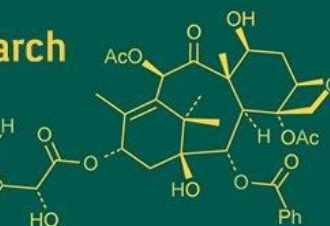
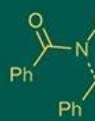


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Stevia rebaudiana as a functional natural sweetener in diabetes management: Health implications and food industry applications: A critical review

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Abstract

Stevia rebaudiana Bertoni, a perennial herb belonging to the family Asteraceae, has emerged as a prominent natural, zero-calorie sweetener with significant health-promoting properties and diverse food industry applications. The sweetness of *Stevia* is attributed to steviol glycosides, primarily stevioside and rebaudioside A, which are 200-450 times sweeter than sucrose. Beyond its intense sweetening capacity, *Stevia* contains various bioactive compounds such as flavonoids, phenolic acids, and antioxidants that contribute to its therapeutic potential. Scientific evidence suggests that *Stevia* exhibits antihyperglycemic, antihypertensive, antioxidant, anti-inflammatory, anticancer, and cardioprotective properties. Regulatory authorities including the Food and Drug Administration (FDA) and European Food Safety Authority (EFSA) have recognized high-purity steviol glycosides as safe for human consumption, with an established Acceptable Daily Intake (ADI) of 4 mg/kg body weight/day. Due to its favorable technological characteristics, including thermal stability and non-fermentability, *Stevia* is widely incorporated into beverages, dairy products, bakery items, confectionery, and functional foods. This review highlights the nutritional composition, bioactive constituents, safety aspects, therapeutic benefits, processing methods, and expanding applications of *Stevia rebaudiana*, emphasizing its potential as a sustainable and health-oriented alternative to conventional sugar and artificial sweeteners.

Keywords: *Stevia*, bioactive compounds, stevioside and health benefits

Introduction

Stevia rebaudiana Bertoni (Family: Asteraceae) is a perennial herb native to South America, particularly Brazil and Paraguay, where it is commonly known as “Honey Leaf,” “Sweet Leaf,” or “Sweet Herb” (Peteliuk *et al.*, 2021) [36]. The genus *Stevia* comprises approximately 230 species; however, only two species *Stevia rebaudiana* Bertoni and *Stevia phlebophylla* A. Gray are known to produce sweet steviol glycosides in their leaves. *Stevia rebaudiana* ‘Criolla’ (also referred to as *S. rebaudiana* var. *criolla* or simply “Criolla”) is a traditional landrace cultivar of *S. rebaudiana* Bertoni and represents an unimproved South American variety of this calorie-free herbal sweetener. The Criolla variety is characterized by larger, broader leaves with more pronounced serrated margins compared to improved commercial cultivars.

Stevia is widely used as a natural, zero-calorie sweetener and has been demonstrated to be non-toxic to human health, leading to its increasing application in the food and baking industries. The sweet taste of *Stevia* is attributed to several steviol glycosides, including stevioside, steviolbioside, rebaudiosides A-E, and dulcoside. Among these, stevioside and rebaudioside A are the major sweetening compounds, with rebaudioside A reported to be up to 300 times sweeter than sucrose.

In addition to its sweetening properties, *Stevia* exhibits several therapeutic benefits, including antihyperglycemic, anticancer (Jeppesen *et al.*, 2000; Jeppesen *et al.*, 2003) [19, 20], and antihypertensive activities (Jeppesen *et al.*, 2003) [20]. Steviol glycosides possess favorable technological properties such as high thermal stability, non-fermentability, and long shelf life. Furthermore, *Stevia* leaves contain various bioactive compounds, including sterols, triterpenes, flavonoids, tannins, and antioxidants. Chlorogenic acid present in *Stevia* reduces the enzymatic conversion of glycogen to glucose and decreases intestinal glucose absorption, thereby contributing to lower blood glucose levels. Experimental laboratory investigations

have reported decreased blood glucose levels along with elevated hepatic glucose-6-phosphate and glycogen concentrations, suggesting improved glucose metabolism. The crude *Stevia* leaves and herbal powder (green) are reported to be 10-15 times sweeter than table sugar. Besides exceptional sweetness, *Stevia* is popular due to nutritional and chemical composition that is characterized by content of amino acids, minerals and phytochemicals, especially polyphenols (Chu *et al.*, 2000; Edeoga *et al.*, 2005; Singh and Rao, 2005) [58] that ultimately contributes to significant increase of antioxidant activity of plant (Chatsudhipong and Muanprasat, 2009; Ahmad *et al.*, 2010) [56, 57]. *Stevia* has various properties such as antibacterial, anticandidal, antifungal, antiviral, cardiogenic (tones, balances, strengthens the heart), diuretic, hypoglycemic, vasodilator. It acts as a weight-loss aid and supports the management of diabetes, hypertension, and heartburn. Additionally, it helps improve the efficiency of cardiac function. Its extracts are not absorbed by the digestive tract, so they do not add calories or affect blood glucose levels, making them a good addition to blood glucose levels. The compound obtained from *Stevia* is considered to be the best alternate source for diabetes sufferer. According to recent market analyses, the global *Stevia* market is expected to reach US\$ 1,241.95 million by 2031, expanding at a Compound Annual Growth Rate of 8.7% from 2024 to 2031, primarily driven by growing health consciousness and the shift toward plant-based sweetening agents derived from *Stevia rebaudiana* (Market reports world, 2025) [26].

Historical development

The origin of *Stevia rebaudiana* can be traced to Paraguay in South America. Among the native population, *Stevia* is commonly known as sweet herb, *Caa-hee*, or *yerba dulce*. In 1884, the Swiss naturalist Moisés Giacomo Santiago Bertoni settled on the banks of the Paraná River in Paraguay, near the Brazilian border, where he discovered the plant commonly referred to as honey leaf or *Caa-hee*. In 1905, the plant was officially named *Stevia rebaudiana* Bertoni in honor of the naturalist Moisés Giacomo Santiago Bertoni and the chemist Ovidio Rebaudi. Rebaudi was the first scientist to isolate and identify the sweet compounds present in *Stevia* leaves. Later, in 1931, French chemists M.

Bridel and R. Laveille provided the detailed characterization of steviol glycosides in their present recognized form.

Proximate composition of *Stevia* leaves

Proximate analysis of dried *Stevia* leaf powder contains appreciable amounts of protein, crude fibre, ash, and carbohydrates, indicating its potential as a functional plant ingredient. In addition, *Stevia* leaf powder contains significant levels of essential minerals such as calcium, magnesium, iron, and potassium (Ruiz *et al.*, 2017 and Ferrazzano *et al.*, 2016) [15, 44]. This nutritional profile highlights that, beyond its role as a non-caloric sweetener source, *Stevia* leaves possess valuable nutritional values that may support their incorporation into food and nutraceutical applications.

Nutritional Composition of *Stevia* Leaves on Dry Matter (g/100g)

Component	Value (g/100g)
Moisture	7.5
Protein	9.63
Fat	3.47
Crude fibre	17.12
Ash	3.08
Carbohydrates	66.5
El-Nassag., <i>et al.</i> 2019 [11, 12]	

Varieties of *Stevia*

Minerals	Value (mg/100g)
Calcium	418.5
Magnesium	286.2
Iron	24.29
Potassium	2195.3
Sodium	29.4
Phosphorus	372.1
Chughtai., <i>et al.</i> [2020] [10]	

Among various varieties of *Stevia*, only two plants provide sweeter substances, which contribute a high concentration of steviol glycosides. The rare Mexican species *S. phlebophylla* A. Gray was found to contain trace quantities of steviol glycoside. It can therefore be concluded that *S. phlebophylla* is unlikely to contain significant amounts of steviol glycosides, if any (Ceunen *et al.*, 2013).



Stevia rebaudiana bertonii
(Source: Diois, 2018)

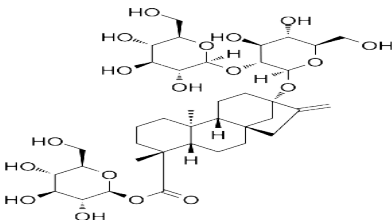
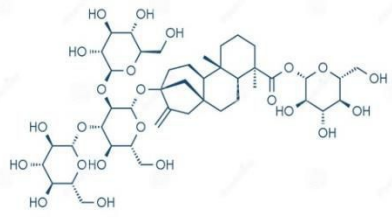
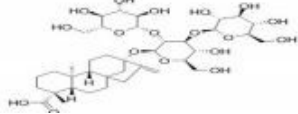
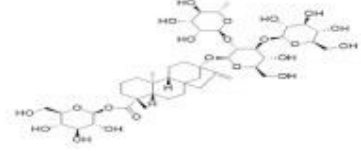
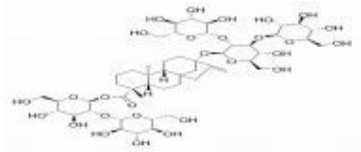
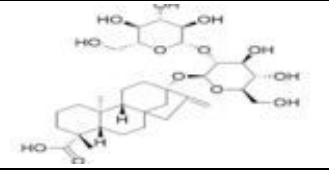
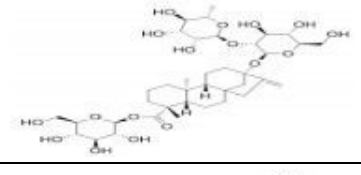
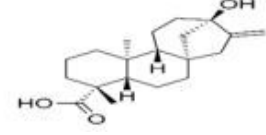


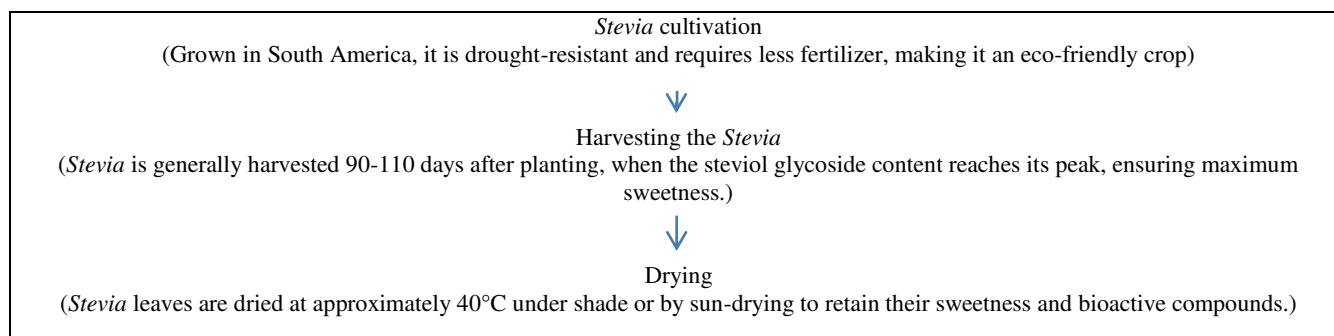
Stevia rebaudiana Criolla
(Source: Verma & Panda, 2018)

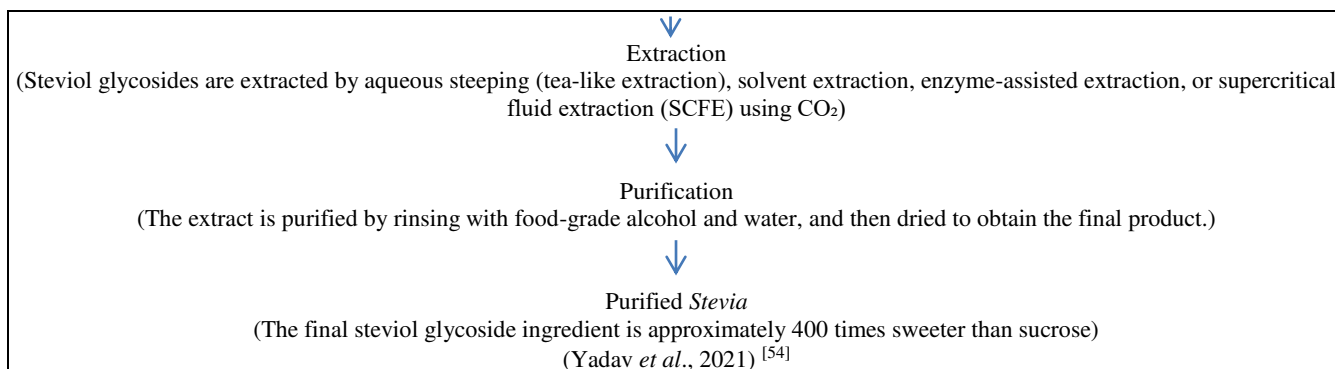


Stevia phlebophylla A. Gray
(Source: Guy L. Nesom)

Bioactive compounds in *Stevia*

Compound	Chemical Structure	Relative sweetness (Vs sucrose)
Stevioside		250-300
Rebaudioside -A		350-450
Rebaudioside B		300-350
Rebaudioside C		20-30
Rebaudioside D		200-220
Steviolbioside		100-125
Dulcoside A		30
Steviol		-
(Khalid <i>et al.</i> , 2021; Singh <i>et al.</i> , 2019 & Peng Z <i>et al.</i> , 2026) ^[23, 35]		

Processing of *Stevia*



Commercial forms and market availability of *Stevia*

1. ***Stevia* tablets:** *Stevia* sweetener tablets are widely used as an alternative to sugar and artificial sweeteners due to their low calorie content, ease of dosing, and potential health benefits
2. ***Stevia* extract (Liquid):** *Stevia* extracts are obtained using various technologies, such as solvent extraction and supercritical fluid extraction (SCFE), to produce a concentrated sweetener that can replace sugar. These extracts are derived from the natural components of *Stevia rebaudiana*, primarily steviol glycosides such as stevioside and rebaudioside A.
3. ***Stevia* leaf powder:** *Stevia* leaves are dried and ground into a fine powder, which is used in herbal and black tea preparations and provides 30-40 times the sweetness of table sugar.
4. **Dried *Stevia* leaves:** Dried *Stevia* leaves are obtained by shade-drying or controlled drying of fresh leaves of *Stevia rebaudiana* to preserve their steviol glycoside content. The dried leaves can be used directly as a natural sweetener in herbal and black tea preparations or further processed into powder and extracts
5. **Granulated *Stevia*:** *Stevia* is blended with bulking agents such as erythritol to mimic the texture, volume, and sweetness equivalence of sugar for baking applications.
6. ***Stevia* blends:** *Stevia*-based sweetener blends are formulated by combining steviol glycosides from *Stevia rebaudiana* with other natural sweeteners to enhance the taste profile and minimize bitterness

Comparison with artificial sweeteners

Stevia extract is considered a promising alternative to synthetic sweeteners, as it is approximately 200-300 times sweeter than sucrose (Sardana *et al.*, 2025; Priscilla *et al.*, 2018; Prakash *et al.*, 2014; Singh and Rao, 2005) ^[37, 47, 58]. The intense sweetness of steviol glycosides, the primary bioactive compounds in *Stevia*, enables their use in very small quantities, thereby contributing negligible calories to the diet.

Steviol glycosides may serve as a natural, fundamental low-calorie, high-potency sweetener in the expanding natural foods market. Additionally, they have been reported to exhibit potential anti-diabetic properties, positioning *Stevia* as a competitive natural alternative to commercially available synthetic sweeteners and certain antidiabetic agents (Konieczny *et al.*, 2021) ^[12].

Although natural sweeteners such as coconut sugar, maple syrup, agave syrup, molasses, and cane syrup are often perceived as healthier options, they still contribute to an increase in glycemic index due to their carbohydrate

content. In contrast, purified *Stevia* extracts do not significantly raise blood glucose levels and may be beneficial for individuals managing hyperglycemia who prefer to avoid artificial sweeteners. Regular intake of steviol glycosides has been associated with reductions in blood glucose and serum cholesterol levels, and may contribute to decreased retention of certain radionuclides in the body (Ferdous *et al.*, 2025) ^[14].

Safety, toxicity, and acceptable daily intake (ADI)

Concerns have occasionally been raised regarding the potential allergenicity of steviol glycosides due to the taxonomic classification of *Stevia rebaudiana* within the Asteraceae family, which includes plants known to trigger hypersensitivity reactions in susceptible individuals (e.g., ragweed, goldenrod, chrysanthemum, echinacea, chamomile, lettuce, sunflower, and chicory). However, a comprehensive review of the literature found no evidence supporting the allergenic potential of purified steviol glycosides (Urban *et al.*, 2015) ^[50].

The long history of traditional use also supports the safety profile of *Stevia*. It has reportedly been consumed for more than 1,500 years by indigenous populations in Paraguay without documented harmful effects. Furthermore, the majority of controlled human clinical trials have demonstrated that *Stevia* consumption does not produce significant adverse effects (Nikiforov *et al.*, 2013) ^[32].

Highly purified steviol glycosides, including rebaudioside A preparations used as food additives, are considered unlikely to pose allergenic concerns for the general population (Health Canada, 2012) ^[17]. In addition, high-purity *Stevia* sweeteners have not been identified as potential food allergens by Food Allergy Research & Education (FARE), a nonprofit organization advised by leading medical and research experts.

Regulatory authorities worldwide have evaluated and approved steviol glycosides for use in foods. The U.S. Food and Drug Administration (FDA) recognized high-purity steviol glycosides as generally recognized as safe (GRAS) for commercialization in 2008. Subsequently, in November 2011, the European Commission approved steviol glycosides as a food additive (E 960). Since then, the food industry has increasingly incorporated *Stevia* extracts into a wide range of products to meet growing consumer demand for healthier, low-calorie alternatives (Buniowska *et al.*, 2020) ^[7].

The Acceptable Daily Intake (ADI) for steviol glycosides has been established at 4 mg/kg body weight/day, expressed as steviol equivalents, by international authorities including the World Health Organization (WHO), The Joint Expert

Committee on Food Additives (JECFA) and endorsed by organizations such as the Canadian Diabetes Association.

Suitability for children and pregnant women

Evidence from toxicological and multigenerational studies indicates that exposure to high doses of high-purity steviol glycosides before and during critical periods of fertility, pregnancy, and lactation, as well as throughout the growth and development of offspring to adulthood over two generations, has not resulted in adverse effects. These findings support the safety of steviol glycosides for consumption by pregnant women and children when intake remains at or below the established Acceptable Daily Intake (ADI) (Canadian Diabetes Association, 2023) [59].

Accordingly, within recommended intake levels, steviol glycosides are considered safe for use across different life stages, including pregnancy and childhood.

Therapeutic potential of *Stevia* in human health

1. Impact on blood glucose levels and diabetes management:

Stevia not only possesses intense sweetening properties but also exhibits potential therapeutic effects, particularly antihyperglycemic activity (Jeppesen *et al.*, 2000; Jeppesen *et al.*, 2003) [19, 20]. Certain bioactive compounds present in *Stevia*, such as chlorogenic acid, may reduce blood glucose levels by decreasing the enzymatic conversion of glycogen to glucose and by limiting glucose absorption in the gastrointestinal tract. The presence of steviol, stevioside, and rebaudioside makes *Stevia* a safe and effective alternative to sucrose for individuals with diabetes (Abed *et al.*, 2025) [28]. Experimental studies have demonstrated reductions in blood glucose concentrations, along with increased hepatic levels of glucose-6-phosphate and glycogen, suggesting improved glucose metabolism.

Stevia leaves have been reported to exhibit antihyperglycemic, insulin-mimetic, insulinotropic, and glucagonostatic properties, all of which play a significant role in diabetes management. These mechanisms may enhance insulin secretion, improve insulin sensitivity, and reduce glucagon release (Bastaki, 2015) [5]. However, despite promising experimental and preliminary clinical findings, there remains a need for more well-designed randomized controlled trials to confirm these therapeutic benefits in humans.

2. Effect on Body Weight and Obesity

Stevia, being a high-intensity, zero-calorie natural sweetener, may contribute to weight management by reducing overall calorie intake when used as a substitute for sugar. Additionally, some studies have reported that *Stevia* consumption may positively influence lipid profiles by increasing high-density lipoprotein (HDL) levels while decreasing low-density lipoprotein (LDL) and triglyceride concentrations (Fathil, 2025) [13]. These effects suggest potential benefits in reducing obesity-related metabolic risk factors.

Due to its natural origin and negligible calorie contribution, high-purity *Stevia* extract has gained considerable interest in the global food industry, particularly among consumers seeking healthier, low-calorie alternatives to sugar.

3. Cardiovascular Health Effects

Cardiovascular diseases (CVDs) are a major public health concern in India, with mortality rates reported to be higher

than the global average. *Stevia* has been found to have lipid-lowering effects, which can help reduce the risk of cardiovascular diseases such as atherosclerosis and coronary artery disease. Its antioxidant, antihypertensive, and others properties make it a valuable functional ingredient, particularly for individuals at risk of CVDs (Ardian and Arora, 2025) [60].

4. Influence on Blood Pressure

Stevia improves glucose regulation by enhancing insulin secretion and reducing gluconeogenesis without causing hypoglycaemia. It may support weight loss, lower inflammatory markers (IL-6, TNF- α), reduce oxidized LDL and atherosclerosis, and help decrease blood pressure in hypertensive individuals without inducing hypotension (Ray *et al.*, 2020) [38].

5. Dental Health Benefits

The association between dietary sugar consumption and dental caries is well established. Oral bacteria metabolize fermentable sugars to produce organic acids, which demineralize tooth enamel and contribute to the development of cavities (Mehta *et al.*, 2016) [29]. Frequent exposure to sucrose enhances the proliferation of cariogenic bacteria such as *Streptococcus mutans*, thereby accelerating enamel erosion.

Moreover, it was demonstrated that the *Stevia* extracts caused less demineralization in enamel than did fructose and glucose solutions. Substituting sucrose with *Stevia rebaudiana*-derived sweeteners may help reduce the risk of dental caries. *Stevia* is considered non-cariogenic, as it is not fermented by oral microorganisms to produce enamel-damaging acids. Consequently, *Stevia*-based sweeteners do not promote tooth decay and may serve as a beneficial alternative for maintaining oral health and hygiene (Rezaei-Soufi *et al.*, 2016) [40].

6. Antioxidant and Anti-inflammatory Properties

Stevia leaves contain various bioactive compounds, including chlorogenic acid derivatives, steviol glycosides, flavonoids, quinic acid, and caffeic acid, which exhibit antioxidant activity. Which are largely responsible for the antioxidant and free radical-scavenging properties of *Stevia* extracts (Karakose *et al.*, 2015) [61]. These phenolic constituents possess aromatic ring structures capable of donating hydrogen atoms or electrons to neutralize reactive oxygen species (ROS) and nitrogen species (RNS). By reducing oxidative stress, they may suppress inflammatory proteins and cytokines, thereby contributing to anti-inflammatory effects.

In contrast, purified stevioside and other steviol glycosides exhibit minimal direct antioxidant activity, as they lack phenyl aromatic rings necessary for effective free radical scavenging. Therefore, the antioxidant potential of *Stevia* is primarily attributed to its phenolic and flavonoid components rather than to steviol glycosides themselves.

Experimental studies have demonstrated that *Stevia* leaf extract can significantly restore oxidative stress markers, with improvements ranging from 65-85% across multiple tissues. Notably, a more pronounced protective effect was observed in diabetic rat models (Papaefthimiou *et al.*, 2013) [62]. These findings suggest that *Stevia* leaf extract may exert protective effects against oxidative stress, potentially through its antioxidant activity.

7. Effect on Insulin Sensitivity

Emerging evidence indicates that *Stevia* and its bioactive constituents may enhance insulin secretion by stimulating pancreatic β -cells, while also exerting antioxidant effects that support glycemic control (Assaei *et al.*, 2016; Massoumi *et al.*, 2020) [3, 27]. Experimental studies suggest that *Stevia* may improve glucose homeostasis through both insulinotropic and insulin-sensitizing mechanisms.

One proposed mechanism involves the modulation of nuclear factor kappa-light-chain-enhancer of activated B cells (NF- κ B), a key regulator of inflammatory pathways. *Stevia* has been reported to reduce NF- κ B activity, thereby decreasing inflammatory responses that contribute to insulin resistance. This modulation may enhance insulin signalling, improve glucose uptake, and increase the glucose infusion rate (Wang *et al.*, 2012) [51].

Additionally, consumption of *Stevia* leaves has been associated with increased circulating insulin levels and suppression of hepatic gluconeogenesis, contributing to improved maintenance of blood glucose concentrations. *Stevia* has also been shown to reduce pro-inflammatory cytokines such as interleukin-6 (IL-6), interleukin-1 (IL-1), and tumour necrosis factor-alpha (TNF- α), which are known to impair insulin signalling pathways. *Stevia* may reduce insulin resistance in individuals with diabetes by suppressing inflammatory mediators (Boonkaewwan & Burodom, 2013) [6].

Although these findings are promising, further well-designed clinical trials are required to confirm the long-term effects of *Stevia* on insulin sensitivity in humans.

8. Effects on Kidney Function

Steviol acts as a diuretic, helping the body remove excess water through urine. Unlike many conventional diuretics, it does this without lowering blood pressure, making it a unique agent for promoting diuresis without causing hypotension (Melis, 1997) [30]. *Stevia* has the potential for a significant improvement of some biochemical parameters in chronic kidney disease patients like rising hypertension and diabetes in chronic kidney disease patients increase cardiovascular risk. Oral stevioside with standard treatment may help prevent chronic kidney disease progression (Rizwan *et al.*, 2018) [41].

9. Anticancer activity

Steviol from *Stevia rebaudiana* shows strong anticancer effects on gastrointestinal cancer cells by triggering cell death and regulating key miRNAs, making it a promising natural chemotherapy agent (Chen *et al.*, 2018) [9]. Stevioside is safe for normal cells even at high doses and can target cancer cells by disrupting their mitochondria. It lowers Cyclin D, increases p21 and p53, and raises the Bax/Bcl-2 ratio, triggering apoptosis through cytochrome C release and caspase activation. This mechanism gives stevioside strong anticancer effects, like MCF-7 breast cancer cells (Paul *et al.*, 2012; Chen *et al.*, 2018) [9, 34].

Stevia products, including steviol, stevioside, and isosteviol, show strong anticancer effects by causing cell cycle arrest, triggering apoptosis, inhibiting DNA replication, and regulating key miRNAs. They may also reduce cancer risk indirectly through their antioxidant and lipid-regulating properties. Most studies focus on stevioside, but other steviol glycosides could have even stronger anticancer

activity, making *Stevia rebaudiana* a promising natural cancer-fighting agent (Iatridis *et al.*, 2022) [18].

Food Industry Applications

Stevia has gained significant popularity and widespread application in various food products. It is commonly incorporated into energy drinks, dairy products such as ice cream, bakery items, and fruit preserves.

1. Beverages

The application of rebaudioside A in food and beverages has been approved as generally recognized as safe (GRAS) by the U.S. Food and Drug Administration (FDA) since 2008. In 2015, FSSAI approved the use of steviol glycosides as a sweetener in food and beverages in India, aligning with global regulatory standards (FSSAI, 2015). Reale *et al.*, 2019 [63, 66] highlighted that the apricot nectars with 0.07% *Stevia* received the same level of consumer acceptability of nectars produced with 10% sucrose and concluded that *Stevia* can be used as a sugar alternative to reduce calories. *Stevia* was used as a sugar substitute in carbonated drinks using Response Surface Methodology, resulting in a 42.9% reduction in calories and carbohydrates, showing its potential as a healthier sweetener (Saniah and Samsiah, 2012) [46].

2. Dairy products

A study on *Stevia* and sucralose as sugar substitutes, with inulin as a fat replacer in starch-based dairy desserts, showed that 50% *Stevia* and 50% Sugar gave the best taste and texture, while inulin improved stability and consistency, resulting in a sugar-free, reduced-fat dessert with good sensory and physical properties (Furlan and Campderros, 2017) [64].

The *Stevia* (0.2%) is Used as a sugar replacement in probiotic ice cream formulation and compared with commercial ice creams and found that it has a positive impact on physico-chemical and sensory parameters (Nikhitha, *et al.*, 2022) [31]. The addition of steviol glycosides (SGs) to dairy products or dietary supplements not only reduces calorie content but also exhibits prebiotic-like properties by enhancing the proliferation of beneficial microorganisms such as *Bifidobacteria* and *Lactobacilli*, thereby promoting gut microbial balance (Wu H, 2021) [53].

3. Baked goods

Stevia (*Stevia rebaudiana*) is a natural, low-calorie sugar substitute used in various food products. Studies show it can affect taste, texture, color, gelling, and appearance in dairy, bakery, beverages, and jelly products, with full sugar replacement sometimes causing bitterness (Siso *et al.*, 2022). Zulkifli *et al.*, 2016 [55, 65] determine the effect of *Stevia* on physiochemical of bakery products by using *Stevia* sweetener in place of sugar and found that a significant decrease in carbohydrates as well as calories, but other nutrient components remained unchanged.

Lupov and Vinogradov, 2021 [25] recommended to substitute sugar with sweetener "Stevioside" in the amount of 30% when producing "Spring" roll, as this allows to increase the amount of the product produced by reducing the technological process and will increase the level of profitability.

4. Confectionary

A study developed reduced-sugar gummy candies using pistachio green hull extract, *Stevia*, and starch. Optimized formulations showed high antioxidant activity, good texture, and stability, offering a healthier candy without artificial flavors or colorants (Roudbari, 2024) ^[43].

A systematic review of 28 studies examined the use of sugar substitutes in jams, jellies, and marmalades, focusing on both natural and artificial sweeteners. The results highlighted that blends of sweeteners, especially natural high-intensity sweeteners like *Stevia* and xylitol, provided the best sensory properties. This approach offers a promising strategy to develop low-sugar or sugar-free fruit preserves that are healthier, calorie-reduced, and consumer-friendly (Souza *et al.*, 2022). Similarly, Kaur *et al.* (2025) ^[4, 22] investigated the use of alternative sweeteners and natural pectin sources in jam production and reported improvements in nutritional value while maintaining product stability and safety standards.

5. Cereal bars

An *in vivo* study assessed the effects of cereal bars sweetened with ethanol-pretreated *Stevia rebaudiana* leaves on metabolic regulation in streptozotocin-induced diabetic rats. Compared to sucrose-sweetened bars, *Stevia*-sweetened formulations significantly reduced hepatic fat accumulation and improved metabolic parameters. The findings suggest that *Stevia*-based cereal bars may serve as a potential functional food for managing diabetes and associated hepatic complications (Silva, *et al.*, 2020) ^[49].

Amala *et al.*, 2017 ^[1] prepared Multigrain bar with flaxseed by replacing 25% sugar content with *Stevia* was found more acceptable and concluded that addition of flaxseed and *Stevia* making suitable for health conscious people in general and diabetic patients in particular.

Conclusions

Stevia rebaudiana represents a valuable natural alternative to sugar and synthetic sweeteners due to its high sweetening potency, negligible calorie contribution, and wide range of health-promoting properties. In addition to its role in glycemic control and weight management, *Stevia* has shown promising effects on cardiovascular health, oxidative stress reduction, insulin sensitivity, and dental protection. Its safety has been supported by toxicological studies and long-term traditional use, indicating that it is suitable for the general population, including children and pregnant women when consumed within the recommended Acceptable Daily Intake. The growing demand for low-calorie and functional foods has further enhanced its incorporation into beverages, dairy products, bakery items, confectionery, and other processed foods.

Despite substantial experimental findings and preliminary clinical evidence supporting its therapeutic potential, further well-designed human studies are required to confirm its long-term efficacy and safety. Additional research is also necessary to identify the specific bioactive compounds responsible for *Stevia*'s health effects and to better understand their molecular mechanisms of action. Overall, *Stevia rebaudiana* plays a significant role in diabetes management and it holds significant promise as a sustainable, natural, and health-oriented sweetener with expanding applications in the global food and nutraceutical industries.

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