significant health risk, suggesting that its widespread demonization may be an oversimplification of the problem (Preinfalk et al., 2024).

In addition, there is a debate regarding the impact of sweeteners on eating behavior. It has been suggested that frequent consumption of very sweet products—even those with no caloric content—could maintain or increase a preference for sweet flavors, which could hinder the adoption of more balanced eating patterns (Campos et al., 2025).

Overall, the scientific evidence suggests that there is no single, universally ideal sweetener; rather, each one has its own specific set of benefits and limitations. Therefore, their selection and consumption should be based on an individualized, contextualized approach that considers both their chemical properties and physiological effects, as well as their role in the overall diet, suggesting that their consumption should be evaluated on a case-by-case basis (Campos et al., 2025; Khan et al., 2023; Urrialde et al., 2023).

4 Conclusions

Sweeteners are essential tools in the food industry and modern nutrition due to their ability to modify the energy and sensory profiles of foods. The scientific evidence reviewed demonstrates that no single sweetener can completely replace sucrose, as each compound has specific advantages and limitations related to its chemical structure, metabolism, and technological functionality.

Sucrose remains a relevant component due to its multifunctionality, sensory profile, and well-characterized metabolism. On the other hand, intense sweeteners and polyols offer significant benefits, such as reduced calorie intake and improved glycemic control, although their use should be evaluated in light of potential side effects and the context of consumption.

Likewise, it is concluded that the health effects of sweeteners depend largely on the dose, frequency of consumption, and individual characteristics. Therefore, it is essential to promote informed and balanced consumption based on up-to-date scientific evidence. Finally, the need to continue researching the long-term effects of these compounds is highlighted, along with

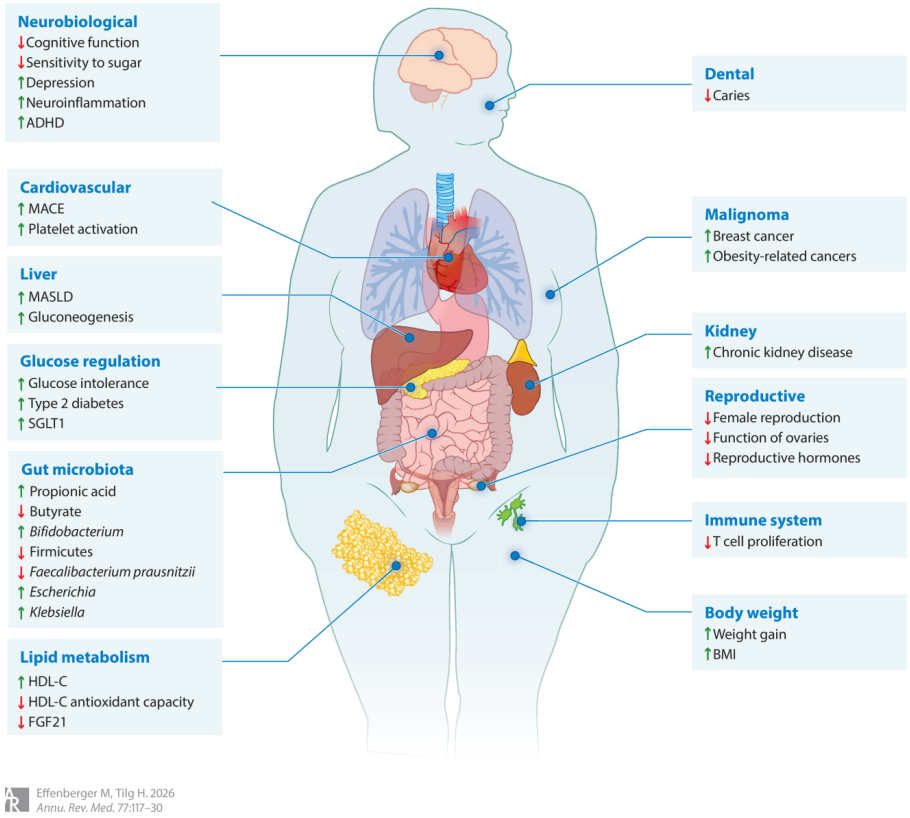


Figure 3: Schematic representation of the potential effects of artificial sweeteners on health and disease. Key physiological effects of artificial sweeteners include impacts on glucose metabolism, cardiovascular function, gut microbiome composition, kidney function, neurobehavioral effects, the reproductive system, and malignancies. Abbreviations: ADHD, attention-deficit/hyperactivity disorder; BMI, body mass index; FGF21, fibroblast growth factor 21; HDL-C, high-density lipoprotein cholesterol; MACE, major adverse cardiovascular events; MASLD, metabolic dysfunction–associated steatotic liver disease; SGLT1, sodium-glucose cotransporter 1 (Effenberger & Tilg, 2026).

the development of new sweeteners that combine safety, functionality, and additional health benefits.

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