

EVALUATING SAFETY AND EFFECTIVENESS OF STEVIA AND MONK FRUIT FOR INDIVIDUALS WITH DIABETES AND THEIR IMPACT ON FOOD FORMULATION AND CONSUMER ACCEPTANCE

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ABSTRACT

The growth and popularity of the South American herb *Stevia rebaudiana* has increased due to its abundance of sugary compounds, particularly stevioside and rebaudioside A, which have sweetness levels 250-300 times higher than sucrose. Additionally, stevia leaves include a variety of phenolic compounds, fatty acids, water-soluble vitamins, and other important components that are critical to human health. *Siraitiagrosvenorii*, also referred to as monk fruit, is a herbaceous perennial plant that has drawn notice for its great sweetness, which is ascribed to mogrosides, which are triterpene glycosides. They possess number of health advantages, including helping with blood sugar regulation, reducing inflammation, and having antioxidant and anti-inflammatory qualities. Nevertheless, despite its benefits, *Stevia* may induce gastrointestinal discomfort and hypotension in some individuals, while monk fruit faces limitations in availability, taste perception, and research gaps. However, the food industry has embraced these natural sweeteners and has utilized them in a variety of goods, including as confectioneries and baked goods. The degree to which consumers accept stevia and monk fruit as sugar alternatives for managing their diabetes varies depending on a number of factors, including taste preferences, health advantages, and education. Both stevia and monk fruit show promise as healthier substitutes for regular sugars, providing sweetness without sacrificing nutritional value, despite certain disadvantages. Further research is essential to completely comprehend their long-term impacts and enhance their marketability and acceptance.

KEYWORDS: *Stevia*, Monkfruit, Diabetes, Antioxidant Activity, Anti-Inflammatory Activity

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INTRODUCTION

The South American herb *Stevia rebaudiana* is becoming more and more popular to cultivate because of its abundance of sugary chemicals, stevioside and rebaudioside A. Steviol glycosides, which are roughly 250–300 times sweeter than sucrose, are the primary source of stevia's sweetness. More than 30 distinct steviol glycosides have been found in *rebaudiana* leaves, with stevioside and rebaudioside A having the greatest concentrations. Depending on the extraction

or processing technique, fresh and dried stevia leaves have different chemical compositions in preparations. Furthermore, the geographic area in which the plant grows affects its biochemical makeup. In addition, numerous phenolic substances such as polyphenols and flavonoids of 25.18 mg/g and 21.73 mg/g have been discovered in stevia leaves. Additionally, this herb has oils that are high in fatty acids that are rich in stearic, oleic, palmitic, palmitoleic, linoleic, and linolenic acids. Water-soluble vitamins, such as vitamin C (14.98 mg/100 g), vitamin B2 (0.43 mg/100 g), and folic acid (52.18 mg/100 g), are also abundant in stevia leaves. Additionally, the plant is abundant in macro- and microelements that are critical to human health, including Zn, Fe, Ca, K, Na, and Mg(Peteliuket *et al.*, 2021). Native to southern China, *Siraitiagrosvenorii* is herbaceous perennial plant that is frequently used as a low-calorie natural sweetener. Mogrosides are triterpene glycosides of the cucurbitane class. Monk fruit extract has a sweetness that is almost 300 times greater than sucrose (Shivani *et al.*, 2021). Many different types of chemicals have been found and separated from various parts of monk fruit, including polysaccharides, amino acids, essential oils, flavonoids, triterpenoids, nucleosides, etc. A class of triterpenoids known as glycosides is frequently thought to be one of the main physiologically active elements of monk fruit(Harshita, 2023).

BENEFITS OF STEVIA AND MONK FRUIT

Stevia, a widely used natural sweetener, has attracted interest due to its diverse range of possible health advantages. Stevia is mostly recognised for its ability to aid in weight management as it is low in calories. It also helps in maintaining blood glucose levels without any spike which is advantageous for people with diabetes(Peteliuket *et al.*, 2021). It does not contribute to tooth decay and may even impede the growth of germs in the mouth, thereby enhancing general oral hygiene. In addition, stevia contains chemicals such as stevioside and rebaudioside A, which have anti-inflammatory and antioxidant characteristics which help in preventing the occurrence of cancer and heart disease. It also has the potential to safeguard the digestive system, promote skin health, and alleviate difficulties linked to metabolic syndrome (Ashwellet *et al.*, 2015).

Stevia is a very promising natural sweetener for people with diabetes, since it has several advantages that help improve glucose management and general well-being. Stevia is very effective in controlling blood glucose levels as it can improve the activity, sensitivity, and pace at which insulin works. Additionally, it has the ability to enhance the release of insulin in response to glucose and control glucagon levels further contributes to the maintenance of glucose balance. Stevia also has antihyperglycemic properties by inhibiting the production of new glucose and decreasing signs of inflammation, which may help alleviate insulin resistance. Furthermore, stevia's impact on lipid metabolism, bile acid metabolism, amino acid metabolism and carbohydrate metabolism highlights its extensive assistance in managing diabetes(Ajami *et al.*, 2020). The capacity to regulate insulin activity, promote insulin secretion and inhibit gluconeogenesis offers diabetic persons a secure option for treating their disease. Due to its favourable safety profile and no effect on blood sugar levels, it is appropriate for various dietary requirements, including persons with diabetes or those seeking to decrease their sugar consumption(Sukhmani *et al.* 2018). It provides individuals with a natural and advantageous choice to regulate blood sugar levels and enhance general well-being(Peteliuket *et al.*, 2021).

Monk fruit is known for its ability to improve sweetness, It also has a wide range of health advantages that emphasise its appeal beyond its taste. One significant benefit is its appropriateness for persons who are controlling diabetes. Monk fruit is a healthy alternative sweetener that does not include any calories or carbs. It efficiently avoids the negative effects of regular sugars by not affecting blood sugar levels. Its lack of calories makes it an enticing alternative to sugar, enabling the decrease of calorie consumption without compromising on sweetness and helps in weight management(Pandey *et al.*, 2019).

In addition to its function in regulating blood sugar levels and aiding in weight control, monk fruit possesses fascinating anti-inflammatory qualities due to its high concentration of antioxidants, particularly mogrosides. These substances have shown effectiveness in reducing inflammation, which might improve problems related to long-term inflammation. However, more study is needed to completely understand how they work and their potential for treatment. Additionally, initial research indicates that monk fruit's collection of antioxidants may have the ability to protect against cancer by protecting against DNA damage and inhibiting the growth of cancer cells. It is crucial to conduct thorough research to determine the full degree of its effectiveness in treating cancer and to understand the underlying processes involved (**Harshita et al., 2023**). It also shows promising antibacterial effects that fight against infections and strengthening immune function using its polysaccharides, which are believed to boost the activity and effectiveness of the immune system. Monk fruit helps protect cells from oxidative damage and prevents the development of degenerative disorders caused by oxidative stress by scavenging free radicals and keeping cellular integrity (**Pandey et al., 2019**).

DETRIMENTS OF STEVIA AND MONK FRUIT

Although stevia has several possible health advantages, it also possesses potential hazards and bad consequences associated with its usage. Some individuals, especially those who are sensitive to sugar alcohols often found in stevia products, have reported experiencing gastrointestinal symptoms such as nausea, bloating, diarrhoea, and stomach discomfort. In addition, stevia has been linked to hypotension, which can potentially reduce blood pressure. It also exhibits advantages in lowering indicators of fatty liver disease and connections with increased liver enzymes, particularly when used in conjunction with other sweets such as sucralose. Prolonged ingestion of stevia can cause liver strain, modify bile production, and disturb the equilibrium of intestinal flora, which may have an effect on immunological function and inflammatory reactions (**Chowdhury et al., 2022**). Pregnant or nursing persons are recommended to use prudence owing to the possibility of unfavourable consequences (**Elnagaet et al., 2016**).

While monk fruit has several health advantages, it also has certain disadvantages related to its limited availability, flavour, additives, and the necessity for more study. One major obstacle is the cultivation, harvesting, and processing of monk fruit, which makes it a somewhat specialised product compared to more widely available sweeteners. The inherent challenge in producing monk fruit leads to its restricted availability and higher cost, which makes it less accessible to customers who are looking for alternatives to traditional sugars. Furthermore, the sense of flavour and taste is a significant obstacle to the broad use of monk fruit sweeteners. When monk fruit is used in commercial goods, it may be necessary to add other components like maltodextrin or dextrose to balance out its distinct taste. Although these chemicals help to provide a balanced flavour, they can modify the nutritional content of monk fruit sweeteners. This may reduce their perceived health benefits and make them less appealing to customers with certain dietary choices or constraints (**Suri et al., 2020**).

In addition, the current study on monk fruit is quite limited, especially when it comes to its possible harmful effects and long-term consequences, despite the promised health advantages associated with it. Therefore, there are still doubts regarding the safety and effectiveness of consuming monk fruit for long periods of time and across different groups (**Pandey et al., 2019**).

ROLE OF STEVIA AND MONK FRUIT IN FOOD INDUSTRIES

Stevia is heat-stable to 200 °C, acid-stable, and non-fermentable, making it suitable for use in a range of culinary applications. Additionally, its acceptable organoleptic qualities suggest its potential use as a substitute for sucrose with zero calories (Siso *et al.*, 2022). Stevia leaves that are enriched with phytoconstituents are used to make a variety of value-added goods, both directly and after processing. Value-added goods produced through ingredients, processing, or packaging food items that are more enticing and useful than the original commodity. Additionally, It is a non-nutritive high-intensity sweeteners with a low glycemic index that enhance the product's sweetness without altering original color, and flavour of the product. When stevia is used as a partial replacement for sugar, other ingredients including bulking agents, hydrocolloids, and proteins are required to compensate for texture loss (Naik *et al.*,2022).However, non-caloric sweeteners are most commonly used in carbonated beverages. A wide range of stevia and its derivatives are used in preparing various food applications (Perez *et al.*, 2016).Monk fruit (*Siraitiagrosvenoriis*) extract belonging to the Cucurbitaceae family has been increasingly applied in food products as it is natural and Generally Recognized as Safe (GRAS) for use. It is also a zero-calorie sweetener with a mogrosides compound that has a sweet taste, about 150-250 times sweeter than sucrose (Akesowanet *al.*, 2021).

Bakery Products

Stevia is used as a functional food ingredient in baked goods, dairy products, and confectionery. But it is still early for the sweets industry to yet benefit from stevia, which can be used in place of sugar as a sweetener. Sweetened food products including cakes, cookies, muffins, and biscuits significantly contribute to worldwide sugar consumption. All cooked and baked foods, including pudding and cakes, can be sweetened with only a small amount of Stevia leaf powder. Stevioside is not fermentable and has no browning reaction when cooked. This broadens its scope of applicability in baking, improving the quality and safety of usage due to its long shelf life (Tejo *et al.*, 2013). Dissimilar to other inert sweeteners, Monk fruit extract has a pleasant aftertaste, that is not found in other non-nutritive sweeteners. This characteristic improves its compatibility with different food and beverage applications and adds to its overall sensory profile. It is used as a sweetener in many items, including drinks, baked goods, confections, dairy products, snack foods, sauces, condiments, and nutritional supplements providing a healthier alternative without sacrificing flavour (Akesowanet *al.*, 2021).

Confectionaries

A rise in stevia-used sweetener chocolates and other sweets has met the needs of diabetic people plus helped with anti-tooth decay problems. Oral hygiene products, toothpaste, mints, and chewing gum also contain stevioside. This low-calorie natural sweetener is used in a wide range of food products, such as sweet corn, sauces, pickles, yogurt, candies, seafood, biscuits, jams, chocolates, ice creams, baked goods, soft drinks, fruit drinks, and some common beverages like pop tea, coffee, and herbal tea (Naik *et al.*, 2022). Monkfruit extract is commercialized as a concentrated liquid or powder extract prepared to undergo the following steps such as harvesting, extraction, processing, purification, concentration, purification, clarifying, drying, and powdering. This extract is in turn used in making other products, such as drinks, desserts, sauces and other processed foods (Tejo *et al.*, 2013).

CONSUMER ACCEPTANCE OF STEVIA AND MONK FRUIT AS A SUGAR SUBSTITUTE FOR DIABETES

Acceptability

In a study conducted for acceptability of stevia as sugar replacement for diabetes, participants consumed stevia as a source of sugar in their morning drinks. Positive results were noted with the high range of acceptability of stevia (**Mu'izzuddin et al., 2020**). Studies evaluating the acceptability of monk fruit sweeteners in chocolate milk among different age groups were examined among young adults (19 to 35 years) and children (5 to 13 years) which shows high range of likability among participants. Iso-sweetness studies comparing monk fruit sweetener and stevia leaf extract to sucrose control are discussed, along with findings on sweetness intensity perception and overall acceptability. Monk fruit has gained popularity in recent years due to its lower calorie value but is more expensive than other sweeteners as it has a higher level of sweetness than sucrose. Due to a growing consumer consciousness and preference for healthier plant-based, vegan, and vegetarian diets, high demand has led to a steady increase in the market for natural sweeteners making it a desirable choice for those trying to cut back on sugar intake or treat ailments such as diabetes and obesity (**Li et al.,2015**).

Consumer Attitudes

Stevia rebaudiana Bertoni, renowned for its sweetness 300 times greater than saccharose, has been actively promoted in Malaysia as a preventive measure against chronic diseases. A recent investigation aimed to understand consumer acceptance of Stevia-based products. A study conducted using face-to-face interviews among 900 consumers revealed a general willingness to adopt Stevia-based products as sugar substitutes. Factors such as education level, health benefits, promotion, availability, and price were identified as pivotal in driving acceptance (**Kamarulzaman et al.,2014**).In a study, Low-calorie syrups made from monk fruit sweetener and blended with rebaudioside A using various bulking agents were explored. Factors such as flavour, texture, sweetness intensity, bitterness, and aftertaste are discussed to highlight their impact on consumer perception and it exhibits positive feedback among consumers (**Massoud et al.,2023**).

CONCLUSION

The stevia plant and monk fruit can be used commercially as sweeteners or therapeutic agent. Stevia contains stevioside and rebaudioside A, which are known to be powerful sweetening components whereas the therapeutic potential of stevioside is displayed in treating diabetes by boosting insulin production in the pancreas and carbohydrate metabolism problems. Monk fruit possesses various anti-inflammatory, antioxidant nature that reduces the incidence of various diseases.

Although, Stevia and monk fruit exhibit various health benefits owing to its composition, it also has harmful effects. The potential interaction between stevia and drugs, especially those that reduce blood sugar levels, as well as the risk of allergic responses, highlight the significance of practising moderation and being mindful of individual sensitivities when adding stevia to one's diet. Therefore, it is important to exercise caution while consuming stevia, since it may serve as a natural substitute for sugar, but it also has both advantages and disadvantages that should be taken into account. although monk fruit shows potential as a natural sweetener with several health benefits, various obstacles prevent its broad use and acceptance which require further investigation and improvement is highlighted by the challenges associated with availability, taste perception, incorporating additives, and gaps in research.

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